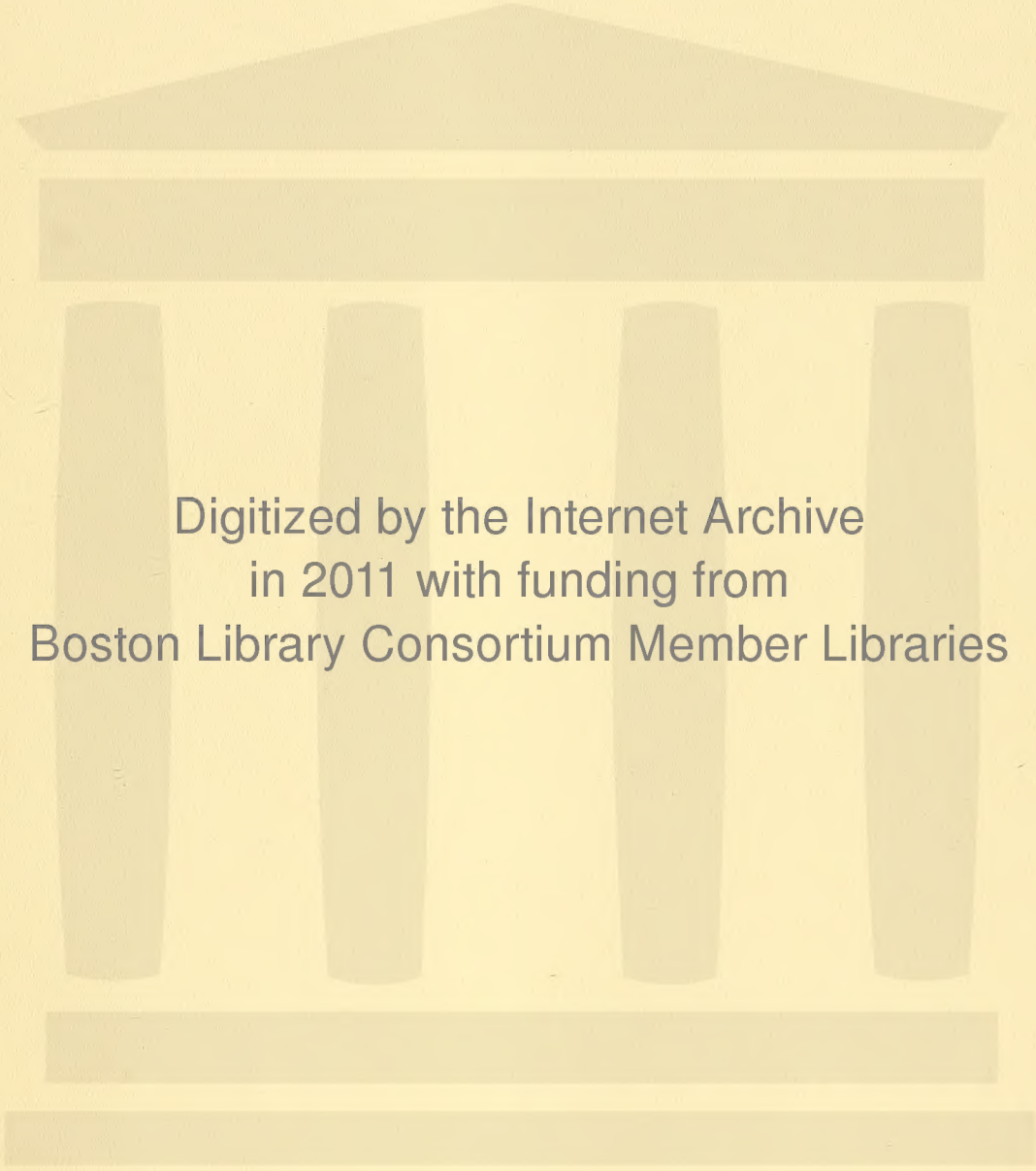

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VOLUME XXXIV.

NUMBERS 1—26

January 2—June 25, 1904

ELECTRICIAN PUBLISHING COMPANY
CHICAGO

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WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, JANUARY 2, 1904 No. 1

The New York Rapid Transit Railway.

By Sydney W. Ashe.

The contract to build, equip and operate the New York Rapid Transit railway was awarded to Mr. John B. McDonald on January 16, 1900. The cost of construction, including subway and structure, was not to exceed $35,000,000. The contractor was to provide motive power and rolling stock and operate the road at his expense for a period of 50 years. At the expiration of this period the lease was to revert back to the city, the city paying a reasonable price for the rolling stock and power equipment. The contractor was allowed to handle freight as well as passenger traffic, provided the transportation of freight did not interfere with the efficient operation of the system. The revenue accruing from the operation of the railroad was to be the property of the operating company, in return for which the company was to pay the city an amount equivalent to the interest on the bonds issued for the construction of the railroad and an additional one per cent. to establish a sinking fund which would retire the bonds and leave the city in possession of a railroad at the expiration of 50 years.

The passenger service to be given the public was to be of two kinds, namely, express service and local service. The local trains were to make a schedule speed, including stops, of 14 miles an hour, and the express trains were to be operated at a schedule speed of 30 miles an hour. On February 19, 1900, the Rapid Transit Subway Construction Company was incorporated at Albany, N. Y. This company was organized for the purpose of assuming Mr. McDonald's contract, which the company did shortly after its incorporation. The construction company deposited $2,000,000 in cash and a bond for $4,000,000 with the city for the faithful performance of its contract, and Mr. McDonald similarly deposited with the city a bond for $1,000,000. The city issued bonds to the extent of $35,000,000 on March 2d to pay for the construction of the railroad. On July 10, 1902, Mr. McDonald made an agreement with the Interborough Rapid Transit company whereby for a consideration that company relieved him of that part of

Fig. 1. City Hall Loop Station.
Fig. 3. View from Portal of Central Park Heading
Fig. 5. Arched Steel Viaduct over Roadway.

Fig. 2. Four track Structure in Elm Street
Fig. 4. Structure on Viaduct.
Fig. 6. Steel Tunnel under East River.

NEW YORK RAPID TRANSIT RAILWAY.

his contract relating to the equipment and operation of the Rapid Transit Railway.

ROUTE AND PLAN OF CONSTRUCTION.

The Rapid Transit railway, as called for by contract No. 1, consists of one main line about 14 miles in length, extending from Park Row and Broadway, Borough of Manhattan, to a point near the Kingsbridge station of the New York and Putnam railroad, Bronx Borough. Branching off from the main line is another section about seven miles in length, extending from a point at the junction of One-hundred-and-fourth Street and Broadway, through the upper end of Central Park, extending up Lenox Avenue underneath the Harlem River, terminating at the junction of Bronx Park and Boston Road, Bronx Borough.

Subsequent to contract No. 1 the Board of Rapid Transit decided to extend the subway down Broadway, under the East River to the Borough of Brooklyn, extending from the outlet by way of a subway to the terminus of the Long Island railway. Bids were advertised for this work, and upon September 11, 1902, the Rapid Transit Construction Company was awarded the contract, entitled contract No. 2, to construct this tunnel for the sum of $3,000,000. Of this amount $2,000,000 was to be expended for subway and tunnel construction and the remaining $1,000,000 for terminals and real estate. This tunnel under the East River, when complete, will consist of two steel tubes of an internal diameter of 15 feet six inches. The tunnel is built partly in the solid rock, as illustrated in Fig. 8. Where such is the case the space between the steel tubes and rock is filled with concrete. Fig. 6 is a view in the East River tunnel showing erecting sections in position. Pure cement under pressure is forced into the concrete filling, making one solid mass of iron, concrete and rock. On the New York side of the tunnel this form of construction has been continued for several months. The railroad through the East River tunnel will consist of two tracks in New York and Brooklyn. At City Hall in Brooklyn will be an additional track for switching purposes. The total length of the steel tube will be 6,550 feet. On March 25, 1903, about 400 feet of this tunnel was completed on the New York side. The excavation is in solid rock, the work progressing at the average rate of 1.5 feet a day. The contractors are constructing the tunnel from both sides of the river simultaneously.

Leakage of water constituted the greatest difficulty anticipated by the engineers in the construction of the subway under the city streets. Every precaution has been taken to make the tunnel waterproof. The bed of the tunnel is of concrete, varying in thickness up to two feet. In some places, such as Battery Park, the thickness of the bed of the tunnel is greater than two feet. During some of the recent storms the tunnel leaked quite badly, but when the system of drainage is complete and the tunnel thoroughly waterproof it is possible that it will not leak sufficiently to cause trouble. At some points where the tunnel is extremely low, pumps will be installed to remove water in case of excessive rainstorms. The method of waterproofing adopted is shown by the accompanying extract from engineers' specifications:

"It is the very essence of these specifications to secure a railway structure, where underground, which shall be entirely free from the percolation of ground or outside water, to which the construction shall be carried out, as follows:

"After the soil has been excavated to the required depth and dressed off to a true grade, as directed by the engineer, there shall be laid a bed of concrete of the proportion as herein described, of such thickness as the local conditions demand, in the judgment of the engineer. On such bed, which shall be made as level and smooth as possible on the top surface, there shall be spread a layer of hot asphalt, and on such asphalt there shall be immediately laid sheets

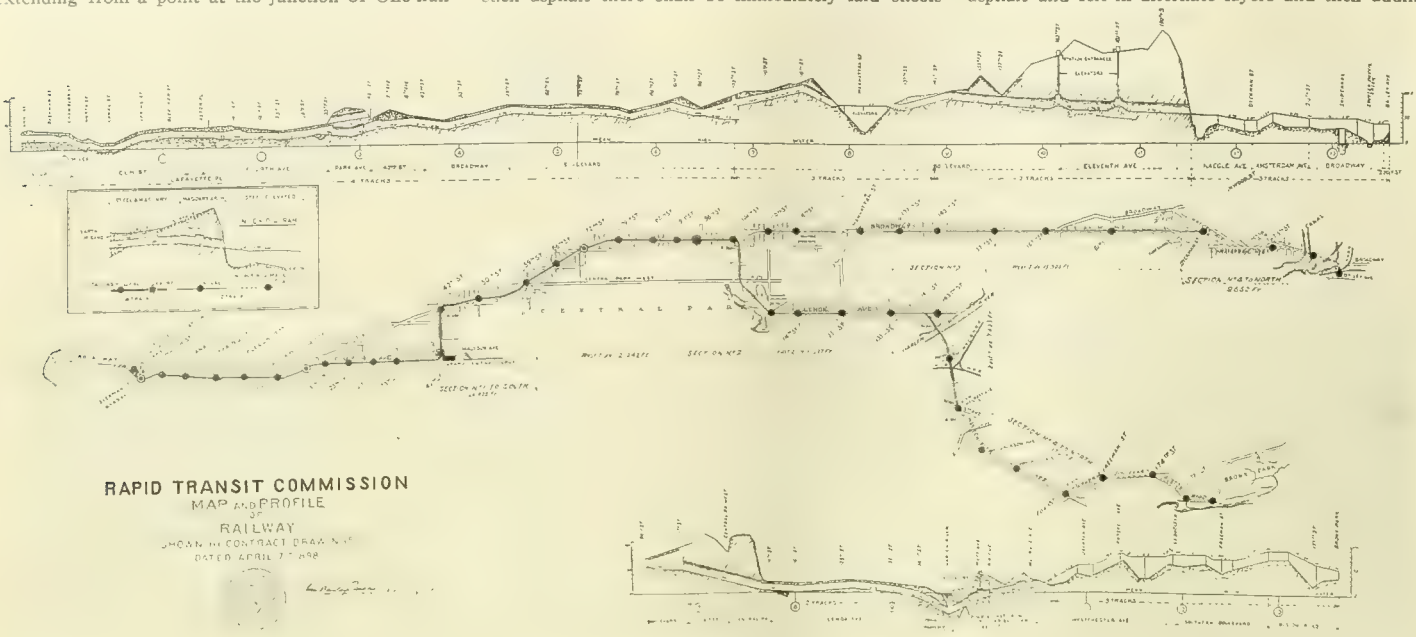


FIG. 7. MAP AND PROFILE OF NEW YORK RAPID TRANSIT RAILWAY.

or rolls of felt, all of the quality hereinafter described; another layer of hot asphalt shall be spread over the felt; another layer of felt laid, and so on until not less than two such layers of felt nor more than six be laid with asphalt between each layer, and below and on top. On top of the upper surface of asphalt the remainder of the concrete, as called for by the contract drawings, shall be put in place. In dry open soil the felt in the floor concrete may be omitted, the base course of concrete being covered with one good layer of asphalt. In rock excavation, where the same is dry and above water level, both the felt and the asphalt in the floor may be omitted.

"When the I-beam columns of the side walls are set and secured permanently in place the concrete composing the side walls shall be rammed in place in such manner that the back or outer face is flush with the outer flanges of the columns. On such outer face hot asphalt shall be placed and felt spread in alternate layers in the manner as described for the foundations, and the backing of the concrete then added, as shown by the plans. Instead of constructing the side walls with waterproofing, as described above, the contractor may build in dry open soils, if permitted by the engineer, and if no additional width of excavation is required for sewers or other purposes, a four-inch brick wall supported at the back by the trench sheathing laid in cement mortar or hot asphalt and at a distance of at least two inches in the clear from the line of the exterior faces of the side-wall beams, and to attach to it the layers of waterproofing material as described above, and then to ram around the beams and against the waterproofing surface the concrete composing the side walls. Under similar conditions in dry-rock excavation the rock may be excavated so that no projecting point comes within three inches of the line of the exterior face of the side-wall beams; and then the rough surface shall be made smooth with a plaster of concrete, and on such smooth surface the waterproofing material shall be spread, and then the concrete of the side walls rammed against the same in the manner as described above.

"The roof of the structure shall be treated in a similar manner by finishing the jack arches to such a height as directed by the engineer, spreading the asphalt and felt in alternate layers and then adding a cover of concrete completing the roof, as called for by the contract drawings.

"By the arrangement above described there will be a continuous sheet of asphalt and felt imbedded within the concrete of the bottom, top and both sides, and completely enveloping the structure."

The Rapid Transit Railroad, as illustrated by profile drawing, Fig. 7, is composed of part subway, a small portion tunnel and the remaining portion viaduct. From City Hall to One-hundred-and-fourteenth Street and Broadway the system will be four-track; the remaining portion, when complete, will consist of two and three tracks. By this arrangement of tracks and the general contour of the system, large sections of undeveloped suburban districts will be supplied with rapid transit. Commuters on the New York Central, New Haven and Hartford will be able to connect at Forty-second Street with the express service and make rapid time to City Hall.

The standard form of construction of the subway is well illustrated by Fig. 2. The bed of the tunnel is composed of concrete varying in depth with the condition of the subsoil. The steel structure supporting the roof is mounted upon concrete pedestals. These pedestals are continuous and serve as a retaining wall for the trap-rock filling in which the ties are embedded. The roof of the subway, when constructed in the open cut, is composed of concrete built between the girders in the form of small arches. The roof of the structure is then covered with waterproof felt and concrete. The number of layers of concrete and felt depends upon the character and level of the street thoroughfare.

Upon the sides of the tunnel is built a wall of 64 cable ducts, as illustrated by Fig. 9. When the ducts

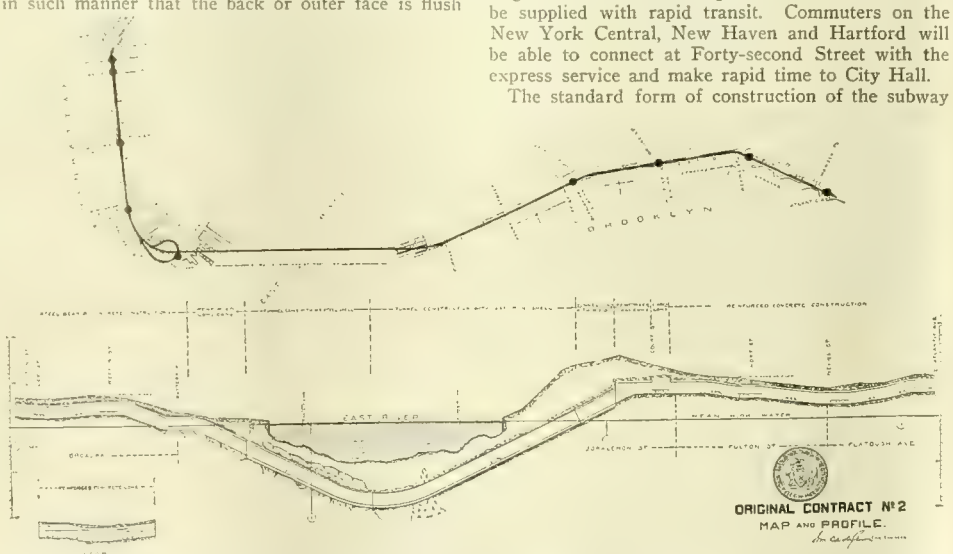


FIG. 8. MAP AND PROFILE OF BROOKLYN TUNNEL EXTENSION OF RAPID TRANSIT RAILWAY.

enter the station they terminate in an upright manhole, in which they change their direction from a vertical to a horizontal position, passing under the floor of the station. In addition to the retaining wall of ducts is a side wall of brick, one layer in thickness.

At City Hall station a large loop has been constructed, passing around City Hall Park and under the four-track structure, entering the tunnel again at the bridge entrance, as illustrated by the map (Fig. 7). At this point a large station, artistically decorated, is located. (See Fig. 1.) The main tiling is white, relieved by a border of dark-green tiles. This is the only station whose character was such as to permit of elaborate decoration. The arched-roof style of decoration was adopted.

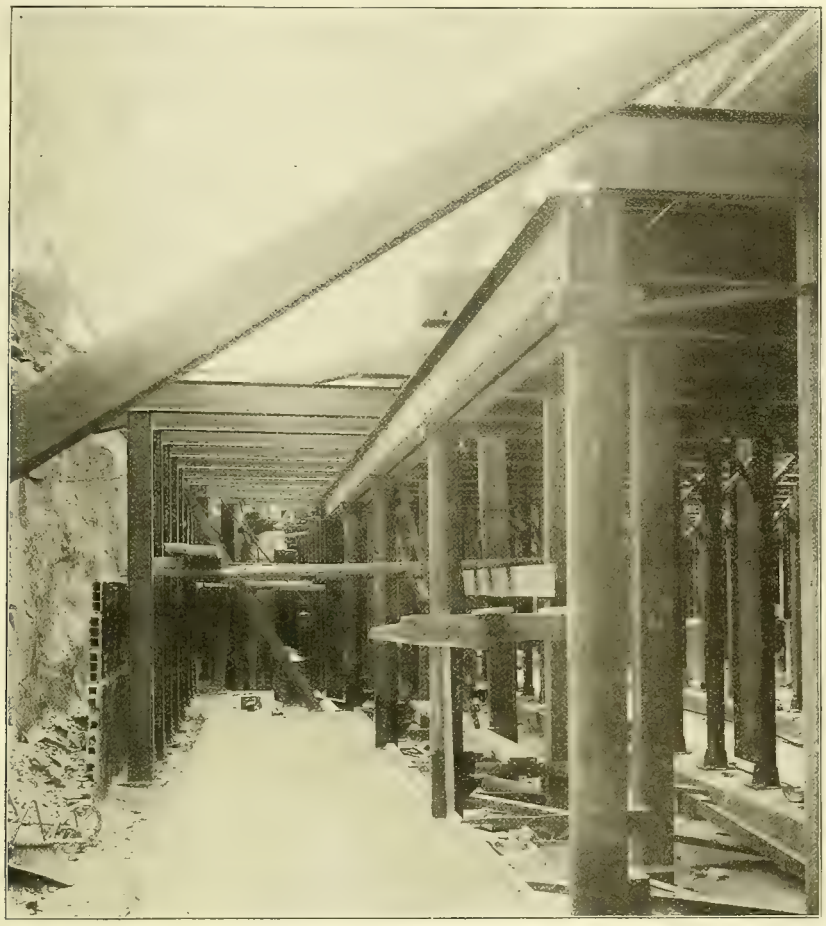


FIG. 9. NEW YORK RAPID TRANSIT RAILWAY.—STRUCTURE UNDER BROADWAY SHOWING CABLE DUCTS.

Fig. 10 represents the tunnel at Thirty-third Street passing from the entire concrete structure under the Fourth Avenue tunnel to the steel structure beyond. It also shows the rails in place embedded in the trap-rock filling. During the period of construction at this point an explosion occurred which demolished the windows of all the houses in the surrounding block.

In many places it was necessary to support the surface-railway tracks upon steel trusses. A sample of these trusses as installed at Ninety-first Street is shown by Fig. 11. When passing under the northern extremity of Central Park an entire concrete formation was decided upon. Fig. 3 well illustrates the method of installing the wooden side walls and arched centers at this point, the whole of which was covered with concrete. Near Columbia University at One-hundred-and-twentieth Street the subway enters the viaduct (Fig. 4), continuing up Broadway to Manhattan Street, where an arched steel structure is built over the roadway, as shown in Fig. 5.

Obstacles Surmounted.

Some points upon the subway called for the exercising of the highest engineering ability. In the construction of the loop at City Hall it was necessary to pass under a large office building, the Times Building. From Thirty-third Street and Fourth Avenue to the Grand Central station two tunnels were built under the existing tunnel of the Metropolitan street railway, which necessitated extending the tunnel under the Murray Hill hotel. In many sections the sewers and sewerage systems had to be entirely reconstructed. At Sixty-sixth Street a large gas main had to be subdivided into several smaller mains in order to pass between the tunnel and the street surface. Forty-second Street, between Fourth Avenue and Broadway, called for special construction. At this point the tunnel is approximately 20 feet below the street surface, which signifies that each square foot of roof of tunnel must carry about 2,000 pounds of earth. It was originally intended that at the section between One-hundred-and-thirty-fourth Street and One-hundred-and-fifty-first Street, on the main line, the structure should be double-track. This plan was subsequently altered to accommodate the building at One-hundred-and-fourth Street of eight tracks for storage purposes. From this storage yard a third track extending north was decided upon. As considerable of the two-track structure had been completed at One-hundred-and-thirty-fourth Street, one of the side walls had to be cut away from the top of the strcture, the entire tunnel supported and the wall moved over to make room for the third track. The gap in the roof was subsequently built in. At many points along the structure the sidewalks in the street had to be entirely reconstructed. A large model section of this work has been accomplished at Forty-second Street under the direction of Mr. Mosher, the contracting engineer. At stations, sidewalks with combination lens and concrete formation have been constructed, which produce adequate illumination.

Details of Construction.

There will be 38 underground stations to the subway when complete, no two of which will be similar. The side walls of the stations to a height of 30 inches from the base of the floor will be built of a form of vitrified brick to withstand the rough usage that such walls are subject to.

The electric lighting in the railway stations will come from a separate source than the power operating the cars. A large turbo-generator creating alternating current is being installed in the power house for this purpose. The separation of the power from the lighting shows forethought on the part of the management for the safety and comfort of its patrons, for in case of an accident necessitating the turning off the power in the sub-stations, the electric lighting in the tunnel and stations will remain intact.

FIG. 11. NEW YORK RAPID TRANSIT RAILWAY. STEEL TRUSSES SUPPORTING STREET-RAILWAY TRACKS.

The tunnel is dimly illuminated with 16-candle-power lamps, which are placed in front of the columns supporting the roof, and are invisible from the motorman's vestibule of the train. The illumination is just sufficient to enable the motorman to distinguish the tracks and improves his chances of detecting signals.

The road is being equipped with 100-pound rails. These rails are fastened to ties which are embedded in broken stone-trap rock, the whole of which rests upon a concrete floor. This forms a very rigid, strong roadbed, which should be free from vibration. The tracks upon entering a station have an up-grade and upon leaving a station a down-grade. A large portion of the energy ordinarily consumed in

FIG. 10. NEW YORK RAPID TRANSIT RAILWAY.—JUNCTION OF STEEL AND CONCRETE TUNNELS AT THIRTY-THIRD STREET.

braking the car will be stored in the form of potential energy by raising the weight of the car. This same energy will assist in accelerating the car upon leaving the station. At stations where only local trains stop this difference in level of the express and local tracks is quite marked, amounting to as much as three feet in some places. This will be particularly observed upon the profile map, Fig. 7, at Chamber Street, and at One-hundred-and-eighty-first Street.

All of the interior of the subway is painted with fireproof paint. The paint is sprayed over the side walls and structure through a special type of sprayer. The paint is termed asbestine fireproof paint. Some 250,000 gallons have been supplied by the Alden Spears Company of Boston, Mass.

Progress of the Work.

The work of excavation on the subway is now almost completed, and south of One-hundred-and-twenty-fifth Street the excavation is practically finished. In September last Mr. Parsons, chief engineer, reported that the construction was then 75 per cent. complete, and since that time the construction has proceeded rapidly. In many sections below One-hundred-and-twenty-fifth Street the tracks have been laid, the road ballasted, and in some sections the tracks are ready for the cars. A considerable number of the cars contracted for have been delivered and are now in operation and undergoing severe tests upon the Second Avenue line operated by the Interborough company.

Elevated Structure.

The elevated line, including the Manhattan Valley Viaduct, has a total length of 5.22 miles. The steel construction was supplied by the American Bridge Company and erected by the Terry & Trench Construction Company of New York city. A standard form of steel construction has been adopted, due to flat curves. Two forms of construction were selected; one form of two-column bent construction was employed when the tracks were not more than 29 feet above street grade. When the height was greater than this a double tower bent form of construction was used. Every 200 feet expansion joints were installed. These joints were designed for any variation of the stringers or defects in the construction as well as the expansion and contraction due to temperature changes. The upright I-beams were mounted upon concrete pedestals. At one particular section, No. 15, where the structure passes over a marsh near the Harlem River, piles were driven into the ground to a depth of 42 feet to support the concrete pedestals. All of the cross-beams are rolled-plate girders.

Power House.

The general method of power generation and distribution adopted by the Rapid Transit engineers was to have one large power house located as near as possible to the load center of the system. High-tension feeders will distribute three-phase power at 1,100 volts from this power house to eight sub-stations located at suitable points over the entire system. The electrical power at 11,000 volts and 25 cycles alternating will be transformed in these sub-stations by 550-kilowatt transformers and converted to 600 volts direct current by 1,500-kilowatt rotary converters. Cables from the sub-station will feed the direct current into the rails at various points. The power house, when complete, will be the largest in capacity in the world. It will be 200 feet 10 inches in width by 800 feet in length. It will contain 12 generators, each capable of delivering a maximum output of 11,000 horsepower, making a total maximum station output of 132,000 horsepower. The generators will each stand a constant load of 5,000 kilowatts.

The contract for the generators, transformers and rotary converters has been let to the Westinghouse Electric and Manufacturing Company. The generators are to be of the revolving-field type with stationary armatures, similar in construction to the generators now in successful operation in the Manhattan power house, New York. Three of the generators are being rapidly assembled and the engineers in charge expect to have these machines in service by April. The oil switches and switching gear is to be furnished by the General Electric Company.

The construction of the power house is quite similar to the standard type adopted by the large companies. There are, however, a few ingenious departures which deserve mention. The coal is taken underground through a tunnel from the coal barges by an endless-belt conveyer to the coal bunker. The bunker is built on an incline above the boilers, so that coal may be delivered by a system of pipes to any boiler from any point of the bunker. The boilers will have a daily consumption of 1,000 tons of coal. Another improvement is in rerference to the steam apparatus. All of the steam pipes are enclosed in a compartment so that in case of accident, such as a break in a pipe, the escaping steam will be confined until the supply is turned off.

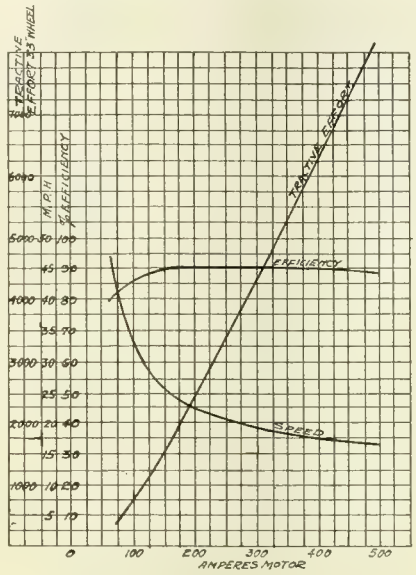


FIG. 12 NEW YORK RAPID TRANSIT RAILWAY.—CHARACTERISTIC CURVES OF CAR MOTOR.

The power house is connected to the river by tunnels so that the salt water may be used for condenser purposes. In the construction of these tunnels a suggestion was made to the sub-contractor by Mr. George E. Thomas, supervising engineer, which decreased the cost of construction about $15,000. The suggestion resulted in the following method of construction: The problem was to construct a tunnel from the shore to a dock built by the dock department. To do this it was necessary to pass through a large gap of water. Piles were driven into the river bottom in the intervening space and cut off at a definite distance below water level. Above these piles was floated a large rectangular boat built of heavy planks. In this boat was constructed the tunnel, composed of concrete, the boat gradually sinking as the construction proceeded, until the boat rested upon the piles. It was then a very simple problem to connect the shore tunnel with the river tunnel.

The steam engines to drive the generators are being supplied by the Allis-Chalmers Company, the boilers and boiler setting by the Babcock & Wilcox Company.

The power house is built on the lines of the modern fireproof construction, namely, rolled-steel girders, side walls of granite, and floors of firebrick covered with concrete. The generators and steam engines are mounted upon concrete piers built into the foundations. The steam-generating apparatus is separate from the electric-power generating apparatus. Every precaution has been taken to make the building strong and fireproof. The work is being well done and is certainly a great credit to the designing engineers, the contractors performing the work, and to the constructing engineers in charge.

The chimneys for the power house are being built upon six columns and are supported 80 feet from the floor, resulting in a saving of considerable floor space.

The firm of Ryan & Parker had the contract for the construction of the foundations. During the progress of the work 30,000 cubic yards of cement was consumed.

Train Equipment.

The motor cars are each equipped with two 200-horsepower motors. The contract for these motors was divided equally between the General Electric Company and the Westinghouse Manufacturing Company. As these motors are to be the pioneers in the field of high-speed service in New York city, much interest will be manifested in their performance. Both companies have designed special machines, the General Electric Company rating its machine as the G. E. 69 railway motor, and the Westinghouse company terming its machine the Westinghouse No. 89 railway motor. All of the motor cars are to be equipped and operated with Sprague-General Electric System of multiple-unit control.

Cars.

The cars are heavier and stronger than the standard type of Manhattan car. This increased weight and additional strength were necessary, as the cars will be accelerated at a higher rate and will travel at much higher schedule speed, more especially the express service. Every precaution has been taken to provide against the cars catching fire. The sides are sheathed with copper up to the base of the window frames. The contract for the cars specified a length of 51 feet, with a maximum width of eight feet 11⅞ inches. The cars have a seating capacity of 52 and will comfortably accommodate about 82 passengers. Comparing with the standard Manhattan car, the subway car is four feet longer, has larger platforms, which are of the vestibule type, the vestibule containing the master controller. When the motorman is directing his train the entire front vestibule of the train is at his disposal. The sliding doors in the vestibule greatly facilitate the handling of passengers. An express train during rush hours usually has its platforms well crowded, and therefore the conversion of the platform with gates into a closed vestibule with sliding doors largely increases the comfort of traveling. The cars are well lighted, the lamps so distributed that passengers seated or standing have plenty of illumination in which to read. A large number of car heaters have been installed in each car.

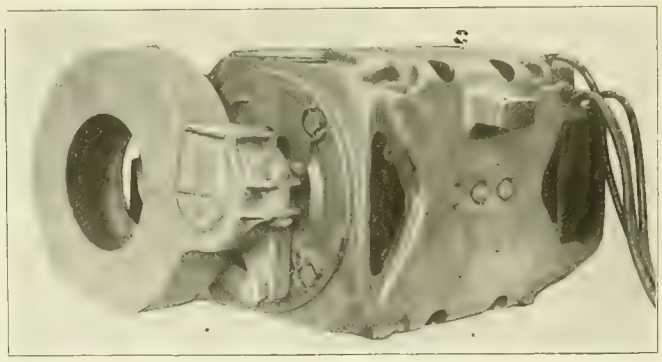


Fig. 15.

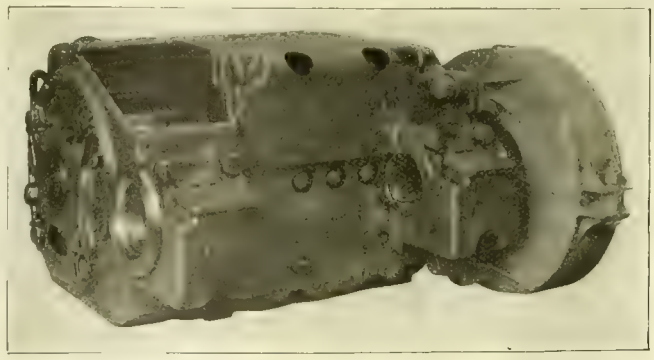


Fig. 16.

NEW YORK RAPID TRANSIT RAILWAY.—VIEWS OF CAR MOTOR

The contract for the cars was divided among several of the large car companies to insure prompt delivery. The cars are quite similar in construction. Dimensions of the type of car supplied by the St. Louis Car Company (shown in Fig. 16) follow:

Length of car over all	51 feet	5 inches
Length over corner posts	42 feet	7 inches
Distance from center to center of needle beams	10 feet	11 inches
Width over side sills	8 feet	8½ inches
Height of end door openings	6 feet	6¼ inches
Height of body from bottom of sill to top of roof	8 feet	9⅞ inches

The car bodies taper to the top, owing to the fact that they are designed to give the maximum seating space and yet allow the maximum clearance in the

tunnel. Bottom framing is of combined steel and wood; the bolsters are of heavy rolled-steel plates, top and bottom members, machined at outer ends, bolted together and reinforced with steel castings, which are planed on faces and edges. Cars have a triple floor, the lower floor being covered with one-quarter-inch transite board securely nailed to all bridges and fitted to side sills. The body proper is covered with copper sheathing so as to make the cars as absolutely fireproof as possible, consistent with building a handsome passenger coach.

The interior finish is of the finest African mahogany. The seats are arranged in the center of the car crosswise, and longitudinal on both ends of the car. Sash are arranged so that top sash will drop, lower sash being stationary. The weight of the car-body is 42,000 pounds.

Trucks.

The type of truck used is the M. C. B. solid forged-top frame, in one piece, insuring squareness and rigidity. The bolsters are of the flitch swing-bolster type and are supported by two double-elliptic springs. There are four double-equalizing coil springs. The brakes are inside hung. Transoms are forged. Transom plates and all wearing parts are machine-fitted; all holes drilled and every bolt frame-fitted. The weight of the truck is 8,800 pounds. The truck is illustrated in Fig. 15.

Motors and Motor Control.

An interesting feature in connection with the G. E. 69 railway motor is its very high range of efficiency. Upon consulting the motor-characteristic curves (Fig. 12), it is obvious that the efficiency of this machine is 90 per cent. through the wide range of 140 horsepower to 340 horsepower. When operating under a pressure of 600 volts, the motor receiving 280 amperes, this machine will exert a tractive effort of 3,750 pounds, operating at a speed of 20 miles per hour. When operated at 30 miles per hour the tractive effort would be 1,000 pounds, the current falling to 120 amperes. In the calculation of the strains of the various parts of the cars a maximum weight of 50 tons has been taken and a maximum speed of 42 miles an hour for express service. A car of the above weight, equipped with two of the motors described, when properly geared, should be thoroughly capable of making the schedule speeds of 30 miles per hour for express, and 14 miles per hour for local service, as called for by the original contract of Mr. McDonald.

The frames of the G.E. 69 motor are composed of one solid casting, the armature being inserted at the end of the machine. This is readily observable in the illustrations (Figs. 13 and 14). The motors are of the nose-suspension type and are supported upon their front side by lugs cast into the frame of the machine. With this form of suspension and having a solid frame, the motors may be removed from their trucks without a pit.

One of the greatest difficulties met with in railroad operation is the fact that the bearings of the motors become heated, the babbitt filling melts out and the armatures drop down, striking the field poles. This tears all the insulation on the armature conductors and causes delay, trouble and expense. To obviate this difficulty, the General Electric Company has constructed the No. 69 motor with a three-sixteenths-inch air gap above, and a four-sixteenths-inch air gap below, and has built up the bearings, so that there is only a one-sixteenth-inch thickness of babbitt filling. It is therefore impossible for the armature to strike if the babbitt is melted out. The armature is series drum-barrel wound and the conductors are copper bars, cross-connected at one end. The self-induction of these motors is great enough to prevent a sudden rush of current in case the circuit is momentarily opened and closed. In the preliminary trials of these motors it was found that the metal shell which supported the field coils acted as a closed secondary of a transformer, and it has been found necessary to cut each shell so it will be open-circuited. The weight of two G. E. 69 motors is 12,200 pounds, while the total weight, with control, is 14,980 pounds.

The system of control with which these Interborough cars are equipped is an improvement upon the type-M control with which the Manhattan cars are operated. The control provides for automatic acceleration at a predetermined current flow. To maintain the rate of acceleration as constant as possible, the number of notches on the controller has been increased from 10 to 12. To operate the controller ordinarily the motorman throws the handle to the full parallel position, the controller cylinder following automatically. When making up trains or controlling cars in the yards the controller may be notched up one notch at a time as with the type-M control. The contact resistance of this control is of sufficient magnitude to provide for whatever self-induction may arise.

Braking and Other Details.

The Interborough cars are equipped with hand brakes as well as power brakes. The contract for the brake apparatus was equally divided between the Westinghouse Air Brake Company of Pittsburg and the Christensen Engineering Company of Milwaukee. The Westinghouse company received the contract for the engine valves, brake cylinders and all the brake apparatus proper, the Christensen company supplying 350 equipments of No. 2 compressors of the independent-motor type and all the air chambers, with their appurtenances. The type of governor will be similar to that now employed by the Rapid Transit Company of Brooklyn, namely the automatic multiple-unit type, which has a capacity of 20 cubic feet per minute.

The block-signal system will be installed in the subway. The Westinghouse pneumatic system, employing alternating current, will be used. This will necessitate using very sensitive relays to differentiate between the direct and the alternating current.

The rails will be bonded with the protected rail bond supplied by the Mayer & Englund Company. This company furnished the bonds for the Manhattan equipment.

In closing, I wish to express my appreciation of the assistance rendered me in securing the above data by Mr. Browning Baker, senior student in electrical engineering in the Polytechnic Institute of Brooklyn.

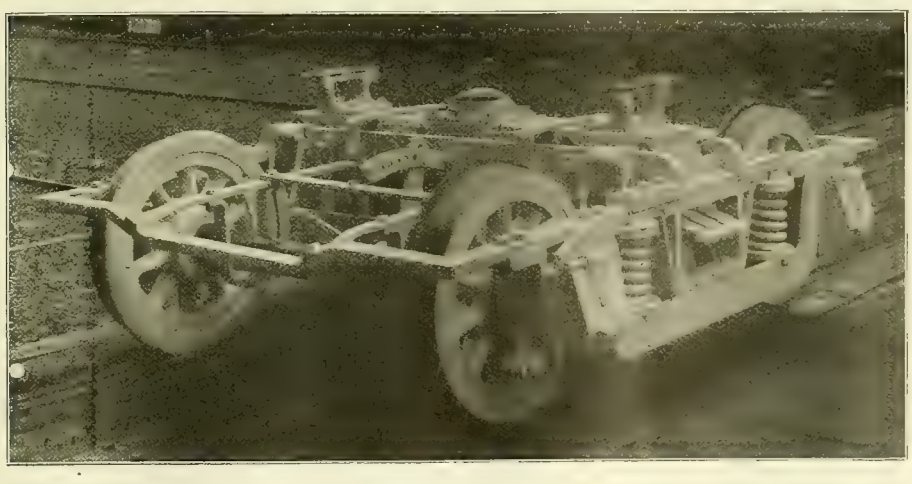


FIG. 15. NEW YORK RAPID TRANSIT RAILWAY CAR TRUCK

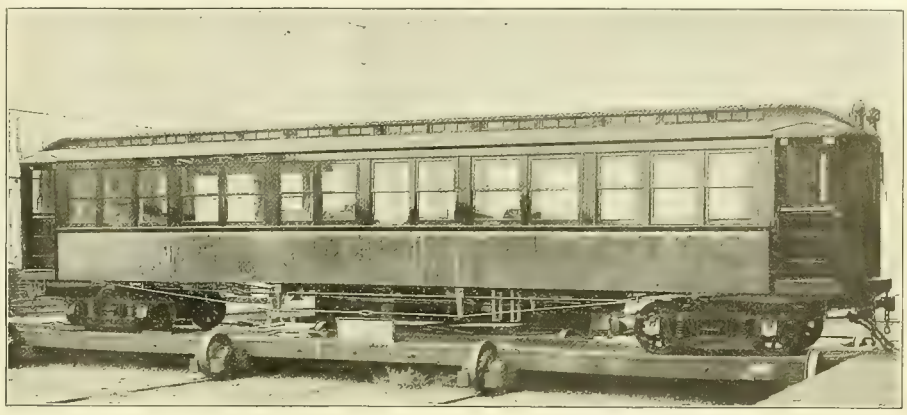


FIG. 16. NEW YORK RAPID TRANSIT RAILWAY. ONE OF THE NEW CARS

More Electric Power Needed in California.

Users of electric power in San Francisco complain of insufficient service. The rapid growth of the city and the coming on of the heavy lighting load of the year are taxing the facilities for supplying current to their utmost. A new 1,500-kilowatt, 10,000-volt generator at the Potrero power house has been put into service by the San Francisco Gas and Electric Company, and this is relieving the situation somewhat. The Mutual Electric Light Company has received a part of its apparatus, but will not be in running order until some time next summer.

At Los Angeles the situation is even more serious and all the systems are running to their full capacity. Lack of rains in the mountains may cause many power houses to close down soon, as the reserve supply of water is getting low. The Pacific Electric Company has just installed a new 1,500-kilowatt generator in its main plant, and this is helping out some. The Los Angeles railway is supplying some current to the traction company from its Sixteenth Street station. The San Gabriel Electric Company's new plant at Third and Los Angeles Streets is now in operation, supplying current to the Pacific Light and Power Company.

Chicago Street-railway Situation.

Public hearings before the local transportation committee of the City Council on the Chicago City Railway franchise ordinance have been discontinued and the committee will now consider the ordinance on its own account with a view to reporting to the City Council within a month. The committee has heard argument both for and against municipal ownership and received many suggestions on the proposed ordinance, all of which will be considered in the committee's deliberations.

David T. Watson of Pittsburg, who has taken in charge the city's side of the contention with the Union Traction Company over the 99-year claims, will be in Chicago in a few days, to remain until the hearing before Judges Day and Grosscup some time this month. The date for this hearing will be set by Judge Grosscup when he returns to Chicago on Monday. Mr. Watson is confident that the claims of the Union Traction Company under the 99-year act will fail.

Lansing Car-barn Fire.

Fire in the car barns of the Lansing, St. Johns and St. Louis Interurban Railway Company at Lansing, Mich., on December 18th resulted in serious loss both to the railway company and to Mr. B. J. Arnold of Chicago. The Arnold single-phase electropneumatic equipment, described in this issue, was greatly damaged, if not entirely destroyed. Nearly $30,000 had been spent in preparation for the tests. The fire started in an oil storeroom and made such rapid progress that little could be saved. The loss to the railway company amounts to about $15,000, two nearly new cars being burned, besides supplies and tools. The company has sufficient cars left, however, so that service will be uninterrupted.

Bad Boiler Explosion in St. Louis.

A destructive boiler explosion occurred in St. Louis on December 21st, when the entire battery of seven boilers in the Geyer Avenue power plant of the St. Louis Transit Company exploded. One end of the building was completely demolished, the generator room was wrecked, and five employes were killed, 30 others, two of whom have since died, being injured. An illustrated account giving further details will appear in the Western Electrician of next week.

Arnold Single-phase Electropneumatic Railway System.

To the Editor of the Western Electrician:

As many of your readers know, I have persistently advocated the use of the alternating current directly in the motors for electric railways for several years (See Transactions American Institute of Electrical Engineers, joint meeting with the British Institution of Electrical Engineers, Paris, August 16, 1900; Niagara Falls convention, August 24, 1901; Great Barrington, Mass., June 19, 1902, and New York, September 26, 1902). By referring to the discussions which took place at these meetings and to the technical journals, it will be found that there were few, if any, other advocates, in this country, of the alternating-current motor for railway work until recently, and that those who supported it abroad advocated the use of three-phase currents until within the last few months. Since my announcement of the principles of my system before the Great Barrington convention the development of the single-phase alternating-current railway motor has been remarkable, both in this country and abroad, and while at that time it had few friends, the development has been such since that it now seems destined to take its place as the leading railway motor, thereby effecting a revolution in electric-railway work.

Many of your readers also know that, since announcing the principles of my system before the

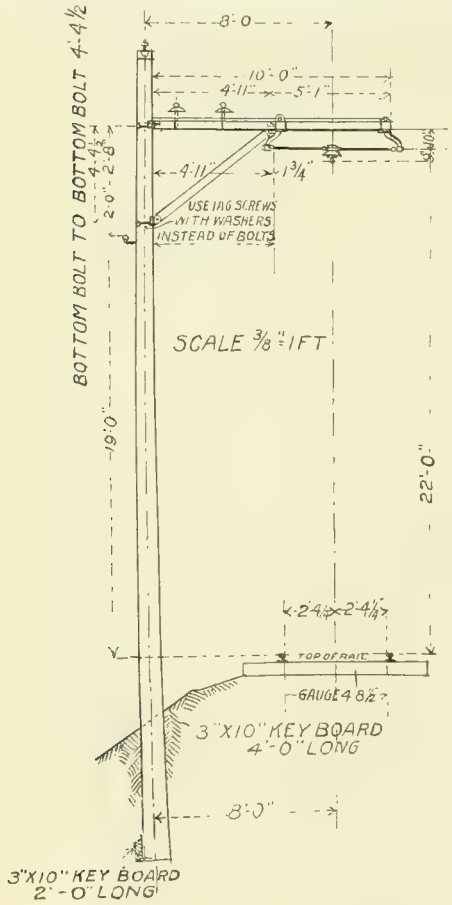


FIG. 2. ARNOLD SINGLE-PHASE RAILWAY SYSTEM.—OVERHEAD CONSTRUCTION.

Great Barrington convention, I have refrained from giving out any further information regarding it, giving as my reasons therefor my desire to test the system thoroughly before making further public statements regarding it, and then to present a full and complete description of it, together with the results of its operation in the form of a paper before the American Institute of Electrical Engineers. Consistently pursuing that policy, I have conducted my experiments privately and at my own expense, and had so perfected my apparatus that I had hoped to be able to celebrate the incoming of the year 1904 with a public demonstration over 20 miles of railroad, which would conclusively prove that the single-phase electric railway is not only operative but efficient and less in first cost and operation than any system now in vogue, not meaning to imply thereby that the system which I have developed was necessarily the only system or the best system, for only time can prove the correctness or incorrectness of such statements, but that it was a system which would successfully do the work, and the system which was first developed and first to be put in actual operation upon the first electric railway in the world especially built for single-phase alternating-current motor operation.

That I would have made a demonstration on January 1st was a certainty to me until December 18th, when I learned by telegraph, while in New York, that the car barns located at Lansing, Mich., of the road upon which I had been experimenting were completely consumed by fire at four o'clock that morning. The fire apparently originated from a stove in the engine house and was communicated so rapidly to the car barns that it destroyed a steam locomotive and two new cars built for my system as well as my experimental locomotive, thus leaving me unable to make the demonstration as I had planned. In view of the fact, however, that the single-phase electric railway is now receiving so much attention at the hands of engineers and inventors in many parts of the world, and that I believe that the year 1904 will be an epoch-making one, marking the revolution from the direct-current to the alternating-current motor for railway work as well as the beginning, on a large scale, of the displacement of the steam locomotive on railways by

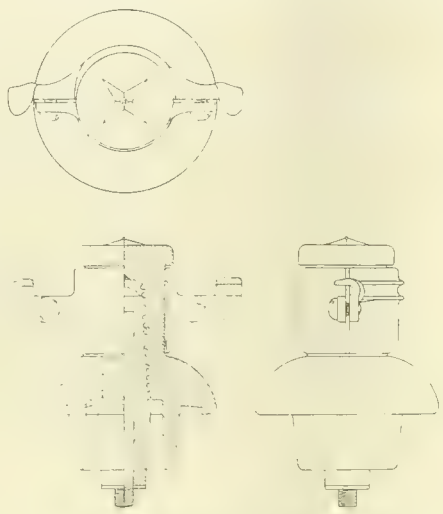


FIG. 1. ARNOLD SINGLE-PHASE SYSTEM.—SPECIAL INSULATOR.

the use of a substantial form of overhead construction rather than the third rail, and from the further fact that I cannot get another machine ready in the near future, I have concluded that I will give to the technical press a record of my work up to the present time, in order that that work and the system which I have developed may be properly weighed in comparison with the work and systems of others, leaving the more complete description of the system and the results of its operation to be presented at a later date before the American Institute of Electrical Engineers.

On January 10, 1900, I rode over the country between Lansing and St. Louis, Mich., a distance of about 60 miles, with a party of gentlemen who desired to build an electric road between these points. This trip resulted in my advising them that the territory was such that I believed the road should be built as economically as possible, and inasmuch as they desired me to assist financially in its construction, I told them I would do so provided I was allowed to construct the road in accordance with certain ideas that I then had in mind, for by such construction the first cost of the road could be kept sufficiently low to warrant its construction, and that if it were built on any one of the systems standard at that time the advisability of building it was questionable. The result was that on April 23, 1900, a contract was entered into wherein I undertook to build and equip the road. Engineers were at once placed in the field to locate it, and after the plans were sufficiently completed the grading, bridging and track work of 20 miles of the road followed,

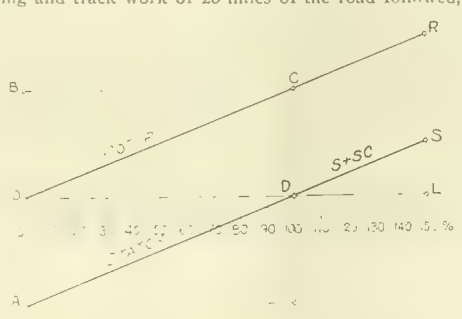


FIG. 4. ARNOLD SINGLE-PHASE SYSTEM.—DIAGRAMATIC REPRESENTATION OF OPERATION.

and this much of the road was completed to such an extent that steam trains were put in regular operation over it about November 15, 1901.

For financial reasons the completion of the road was delayed, and in the meantime the development of my system was taking place and the parts being perfected in different offices and shops.

Since it was my intention to experiment with pressure as high as 15,000 volts on the working conductor, all of the line material had to be specially designed, but the work progressed to such an extent that the overhead and line work of 20 miles of road was practically completed and ready for operation about December 15, 1902, and the power installed, so that experiments began in March, 1903. One June 15, 1903, two trips were made, each about three miles long, with my first experimental machine, shown in Fig. 8 of the accompanying description. On the first trip seven persons were carried and on the second trip 13 persons were aboard.

The result of the experiments with the first motor proved the correctness of the theory and that the machine would work. Inasmuch as it consisted of but one somewhat crude electropneumatic motor, it was impracticable to get full and efficient tests of the system, and it was thought best to conduct no further experiments until a complete new double-equipped truck could be perfected. Not being connected with manufacturing establishments, I have been compelled to develop this system under trying circumstances, necessitating the construction of parts in different shops and assembling them at far-distant points, with crude facilities. This fact, combined with the financial difficulties that have arisen, and the necessity of my having to give the main part of my attention to other matters, have been the causes of the delay in completing the road and the system.

A new double-motor equipment, in the form of a locomotive, was finally built and brought to perfect working condition on the evening of December 17th, and it was this locomotive, with the necessary instruments for testing purposes, that was destroyed by fire on the following morning. Since it will be impracticable for me to get a new one constructed for some time, I have thought best to state the facts as outlined above, and give to the technical press a description of the apparatus and the road, reluctantly omitting the records of operation and the tests which I had hoped to have accompany any future statements I made, but which, through "the irony of fate," must now be left for the future.

I hand you herewith a hastily prepared description of the road and the system, which I trust will be found sufficiently comprehensive to interest your readers.

BION J. ARNOLD.

Chicago, December 26, 1903.

Roadbed and Track of Lansing-St. Johns Railway.

The Lansing, St. Johns and St. Louis railway was originally projected to extend from Lansing, the capital of Michigan, northward through St. Johns, Alma and St. Louis, a distance of about 60 miles,

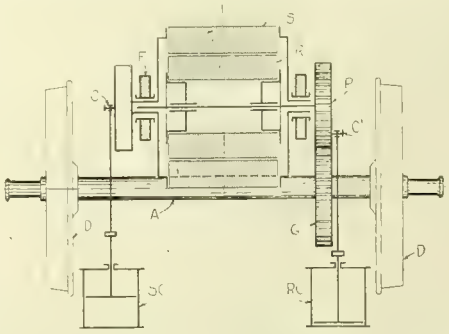


FIG. 3. ARNOLD SINGLE-PHASE SYSTEM.—DIAGRAMATIC ARRANGEMENT OF ELECTROPNEUMATIC MOTOR.

but up to the present time only that portion extending from Lansing to St. Johns, a distance of 20 miles, has been constructed.

This road was built in accordance with steam-railroad practice, with easy grades and curves, so that steam locomotives could be operated over it until such time as electrical equipment could be put upon it, the idea being to complete the road in such a manner that it could be utilized for both freight and passenger service, and thus secure all the business available from the territory through which it passes.

The road is equipped with 67-pound T-rail, laid on ties spaced two feet apart between centers, and as alternating high-tension current was to be used, but one of these rails was bonded with 38-inch No. 0000 bonds, extending entirely around the splice bars.

Since it was impossible to secure rails from the rail manufacturers in time, rails and splice bars were secured from one of the leading steam railways, and this necessitated the adoption of a supported joint and a long bond, as there was not room under the splice bars for concealed bonds.

The road, as at present constructed between Lansing and St. Johns, has no grades exceeding one per cent. and no curves exceeding seven degrees, except in the cities themselves, where the terminals of the road run over the streets and make such curves as ordinary street cars make, the minimum radius being 50 feet. At each city a terminal was planned so that all freight would be diverted to connecting steam roads, thus making it unnecessary for the freight service to pass over the city streets or curves.

At the Lansing end it was necessary to pass over the steam-railway tracks of the Pere Marquette railroad, and this necessitated the construction of a bridge, with pile approaches. The grade as ap-

proached from the Lansing end of the bridge is four per cent. for a distance of about 700 feet, and after passing over the bridge the descending grade is 2.3 per cent. for about 500 feet. At the St. Johns end there is a grade on the principal street of the town averaging about two per cent. for about 1,500 feet.

Overhead Construction.

Considerable care was taken in planning a suitable insulator for carrying the trolley wire, and Fig. 1 shows the construction of the annealed-glass insulator used.

Fig. 2 shows a typical arrangement of the straight-line overhead construction, and it will be noticed that wood is used for the pole, cross-arm and brace and that the insulator is supported by means of a short span wire from iron brackets secured to the wooden cross-arm. This construction insured a high insulation at a low first cost, the entire line having been constructed for but a slightly increased expense over the cost of standard construction, and at the same time so built that in case of failure of the alternating-motor system the standard direct-current motor system could be put into service without changing any parts; even holes for the pins for carrying the extra feeders which would be required were provided, as shown.

It will thus be seen that the line and track work were constructed in such a manner that no expense was incurred for any parts which would not be required for standard construction in case it became necessary ultimately to adopt the standard direct-current motor system, the entire idea in the construction of the road being to save first cost and to invest all that was invested in such a manner that all material purchased would be utilized in case either system were adopted, and should the alternating system prove successful the additional investment for a direct-current motor system need not then be installed.

The working conductor was placed 22 feet above the top of the rails, in order that trainmen when standing upon the tops of the freight cars going over the road could not come in contact with the working conductor.

It was planned to operate the entire road from a single No. 00 trolley wire and with one rail bonded, as hereinbefore mentioned, this amount of copper being sufficient to operate four 40-ton cars at an average speed of 30 miles an hour with power house located 1½ miles from one end of the line, and operating with from 6,000 to 10,000 volts on the working conductor.

Power Transmission.

The power house is located at one end of the line, owing to the electric company from which power is purchased by the railroad having a waterpower at this point. Current is transmitted to the nearest end of the line over two No. 3 wires. The power is furnished from a 300-kilowatt rotary converter generating at 380 volts at 25 cycles, the energy from which is stepped up to the working pressure of the line. It was the intention, after experimenting a sufficient length of time to determine the best voltage for the working conductor, to have the generators for the premanent plant constructed so as to generate at this determined voltage, and it was for this reason that a temporary rotary converter was first installed to conduct the experiments with.

During the preliminary experimental period upon the apparatus herinafter described all power was transmitted from the above-mentioned power house to a point about two miles distant, where were located the car barns in which the preliminary experiments were made.

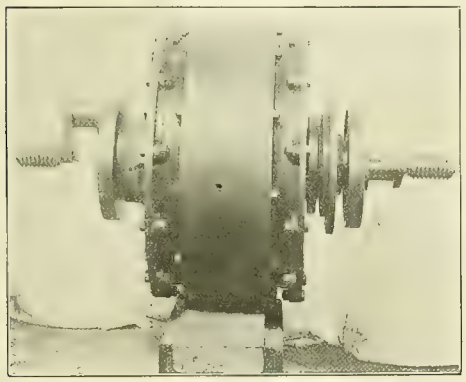


Fig. 5. Outside View.

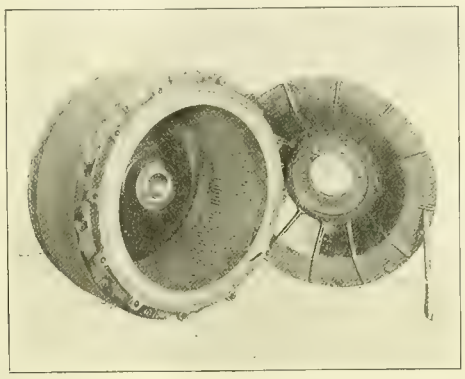


Fig. 6. Interior View

ARNOLD SINGLE-PHASE SYSTEM. ELECTRIC MOTOR.

The Electropneumatic System.

The conditions under which the first application of the system took place having thus been set forth, it may be well, in order to get clearly before the reader the principles on which the system is based, to quote here the statements made by Mr. Arnold before the Great Barrington convention on June 19, 1902, as follows:

"The principles underlying the system I advocate, and which I call an electropneumatic system, are as follows:

"First—A single-phase or multiphase motor, mounted directly upon the car, designed for the average power required by the car, and running continuously at a constant speed and a constant load, and, therefore, at maximum efficiency.

"Second—Instead of stopping and starting this motor and dissipating the energy through resistances, as is customary with all other systems known to me, I control the speed of the car by retarding or accelerating the parts usually known as the rotor and stator of the motor by means of compressed air, in such a manner that I save a portion of the energy which is ordinarily dissipated through resistances, and store it to assist in starting the car, helping over grades, for use in switching purposes, and for the operation of the brakes.

"Third—By this method of control I secure an infinite number of speeds from zero to the maximum speed of the car, which may or may not be at the synchronous speed of the motor, for with the air-controlling mechanism working compressing, the speeds below synchronism are maintained, and by reversing the direction of the air through the controller speeds above, synchronism may be attained for reasonable distances. This feature gives to the alternating-current motor the element absolutely essential for practical railway work, for it permits a car or train to ascend a grade at any speed with the motor working at its maximum efficiency and imparting its full torque to the car. When descending the grade the motor may utilize its full power drawn from the line in compressing air, or it may be used to compress air with the stored energy of the train, thereby acting as a brake.

"Fourth—By virtue of the air-storage feature, each car becomes an independent unit and capable, in case of loss of current from the line, of running a reasonable distance without contact with the working conductor. This feature will enable a car to work on a high-tension trolley wire or active conductor over private right-of-way, and allow the active conductor to be stopped where the private right-of-way ceases, and the car to proceed through a city or town on any tracks, whether electrically equipped or not, until it reaches the outskirts of the city or town, where it can take up the working conductor again on private right-of-way. This feature is also valuable in switching work, for each car being independent it can leave the main-line track and operate over switches or sidings without complicating the yards with additional overhead or third-rail conductors, thus necessitating through-line conductors over main-line track or tracks only.

"Fifth—Since a single-phase motor can be used, the motors can be supplied with current from a single overhead wire or third rail, and with a single-rail return circuit, thus permitting the overhead construction, or third-rail construction, to conform to the standard of to-day, except that a much higher working voltage can be used, provided the insulation is taken care of. Furthermore, in steam-railway work, this system, by virtue of its single-phase feature, will only require the use of one of the track rails for the return circuit, thus leaving the other rail for the use of the signal system, which, up to the present time, does not seem to have been satisfactorily solved without the use of one of the track rails.

"Sixth—The current will be taken from the working conductor at any voltage up to the limit of the insulation, and in case this voltage is high (I am building my line for 15,000 volts), a static transformer will be carried upon each car and the pressure reduced from the line voltage to the voltage of the motor, which, in the case under construction, is designed for 200 volts. Where it is unnecessary to utilize so high a line pressure, the motor may be designed for the working voltage, and the current fed directly from the working conductor into the motor, thus eliminating the static transformer. When a high-voltage working conductor and static transformer are used, and it is thought advisable to use a working conductor through cities or towns, this working conductor will be supplied with energy through a stationary transformer at each city limit, thus making the working conductor through the cities or towns safe.

"Seventh—By virtue of the speed of the motor and its constant load, either when the car is in motion or when it is standing still, and the motor is compressing air, the variable load now customary in electric-railway power plants is eliminated, and the power station works at practically a constant load, thereby eliminating a large part of the investment at present requisite in power-station and line construction. Furthermore, by virtue of the air-storage feature, each car, in the particular apparatus I have designed, is capable at any time when current is on the working conductor of delivering to the car

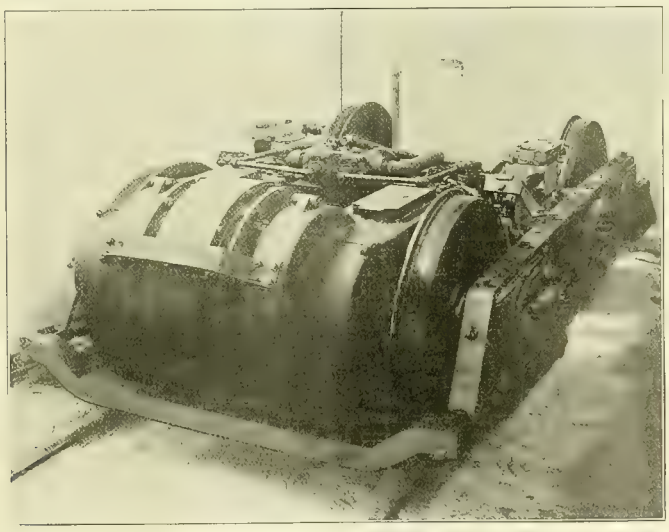


Fig. 7. View with Motor Forward.

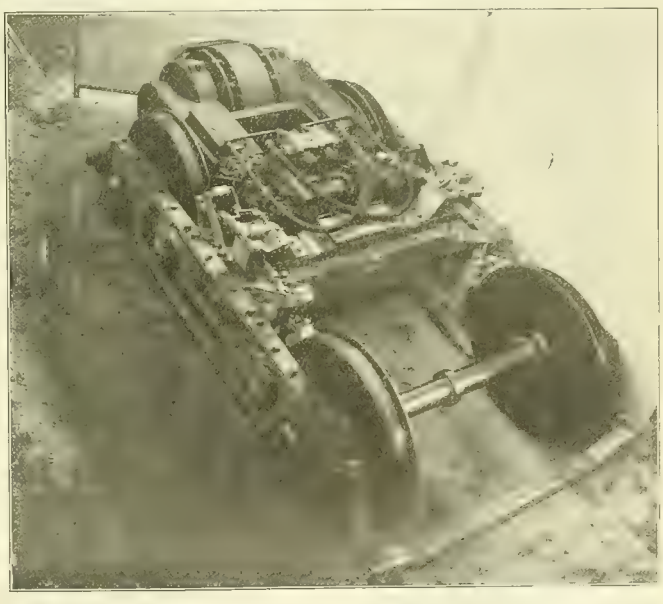


Fig. 8. View with Motor in the Rear

FIRST EXPERIMENTAL MOTOR OF ARNOLD SINGLE-PHASE SYSTEM.

wheels a much greater torque in proportion to the capacity of the motor than is possible with any electrical system known to-day.

"I believe that by the adoption of this system the following results will be accomplished:

"First—The entire elimination of the present standard system of rotary-converter sub-station plant, together with the maintenance thereon, and the cost of the necessary attendants.

"Second—The absorbing and rendering available for useful work in starting, or otherwise, a large percentage of the energy stored in the moving mass

FIG. 9. ARNOLD SINGLE-PHASE SYSTEM.—COMPLETE CAR.

which under the present methods of operation is dissipated at the brake shoes.

"Third—A large reduction in the first cost of electrically equipping long-distance railroads, thereby making it feasible, from an engineering and business standpoint, to equip many roads which cannot now be shown advisable, thus opening up the steam-railway field to the industry in which we are now engaged."

The following description will explain more in detail the application of the principles of the system and the mechanism of its working parts:

Fig. 3 represents diagrammatically the working parts of one form of the system. The rotor (R) of a single-phase induction motor is geared to the axle of the car and by means of crank pin (C') secured in pinion (P) also drives the compressor cylinder (RC), while stator (S) can freely revolve around the rotor and drive, by means of crank pin (C) the compressor cylinder (SC). Both cylinders are piped to air reservoirs located under the car and are also provided with suitable valves manipulated from a single controller on the car platform for making them perform their various functions; thus the entire regulation of the speed and power of the car is controlled by the air cylinders, and no other regulating devices are necessary. The cylinder valves are electrically operated, which makes it possible for each cylinder when driven by the electric motor to compress air into the tanks and when operated by compressed air to furnish mechanical energy for moving the car. When, for instance, the cylinder is compressing air, the valves work like inlet and outlet poppet valves of a common air pump, while, on the other hand, if the cylinders are supplied with compressed air, each valve is operated electrically by a pilot solenoid connected with the valve seat in such a manner that the energy for moving the valve is supplied by the compressed air, thereby making the valve practically self-actuating. The time of operation of the valves is controlled by a series of collector rings, revolving with the engine shaft, and their regular operation is interrupted and varied to suit the requirements by means of the motorman's controller.

When a rotary or turbine type of air engine is used, all of the above valves and reciprocating parts are eliminated and the entire controlling mechanism

FIG. 10. ARNOLD SINGLE-PHASE SYSTEM.—FIRST EXPERIMENTAL LOCOMOTIVE.

consists of two air valves operated from a single engineer's valve, which may be located upon the platform of the car or in the cab of the locomotive, and so arranged that one or more units may be operated from the platform or cab of any unit without the necessity of connecting wires between the units.

Since the motor may be of the simplest type of induction motor without a commutator, and the system does not require the manipulation or breaking of the main current, the motor may be designed for any working voltage and be of any type which will maintain a constant speed when provided with a constant load. This eliminates the necessity of all step-down transformers, resistances or other regulating devices and confines the current to the motors themselves, and as these are below the car floor, the danger from the current is reduced to the minimum.

At the same time the air cylinders, in addition to performing all the functions of speed control, give to the machine the independent-unit element, and the ability to store the kinetic energy of the train in stopping and utilize it in starting. On account of these and other features the electric motors of this system can be much smaller in capacity, when rated as continuous working motors, than those of other systems not possessing this equalizing-load feature, and the capacity of the power house and line can be reduced to about one-half of what would be required with systems where the fluctuating starting loads of the cars are transmitted back to the power house.

In order better to understand the different operations of the system, Fig. 4, showing a speed diagram, has been prepared, in which on the axis of abscissæ (ODL) are represented the different car speeds in per cent. of the synchronous-motor speed, while the co-ordinate axis (AOB) represents the rotor and stator speeds corresponding to the car speeds shown.

The operation of the car may be divided into the following periods:

1. Standing in the Station.—Referring to Fig. 3, the rotor (R) is standing still, while the stator (S) runs with full synchronous speed. The stator is then transferring the full energy of the electric motor through crank (C) to the compressor cylinder (SC), which energy is being delivered in form of compressed air into the air reservoir.

Since the relative velocity between the stator and the rotor is, under all conditions of operation, constant, the speed curves of stator and rotor may be represented by two parallel lines (O C R) and (A D S) in Fig. 4. The origin (O) of the given co-ordinate system represents the period of rest of the car, and, therefore, indicates zero rotor speed and full stator speed in a negative or downward direction, as the stator is now revolving in the opposite direction from that which the rotor must revolve to drive the car forward.

Let it be further assumed that for an instant (OA) equals the active torque of the stator, then it will be easily understood that (OB), which equals (OA), represents the reactive torque of the rotor exerted on the car axle, meaning that if the car is free to move, the reactive torque can be used advantageously for the starting and acceleration of the car.

When the car is standing in a station it is held at rest by moving the controller to such a position that the outlet pipe from rotor cylinder (RC) is throttled, thereby increasing the pressure behind the piston to such an extent that it overcomes the effort of the rotor (R) to revolve, thus tending to cause the stator (S) to revolve and at the same time holds the car at rest without the use of wheel brakes.

2. Starting and Accelerating.—To start the car, the air cushion behind the piston of (RC), Fig. 3, is removed and the air which is being compressed by cylinder (SC), supplemented by the stored air from the tanks, is admitted to cylinder (RC), with the controller at the position of maximum cut-off. The rotor then begins to revolve, and as it accelerates the stator slows down by exactly the same amount that the rotor has increased its speed, and as the rotor and car speed increase the controller is gradually moved to a smaller percentage of cut-off until the car speed coresponds to the full synchronous speed of the motor, at which time the stator comes to rest.

During this period of acceleration the air compressed by cylinder (SC) instead of being delivered to the tanks to lose its heat, is delivered, hot, directly to the rotor cylinders, thus greatly increasing the efficiency of the combination, as the heat usually lost in air systems is utilized and the advantages of heated air gained without a reheater, and as the pressure used is low, many of the ordinary difficulties in the use of compressed air disappear. If the rate of acceleration is such that cylinder (RC) uses all of the air supplied by cylinder (SC), no exhaust to the atmosphere from cylinder (RC) takes place.

Referring now to Fig. 4, which graphically represents this process, since the electric motor runs always at a constant speed and a constant load, it has a constant torque, and, therefore, the distance between lines (OCR) and (ADS) may be considered as representing the energy delivered by the electric motor.

The length of any ordinate extending from (OD) to (OC) represents the proportionate amount of energy derived from the electric motor which is applied directly through pinion (P) and gear (G) of Fig. 3 to the propulsion of the car, while the corresponding ordinate extending below (OD) to (AD) represents the proportionate amount of the energy of the electric motor which is absorbed in compressing air through cylinder (SC), which energy, in the form of air, is immediately transferred to cylinder (RC) and is utilized in accelerating the car.

In practice, however, since there will be a loss in transferring the energy from electrical energy into energy in the form of compressed air and back again into mechanical energy, this loss, whatever it may be, must be drawn from the storage tanks, and the requisite amount of air from these tanks supplied to rotor cylinder (RC), in order to maintain the full power of the electric motor upon the car axle during the period of acceleration. Should it be desired to accelerate at a greater rate than full power of the electric motor is capable of giving to the car the additional energy may be supplied in the form of air from the storage tanks through cylinder (RC), thus increasing the total energy given to the car during acceleration, in which case this total power would be represented for any given instant by a point above line (BC).

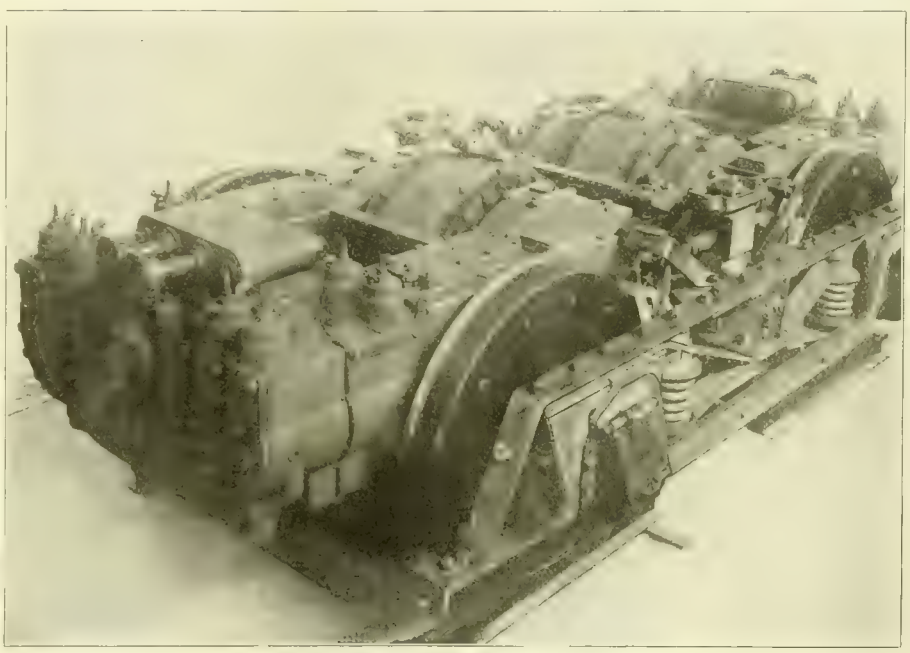


FIG. 11. ARNOLD SINGLE-PHASE SYSTEM.—LATEST DOUBLE-MOTOR EQUIPMENT.

3. Full Speed.—When the rotor has reached full synchronous speed by the previous operation, this speed can be maintained by moving the controller to another position which will throttle the outlet pipe of cylinder (SC) until the reaction due to the pressure behind the piston equals the full capacity of the electric motor. An overload or underload may be placed upon the motor by varying this pressure, but under normal conditions of operation cylinder (SC) is provided with an automatic valve which keeps a constant pressure behind its piston, thus maintaining an absolutely constant load upon the electric motor and consequently a uniform demand of electrical energy from the line. This uniform load is represented by the parallel lines (OCR) and (ADS) of Fig. 4.

With the controller set at full-speed position the inlet valve of rotor cylinder (RC) are held open, and the piston runs free, and the electric motor now gives its full power to the car axle, and the stator and its air mechanism will remain at rest as long as the car runs at the speed corresponding to the synchronous speed of the motor.

4. Speed Variations.—There are usually certain places on any road where high rates of speed can be maintained for short distances, and as these speeds might be higher than the synchronous speed for which the motor was designed, they are provided for as follows:

Assuming that the car is running at synchronous speed, the controller may be moved to such a posi-

tion that the valves of stator cylinder (SC) operate in such a manner as to cause it to act as an engine and revolve stator (S) in the same direction as rotor (R) is revolving. This now causes, owing to its only electrically maintained relative difference in speed between the stator and the rotor, an increase of speed of the rotor and car axle, due to the motor automatically working as a magnetic clutch, without mechanical contact, and if the resistance of the car or train is less than the capacity of the electric motor, the air necessary for revolving the stator can be obtained, hot, from the rotor cylinder (RC) without drawing from the tanks and a speed above synchronism indirectly proportional to the resistance of the train maintained indefinitely. When the resistance of the train is greater than the capacity of the electric motor speeds above synchronism can be obtained only by supplying rotor cylinder (RC) with stored air from the tanks, and can only be maintained for short distances, or until the storage capacity of the air reservoirs is exhausted. This condition corresponds to the spurts that can be made by a steam locomotive when working above the steaming capacity of the boiler. The distance from the line (ODL) to that portion of the line (ADS) aoove (ODL) in Fig. 4 represents, at any given speed, the proportionate amount of energy which must come from the tanks and be supplied through cylinder (SC), and the distance from (DL) to (CR) represents the total energy given to the car by the combined action of the electric motor and the stator cylinder when operating under these conditions.

The energy delivered to the car can be still farther increased by admitting air into rotor cylinder (RC) and allowing it to work as an engine.

5. Retardation.—To bring the car or train to rest, instead of applying mechanical brakes to the wheels in the ordinary manner, and thereby dissipating the entire stored energy of the car or train in the form of heat, this energy is saved in the form of compressed air, to assist in starting the car or train by seting the controller in such a position that rotor cylinder (RC) compresses air and delivers it into the storage tanks. Any desired rate of retardation can be secured by throttling the delivery pipes from rotor cylinder (RC), and in practice this pipe is provided with an automatic valve which releases just before the slipping point of the wheels, thus allowing the motorman to brake as rapidly as he desires without liability of flattening the wheels. Supplemental wheel brakes are provided for emergency, but need not often be used, and the ordinary wear and tear on them is saved. When the car is again at rest the cycle of performance as above given is repeated for the next run.

6. Reversing.—When it is desired to run the car backward for short distances, the electric motor is not disturbed and the power is furnished by the rotor cylinder (RC) by reversing the action of the valves, but if it is desired to run backward for any great distance the current is thrown off the motor, the stator engine reversed, and the stator brought to speed by the air, when the current is again thrown on to the motor, and the cycle of operation is the same as when running forward.

Fig. 5 represents the exterior of the electric motor, showing the cranks of the stator and rotor; also collector rings for operating the valves of the air cylinders when working as engines.

Fig. 6 shows an interior view of the stator of the motor with the flange removed, the rotor of the motor being of the standard squirrel-cage induction type.

Figs. 7 and 8 show, mounted upon a truck, two views of the first electropneumatic motor constructed, and upon which the first experiments were conducted, while Fig. 9 shows one of the cars constructed for the system.

Since the single motor represented in Figs. 7 and 8 was too small in capacity to propel so large a car, it was decided to experiment with an improvised locomotive, consisting of the truck and motor shown in Figs. 7 and 8, carrying suitable air tanks and transformers upon a temporary frame structure. This locomotive, shown in Fig. 10, was the one upon which the trial runs were made and passengers carried on June 15, 1902.

Fig. 11 shows the end and side views of the new electropneumatic motor, constructed after the preliminary experiments had been made on the first motor. For experimental purposes this truck was fitted up in the form of a locomotive, as shown in longitudinal and transverse section by Figs. 12 and 13, and it was this locomotive that was recently destroyed by fire. In order that the locomotive might operate as an independent air unit upon tracks not equipped with overhead electrical conductor, it was provided with a small storage battery and small motor-generator for charging the batteries and for operating the headlight. These auxiliaries are not necessary for the successful operation of the system, provided the locomotive can always be supplied with electric current from the working conductor, for then the valves can be made to operate from alternating current, and thus eliminate the use of motor-generator and batteries. When, however, it is desired to operate independently of the electric conductor these auxiliaries are necessary, and one set may supply an entire train. It will be seen that the locomotive is also provided with transformers, another auxiliary which is unnecessary in case the motors are designed for the voltage transmitted over the working conductor, but in this case transformers were used because the manufacturer of the motors could not be induced at the time they were purchased to build a high-tension motor for railway work, consequently the parts of a standard motor were utilized, and a pressure of 200 volts adopted for the motors, as this was the most economical voltage that could be used with the particular parts selected. This locomotive was provided with all necessary testing instruments and had been operated in the barns for some time and found to perform all its functions successfully, and would have been placed on the road and experiments with it would now be in process had it not been destroyed.

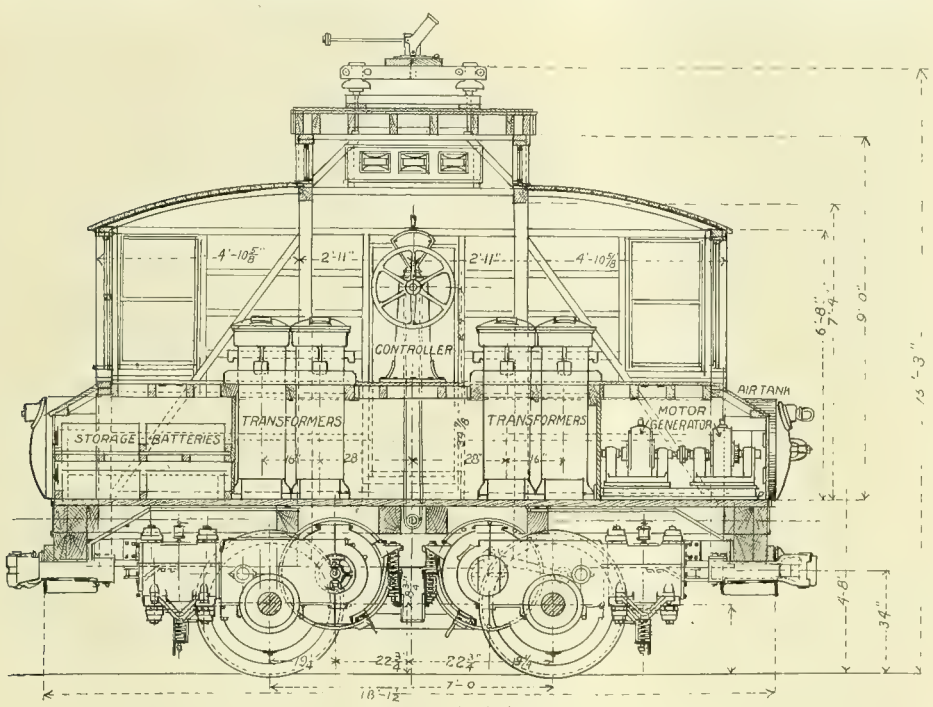


Fig. 12. Longitudinal Section.

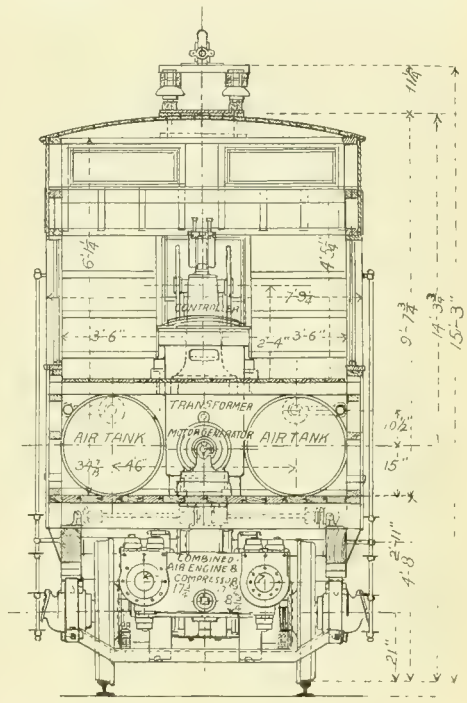


Fig. 13. Transverse Section.

ARNOLD SINGLE-PHASE ELECTROPNEUMATIC RAILWAY SYSTEM.—DRAWINGS OF LOCOMOTIVE.

Undeveloped Waterpower in Maine.

Waterpower in abundance is to be found on the Kenebec River in Maine. Much of this at present is wasted. At Augusta a 17-foot dam furnishes about 20,000 horsepower, of which only 4,000 horsepower is used. Eighteen miles up the river, at Waterville, two dams use only a trifling part of an available head of 42 feet, and at Fairfield not more than one-tenth of the power of a 16-foot dam is employed. The same is true of the 12-foot dam at Shawmut. At Skowhegan, where there is a fall in the river of 20 feet, only 7,000 horsepower is used. Between Norridgewock and Madison there are sites that present fine opportunities for power development. For 24 miles above Solon there are a great many rapids and shoals, which have a total fall of 160 feet. Three miles above the Forks, the last settlement up the river, is the first power, on Moxie Stream, with a vertical drop of 85 feet. For four miles below Indian Pond the river gorge is very narrow, with walls about 200 feet high. In this distance there is a fall of 190 feet, with several excellent sites for power development. The outlets of both Indian Pond and Moosehead Lake are controlled by crib dams that regulate the water for lumbering purposes.

Practical Questions Arising in Three-phase Work.

A recent communication from a Canadian correspondent of the Western Electrician contains several questions upon the connection and operation of three-phase circuits which no doubt are being asked by many other operators of electric plants, to whom the answers will be of benefit. These are the questions:

How can a mixed load of three-phase light and power be best supplied? Is 440 volts, three-phase standard voltage to-day for motors? Is 250 volts a standard for lighting? Do eight, 16 and 32-candlepower lamps work satisfactorily on 60 cycles? How about 40 cycles? Do the lamps flicker? Is 230 volts for lighting and 400 volts for power to be recommended on a three-phase system? Would it be safe to ground the neutral on a 250-volt and 440-volt circuit? We wish to use the highest allowable potential, both primary and secondary. Do you recommend 5,000 volts on the streets? We have some long country lines. We would like to adopt 5,000 volts without sub-station transformers, using simply our 5,000-250-volt lighting transformers. Is there any likelihood of 250 volts for dwelling wiring being at some future time prohibited?

ANSWERS.

A mixed load of lighting and three-phase power can usually be supplied advantageously by means of four-wire three-phase generators. The lighting can be connected single-phase betwen the neutral and one of the outside conductors and the two additional conductors for the other two phases run out only to localities demanding three-phase power. Such an arrangement is comparatively simple and convenient.

Standard transformers having a ratio of 18 to 1 are used throughout for both light and power. For lighting, these transformers are connected single-phase on the primary, the feeder itself being connected between neutral and one outside conductor at the switchboard. The secondaries are connected either two-wire or three-wire, delivering single-phase current to the lamps. For power, usually three of these standard 18 to 1 transformers are connected in star on the primary and in delta on the secondary, delivering three-phase current to the motors.

If 113-volt lamps are used, allowing about 10 per cent. for feeder drop at time of full load, the generator should be star-wound for about 2,300 volts between the neutral and outside, or 4,000 volts between the outside conductors. If a new system is laid out, or if there are no serious local limitations, higher-voltage lamps would be desirable, say 117 or 122 volts. In that case, assuming the same feeder drop and using standard 18 to 1 transformers, the generator potentials should be correspondingly higher.

An old single-phase system of proper voltage and

frequency can readily be connected to four-wire three-phase generators, and the system further developed as the demand for three-phase current increases. The advantages of three-phase transmission for both lighting and power to more distant localities or nearby towns may be obtained from the same system if the loads and distances are within the limits of economical transmission at 4,000 volts. If the loads and distances are too great for this voltage, step-up transformers can be used on the particular line to secure such potential as may be desirable for the conditions.

On long lines to distant localities or nearby towns, and also on lines to densely loaded districts within moderate distances, it will often be economical to connect lighting on all three phases. In order to secure good regulation, some care will need to be taken in properly balancing the load between the three phases and also in maintaining such balance. The three-phase transmission extends from the station or sub-station to a center of distribution on the poles from which emanate three single-phase branches for the lighting load. If the loads are considerable and good regulation is desired, it will be necessary to have three potential regulators, by means of which the potential between each phase and neutral could be regulated independently.

In all cases where the loads are small and distances moderate, single-phase transmission for lighting, with three-phase for power, all supplied from the same generators, will be found more convenient, involving fewer regulators and simpler switchboard and line connections. It is to be noted, however, that even with single-phase feeders for lighting, potential regulators are necessary for good regulation with heavy and varying loads.

A three-wire three-phase system may also be used for a mixed load in a manner similar to that outlined above. Standard 18 to 1 transformers can likewise be used for both light and power. They are connected in delta on both primary and secondary for delivering three-phase current to motors. In this case, however, there is only one voltage available from the generators, namely, 2,300 volts single-phase or 2,300 volts three-phase, while in the four-wire three-phase system, two voltages are available, 2,300 volts single-phase or 4,000 volts three-phase. In the latter the potential between any outside conductor and the neutral, which operates normally at ground potential, is about 2,300 volts. The neutral should be permanently connected to ground in the generating station.

In reply to the question of allowable voltage on the streets, it may be said that the four-wire three-phase system carrying approximately 4,000 volts, is used extensively in several of the large and many of the small and moderate-size cities of the country with very satisfactory results. Sub-station step-down transformers are not used except in the few cases of very long lines on which the voltage has been stepped up at the station.

In regard to frequency, there will be, in the large majority of cases, no need for installing a 40-cycle system in this country. While there is no trouble from flickering in incandescent lamps, the arc lamps do not operate as satisfactorily as on 60 cycles. Motors for 40 cycles are supplied by the leading manufacturers, but the demand being comparatively small, they are not made up in such large quantities, and both prices and deliveries are less satisfactory to all concerned. The two standard frequencies in this country to-day are 25 and 60 cycles. The former is preferable for transmission of power in large cities where the alternating is converted to direct current for lighting and general power and for street-railway work. The latter is preferable for general distribution to customers for lighting and small power, where the conditions for distribution demand alternating-current service to customers. The conditions mentioned by the correspondent are such as would seem to demand a 60-cycle alternating-current system.

In regard to voltages, both 220 and 440 are standard voltages for three-phase motors. Incandescent lamps of eight candlepower and larger are now made for voltages varying from 200 to 250 volts, but in much smaller quantities than lamps for voltages varying from 100 to 125 volts. Most of the 250-volt 16-candlepower lamps on the market to-day consume from 10 to 20 per cent. more energy than the ordinary 3.1-watt, 125-volt, 16-candlepower lamps of the same useful life and candlepower area. In addition to this, the first cost of 250-volt, 16-candlepower lamps is from 10 to 25 per cent. greater than 125-volt, 16-candlepower lamps of the same wattage. These differences are even greater with the lower candlepower lamps.

While it does not seem probable that the use of 250 volts in residences will be prevented, there is nevertheless much more trouble in fixtures, sockets and lamps than when 125-volt lamps are used.

In regard to grounding, it is advisable to have the neutral of a three-wire service or one side of a two-wire service to every customer permanently grounded at the pole.

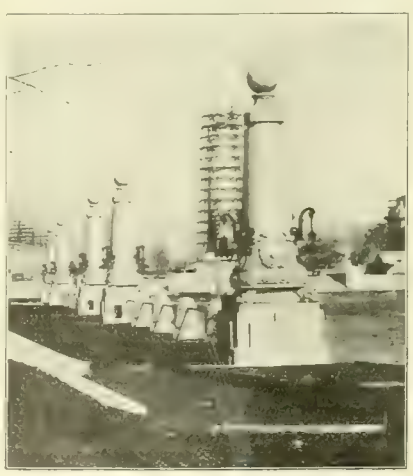
In and About the Palace of Electricity, St. Louis World's Fair.

The thousands who visit the St. Louis Exposition grounds on Sundays will probably do more to refute the oft-repeated assertions that the exposition will not be completed on its opening day than will all the press notices published between this time and the 30th of April. The glowing stories regarding the exposition progress that are found in the many magazines and papers are easily discredited, but let the skeptic climb the steps leading to the Terrace of States; a brief survey of the picture spread before him will displace all doubts as to the

LAMP POST ON BRIDGE FROM ELECTRICITY BUILDING TO CASCADE HILL.

ability of the Division of Works and the Division of Exhibits to have the exposition ready as an entirety on the date specified. From this elevated position, which is both figuratively and geometrically the focal point of the main picture, all the great exhibit buildings can be seen. Naturally, the two most prominent buildings are those devoted to Electricity and Education, the former standing upon an island to the left of the Grand Basin, the latter occupying a similar position on the right.

The contrast between the two is great, the Education Building being a severe, stately and dignified treatment of the Corinthian order, with a straight, unbroken skyline and impressive colonnade, broken only by the main entrance, while the Electricity Building is ornate in the extreme, the facade being



LAMP POSTS NEAR ELECTRICITY BUILDING.

broken on the cascade side by numerous pairs of detached columns, between which, on high pedestals, will be placed heroic statues of great electricians. On the entablatures surmounting these columns have been placed the four figures typifying the attributes of electricity: "Light," "Heat," "Power" and "Speed."

Several roof lines are marked by rows of the Greek honeysuckle ornament, while from over a hundred flag poles will be hung gay banners and streamers. The four corner towers and those flanking the main north entrance rise to a height of 120 feet, and these are surmounted with groups rising 20 feet above their bases. The southern facade, while not so ornate as the eastern, carries a balustrade, from any point of which the full swing of the cascades can be seen. To the westward lies Machinery Hall, another of the buildings which has been lavishly supplied with decorative and sculptural

ROOF DETAIL, ELECTRICITY BUILDING.

effects. In great panels, prominently located, are bas reliefs of mechanisms and machines, above which appear the names of their inventors or designers.

Just north of the Palace of Electricity, between it and the Pike, is the Liberal Arts Building, the southern facade of which is one of the most striking architectural features of the exposition. Between each of the columns is an immense urn, and the effect, when these are filled with vines and flowering shrubs, will

ARRANGEMENT OF LIGHTS ON COLUMNS OF BUILDINGS AT ST. LOUIS EXPOSITION.

undoubtedly leave a lasting impression on the mind of a visitor. Descending from the hill and passing over the bridge to the Palace of Electricity one is struck by the treatment of the landscape. Between the broad driveway of crushed red gumbo and the building is a wide stretch of grass, broken at intervals by beds of flowers and ornamental shrubs, while behind it and the lagoon the ground drops away in a series of terraces, along each of which extends an avenue of trees. The lagoons are surrounded by iron railings supported by ornamental posts of staff, while at intervals of 50 feet rise the great pillars designed to serve as lamp posts, yet avoiding the appearance of being such. Two of the illustrations show the details of these columns, which have, however, yet to receive the lamps. Surrounding the tops in several rings will be placed eight-candlepower incandescent lamps, while each of the four arms will terminate in a Meridian lamp of high candlepower. Sixty incandescent lamps will be placed on each pillar. The same scheme is carried out in the treatment of the bridge as is shown in another view. As an average of 10,000 lamps

will be used to mark the outlines of the buildings at night, the accompanying views showing the general scheme of lighting and the arrangements of the sockets and feeders will be of interest. In all of the buildings in which a colonnade or arrangement of columns is introduced the lamps are located on the rear of the columns and the light striking the screen behind the colonnade is reflected to the eye. In this way the columns stand out boldly against the building, and the only lights visible are those marking the cornice, corners and other architectural features. In the view shown the lamps have been placed in their sockets.

All lamps used for exterior lighting have been spaced 15 inches apart. In addition to marking the lines of the building, each flagstaff carries a line of lights as well as a circle at the top. This is clearly shown in the view of the corner tower of the Electricity Building. In this view the lighting of the urns and pediments is shown. Another view of the pediment from the main north entrance shows

"Light"

"Power"

"Speed."

"Heat."

TYPICAL FIGURES FOR ELECTRICITY BUILDING, ST. LOUIS EXPOSITION.

more in detail the arrangements of the lights on each of the honeysuckle ornaments. On the roof line three lamps are placed, while the entire front of the great piece surmounting the peak is solid with lights. Lower down is seen the line marking the cornice, while the arched window is lighted by a row of lamps seen on the inside. Some idea of the magnitude of the plans for electric lighting can be gained from the fact that a contract has just been awarded the General Electric Company for 300,000 incandescent lamps, to be used in illuminating the buildings and grounds of the main picture.

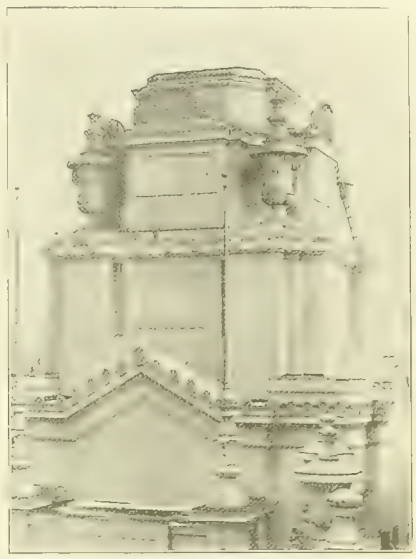
The statuary to be placed above the Palace of Electricity has already been described in the Western Electrician. The accompanying views show the figures by Lukerman which have been placed in position. These are of heroic size and each is appropriately symbolical of the theme. In the figure of "Power" it is interesting to see how the sculptor has clung to the stereotyped conception of a motor, employing the old Edison bipolar type. Nevertheless, although now out of date, the machine will be quickly recognized by the public, whereas, a modern enclosed type of motor would be a thing of mystery to the average layman.

As has been stated before, the applications for exhibit space in this building were sufficient to fill it twice over without accommodating any of the foreign countries; this has naturally placed the space at a premium, for although no charge is made for space, yet the large number of prospective exhibitors makes it possible to choose those of high standing only, and, as a consequence, the manufacturers have been prompted to do something out of the ordinary in order to secure space in which to exhibit their product. By transferring the great service generators to Machinery Hall, a great deal of room has been gained for the exhibit of carefully worked-out displays, showing the application of electricity to the shop in the form of variable-control systems and special adaptations of motors to machine tools; to the railroad in the form of signals, braking and multiple-control devices, as well as headlights and other accessories; to the home in the shape of small generators direct-connected to gas engines and used in connection with storage batteries, and many others literally too numerous to mention.

Power will be available in the Palace of Electricity to the extent of 1,000 kilowatts. This will be received from the power plant in Machinery Hall at 2,200 volts and may be used either at that voltage or at other commercial voltages through the medium of rotary transformers, motor-generators and frequency changers, all these being located in the northern part of the building.

The equipping of a testing laboratory by the National Bureau of Standards with electrical instruments worth $50,000 and placed in the hands of experts from the bureau will facilitate the making of tests of almost any kind of the exhibits in this building. This great laboratory, covering approximately 4,000 square feet, is far in advance of anything of the kind previously attempted.

Something over a mile from the building is now being erected the office of the Woman's Magazine, on the top of which will be placed the largest searchlight in the world, requiring 300 amperes. It is the intention to equip a receiving station with the selenium cell, so placed that conversations carried on over a mile away will be audible to visitors in the Electricity Building. It is significant that the year of the exposition falls upon the twenty-fifth anniversary of the introduction of the incandescent lamp by Edison, and, in view of this fact, preparations are in progress looking to a comprehensive



DETAIL OF TOWER, ELECTRICITY BUILDING.

exhibit showing the developments of this and other inventions of the foremost of American electricians. While the plans for various exhibits are rounding into shape, elaborate preparations are being made for the reception of exhibits. A track enters the Electricity Building at the southwest corner, running direct to the main line of the Intramural Railroad, which will be utilized during the pre-exposition period as a belt road, being connected to all the roads running through that portion of the city. A 30-ton crane will be installed in the west corridor within the month, and numerous portable cranes and hoists will be provided in order that exhibits may be handled with as great dispatch as possible.

It is confidently believed that every exhibit will be in place on the opening day, as every contingency has been provided for by the exposition officials.

Northwestern Cedarmen's Convention.

The eighth annual meeting of the Northwestern Cedarmen's Association will be held in Chicago, Tuesday, January 5th, at the Auditorium Hotel. This association consists of the representative producers of cedar poles, ties, and other products in the cedar line, principally from the northwestern states. Many matters of vital interest which need the attention of the members of the association will come up at this meeting, and it is expected that a large attendance will be on hand. The board of directors and the standing committees will meet in the morning, while the open session will begin at two o'clock in the afternoon. The officers of the association are: President, R. H. Downing, Minneapolis, Minn.; vice-president, William Mueller, Jr., Chicago; secretary, Fred. H. Gilman, Minneapolis; treasurer, H. W. Reade, Escanaba, Mich.; directors, C. H. Worcester of Chicago, G. L. Lindsley of Chicago, George Nicholson of Manistique, Mich., and H. S. Gilkey of Minneapolis.

Electric Hot-water Heating System.

The invention of Dr. H. M. Hill, a dentist of St. Louis, for heating electric cars by hot water was tested on a car of the St. Louis and Suburban railway recently before a large gathering of street-railway men, and is said to have proved a success. The heating apparatus consists of a small cylinder, in which are two insulated electrodes with which to apply the heat to the water, and to which are attached pipes that extend along the sides of the car, through which the water circulates when heat is applied, as in other hot-water heating devices. Both sides of the car are equipped alike. The advantages claimed are that it will require less than half the current required by the electric-coil heating device; that the heat will be uniform through the car and that it affords absolute safety from fire. Members of the party expressed general satisfaction with the working of the device.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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There is no great loss without some small gain. Therefore, while we sincerely regret the fire by which Mr. Bion J. Arnold suffered the loss of his single-phase electropneumatic railway equipment at Lansing, Mich., we can see a brighter side to the disaster, in that we are this week enabled to lay before our readers an authoritative account of this most interesting invention, which otherwise we should have been unable to do. The Arnold electropneumatic system is original but beautifully simple in conception, and carefully and thoroughly worked out. No one can examine it without being interested, and we are sure our readers, while joining with us in lamenting the calamity that has befallen the inventor, will be glad of the opportunity to read his description of his work, which the disaster impelled him to make somewhat sooner than he would have done in the normal course of events. But we would not be understood as minimizing the gravity of the accident. When an inventor who is at the same time an engineer whose services are retained for projects of great magnitude, a busy man of affairs and the president of a great electrical society having particularly important work to do within the next few months—when a man with all these demands on his time sees the results of the unremitting labor of over three years consumed in a night, it is no small thing. We tender our sincere sympathy. But Mr. Arnold's work is not lost, only the product of it; the motors, connections, tanks, valves, trucks and the like can be built anew. He does well to give the engineering world an account of it at this time, fixing accurately the dates involved, which are interesting and important. The system described is certainly bold and ingenious and it is undoubtedly an advance in electric railroading of much importance. We hope that the burned apparatus may be speedily replaced, to the end that the actual demonstration of the system, inevitably deferred, may be given as soon as possible.

NINETEEN HUNDRED AND THREE leaves an electrical record which is, all things considered, very satisfactory. Some slackening of the demand for electrical machinery and apparatus was observed in the closing months of the year in the United States, but the falling off was only sufficient to show a decrease in the rate of growth and did not prevent an actual increase of the value of electrical and auxiliary manufactures, compared with 1902. The Western Electrician's estimates of electrical and closely allied manufactures, given in detail on the opposite page, show a total for 1903 of $234,750,000, which is a comfortable advance over the $221,165,000 of 1902. This increase shows not only that the volume of electrical business during the first three quarters of the year was exceptionally large, but that the slackening toward the close was less than some persons, observing conditions in the iron and steel trade, for instance, may have been led to suppose. And while the retrospect of the year just closed is pleasing, the outlook for 1904 is good. It is inferred that the political activity of a presidential campaign will interfere with industrial conditions to some extent, but when this is taken into account the general consensus of opinion among electrical business men seems to be that a year of sound, healthy trade is to be expected. The electrical exports of the year show a slight shrinkage—not enough to cause alarm, but perhaps sufficient to show that the foreign trade in American-made electrical equipment is not to be retained without effort. But in considering the volume of electrical apparatus exported from the country it is always to be remembered that several of the great manufacturing companies have factories in foreign countries whose output is not included, of course, in the volume of actual exports. More detailed information on the industrial record of the year will be found elsewhere in this issue under appropriate headings. The "Statistics of Electrical Manufactures" and the symposium entitled "Business of the Year 1903 in Review" will be found to be of especial value and interest to students of the electrical business affairs of the United States. On the continent, it will be noted, there has been a marked improvement in the electrical situation, while in Great Britain the condition of the industry appears to be not quite satisfactory.

The three general articles on the technical and engineering aspects of electrical development presented in this issue show that the year has been one of activity, worthy to be ranked with its immediate predecessors. One event of importance was the opening of the American Pacific cable on July 4th. Otherwise the year has not been particularly notable in telegraphic circles, the commercial application of space telegraphy being still backward in development. Several rapid-telegraph systems have been invented or are in various stages of development, but actual improvement in service to any considerable extent, resulting from these ingenious devices, is still to come.

In telephony the automatic-exchange systems give evidence of growth, but whether the manual operation of exchanges is destined to be seriously affected or even superseded by the newer system is one of the interesting questions which the future must determine. The telephone is finding an increasing field of usefulness in railroad operation, but on the whole it is to be noted that telephone construction work was somewhat less in 1903 than in the preceding year.

Perhaps the two most interesting and significant factors in the engineering advancement of the year are to be credited to the single-phase electric-railway system and the steam turbine. In all countries where electrical apparatus is originated much attention is paid to the possibilities of the single-phase motor in electric traction and to the steam turbine as a prime mover for alternating-current generating stations. Many keen minds are engaged on the problems presented by these two diverse types of mechanism, and already very striking results have been obtained in the case of the steam turbine—the great Fisk Street station in Chicago, first put into operation during the year, is one example—while the single-phase railway motor, although not quite "commercial" as yet, is very promising and most interesting to electrical engineers. Electrically speaking, the year 1903 has nothing more important to show than the work on the steam turbine (which is not, of course, electrical at all in itself) and on the single-phase railway.

Power transmission exhibited no startling surprises during the year, although there seems to be an increased tendency on the continent of Europe to regard respectfully the use of direct current at high potentials for this purpose. The work at Niagara, in California and in other power-transmitting centers continues steadily, although the financial difficulties of the plant at Sault Ste. Marie show that electrical enterprises, just as much as other ventures, must be wisely planned and administered to meet success.

Many of the newer types of apparatus can "report progress" during the year. Perhaps the internal-combustion engine, with its high efficiency, comparatively, and great possibilities, did more than that. In considering prime movers it is always well to keep an eye on the gas engine. The Edison storage battery, the vapor lamp, the osmium lamp, submarine signaling devices, new and important electrochemical processes, the speaking arc, electrical water purification, the Bremer lamp and other types of apparatus attracted attention during the year and make a diversified list, to which mere mention only can be made here.

In pure science the investigators continued their researches into the ultimate composition of matter. The examination of the theory of electrons, the N-rays of Blondlot and the remarkable properties of radium were branches of the great problem accorded particular prominence during the year.

The death roll of prominent electrical men is not, fortunately, a long one. Among Americans, the death of Stieringer is the one perhaps most widely deplored.

Electrical men—more particularly those of the United States—will remember 1903 as a year of success and activity. If the New Year makes as good a record, there will be no cause for regret. But let us hope that when the history of 1904 is written, it may be a story of greater successes, not only in material prosperity, but in lasting improvements that make for the betterment of the world.

STATISTICS OF ELECTRICAL MANUFACTURES.

Despite the reduced volume of trade in the electrical and closely allied industries which was evident in the last quarter of the year just closed, it is gratifying to note that the total value of electrical and auxiliary manufactures in the United States in 1903, as shown by the Western Electrician's estimates, given in tabular form below, was greater than in 1902. The total for 1902 was $221,165,000, while the corresponding amount for last year stands at $234,750,000—an increase of about 5½ per cent. To be sure, the increase from 1901 to 1902 was nearly 15 per cent., but in view of the generally diffused opinion that the high-water mark of commercial prosperity has been reached and that the country has entered on an era of less pronounced activity, it will be a welcome surprise to many to learn that in the electrical industries at least, the country not only held its own in 1903, but even surpassed the remarkable record of 1902. It is evident that while there has been a decrease in the rate of growth, the falling off has been much less than many persons supposed. There can be no question, therefore, that the cheerful tone shown in nearly all the "Business Review" letters published elsewhere in this issue is justified by the actual situation.

The estimates given herewith have been prepared with the usual care which the Western Electrician bestows on its New Years statistics and are rendered possible by the assistance of many collaborators, whose co-operation is thankfully acknowledged. As the years go on, the figures presented become increasingly accurate and authoritative, and those for 1903 are confidently laid before the electrical public in the belief that they are substantially correct approximations of the volume of business in the lines indicated.

Many branches show only comparatively slight variations from the 1902 figures. The largest single item is "dynamos and motors," given as $52,000,000, showing a healthy growth. However, if all classes of wires and cables be considered together, the total is over $60,000,000, being the largest item that enters into electrical construction. Here, too, a steady improvement has been shown. After wires and dynamos and motors, the third largest entry is opposite the telephone output, valued at $19,500,000. Some falling off is shown in this department, the estimate for 1902 being $21,000,000. Reciprocating steam engines for electrical plants show a slight decrease, but gas engines and steam turbines exhibit gains, more pronounced in the case of the latter. Undoubtedly "steam turbines" would be still larger if all the work in sight could be counted in the output of the year 1903.

For the first time "vapor lamps" appear in the list, the estimate being $30,000. Electric fans show a slight decrease, probably due to the cool weather of last summer. "Circuit-breakers" have taken a decided jump, but perhaps in this case the estimate of 1902 was too low. "Nernst lamps" and "space-telegraph apparatus" are comparative newcomers that show good gains.

Not included in the classification, but nevertheless of present-day interest, is the valuation of central-station heating plants installed in connection with electric-light installations. One authority states that the value of this class of apparatus made in 1903 was $1,500,000, and this is undoubtedly a good estimate.

WESTERN ELECTRICIAN'S ESTIMATES OF THE VALUE OF ELECTRICAL AND AUXILIARY MANUFACTURES IN THE UNITED STATES.

Articles.	For the Year 1900.	1901.	1902.	1903.
Arc lamps, enclosed	$ 1,200,000	$ 1,600,000	$ 1,800,000	$ 1,900,000
Arc lamps, open	125,000	125,000	135,000	125,000
Auxiliary steam plant for electrical installations, such as pumps, condensers, separators, feed-water heaters, injectors, piping, etc	1,500,000	1,850,000	2,000,000	1,950,000
Bells, buzzers, push-buttons, call-boxes, annunciators	600,000	720,000	815,000	800,000
Belting used in electrical plants	550,000	600,000	615,000	575,000
Boilers for electrical plants (water-tube)	4,000,000	6,000,000	5,100,000	4,500,000
Boilers for electrical plants (other than water-tube)	1,100,000	1,850,000	2,400,000	2,000,000
Cables, underground, aerial and submarine	15,000,000	18,000,000	18,650,000	19,700,000
Carbons for lamps, batteries, brushes or other electrical purposes	1,625,000	1,985,000	2,300,000	2,600,000
Cars and trucks for electric railways	3,000,000	3,700,000	7,500,000	7,500,000
Circuit-breakers		230,000	300,000	1,200,000
Conduits (underground) and similar material	1,600,000	1,700,000	1,925,000	2,350,000
Conveyors, coal and ash, used in electrical plants	350,000	650,000	750,000	750,000
Cranes and hoists, electrically operated	2,400,000	2,730,000	3,500,000	4,750,000
Dynamos and motors, including parts of machines, boosters, rotary converters, etc., and all motor applications, such as automobiles, not specifically enumerated in this list	36,000,000	41,500,000	48,000,000	52,000,000
Electroplating and other electrolytic apparatus not elsewhere specified	250,000	325,000	275,000	300,000
Electrostatic machines, induction coils, medical sets, etc	150,000	250,000	325,000	425,000
Elevators, electric (mechanism only)	2,500,000	1,800,000	2,000,000	2,000,000
Engines, gas, gasoline or oil, used to drive electrical machinery	900,000	950,000	1,300,000	1,500,000
Engines, steam (reciprocating), used to drive electrical machinery	15,000,000	16,425,000	17,000,000	16,500,000
Fans, electrically operated and direct-connected	1,100,000	1,350,000	1,500,000	1,450,000
Fire-alarm apparatus, also burglar alarms, crossing indicators, etc	700,000	800,000	950,000	950,000
Fixtures for electric lighting	3,850,000	4,200,000	4,100,000	4,250,000
Fuses		175,000	185,000	250,000
Glassware, electrical			500,000	450,000
Heating and cooking apparatus, electrical	225,000	285,000	330,000	325,000
Incandescent lamps	3,400,000	4,150,000	5,000,000	5,400,000
Instruments for measurement and meters of all kinds; also ground detectors, scientific and laboratory apparatus, photometers, Leyden jars, X-ray outfits, etc	2,500,000	3,250,000	3,750,000	3,850,000
Insulating material, fiber, tape, etc	1,200,000	1,135,000	1,250,000	1,400,000
Insulators (glass and porcelain)	1,325,000	1,600,000	1,750,000	1,900,000
Interior wiring supplies, as tubing, interior conduit, molding, junction boxes, rosettes, outlet boxes, etc	850,000	1,050,000	1,000,000	1,950,000
Lightning arresters	310,000	390,000	425,000	470,000
Nernst lamps			350,000	450,000
Poles, cross-arms, brackets and pins	2,900,000	3,875,000	4,350,000	4,700,000
Primary batteries	450,000	550,000	685,000	775,000
Railway supplies, electric, such as trolleys and other contact devices, strain insulators, cross-overs, rail-bonds, etc	950,000	1,575,000	2,150,000	2,150,000
Rheostats, car controllers, motor starters, etc	775,000	1,050,000	3,200,000	3,400,000
Shafting, pulleys, clutches, etc., used in electrical generating plants	500,000	475,000	425,000	400,000
Sockets, switches, cut-outs	1,500,000	1,850,000	3,500,000	3,675,000
Space-telegraph apparatus			200,000	250,000
Steam turbines used to drive electrical machinery			500,000	1,200,000
Storage batteries, including those used on automobiles	3,500,000	4,500,000	4,500,000	5,000,000
Telegraph instruments and apparatus	115,000	120,000	200,000	200,000
*Telephones and telephone supplies, including telephone switchboards	17,500,000	18,750,000	21,000,000	19,500,000
Third rail for electric railways		300,000	500,000	500,000
Transformers, stationary	2,600,000	3,250,000	4,200,000	4,500,000
Vapor lamps				30,000
Waterwheels, used to drive electrical machinery	850,000	1,125,000	1,300,000	1,500,000
Wire, bare	7,250,000	16,200,000	17,500,000	18,350,000
Wire, rubber covered	3,100,000	5,750,000	6,425,000	8,250,000
Wire, weatherproof	6,250,000	8,500,000	8,750,000	9,000,000
Wire, all other electrical	1,250,000	1,725,000	2,000,000	2,700,000
Miscellaneous, including switchboard panels, sign flashers, automatic stokers for electrical plants, wire guards, electrical tools and toys, projectors, solenoids, etc	200,000	1,500,000	2,000,000	2,150,000
Total	$153,000,000	$192,470,000	$221,165,000	$234,750,000

*Telephone estimates are divided as follows: 1900—Bell, $13,500,000; Independent, $4,000,000. 1901—Bell, $13,000,000; Independent, $5,750,000. 1902—Bell, $14,500,000; Independent, $6,500,000. 1903—Bell, $14,000,000; Independent, $5,500,000.

ELECTRICAL PROGRESS IN UNITED STATES IN 1903.

By Morgan Brooks.

The year 1903 is conspicuous for continued commercial prosperity, in which electricity is playing an ever-increasing part. The launching of new enterprises, especially those of a speculative nature, has, no doubt, diminished; but we must not let this fact prevent recognition of the healthy growth of lighting, traction and power plants, and the establishment of many new ones.

Power Transmission.

From past brilliant successes, such as those in California, in utilizing electricity to bring to market power otherwise inaccessible from mountain streams, many new installations have been inaugurated. The aggregate importance of the year's work along this line is great, but the results have attracted comparatively little attention, since they had been predetermined with certainty. The pioneers having blazed the way, it is easy for settlers to follow. The great increase in the utilization of the power of Niagara, the Spiers Falls plant near Albany, the projected development of the St. Louis River near Duluth, and the Fremont (Neb.) plant may be mentioned to show that waterpower development goes on apace. The financial failure of the various allied enterprises at Sault Ste. Marie has no doubt had depressing influence upon such development. This failure should be charged to an over-sanguine management, and the cheering news reaches us at the close of the year that sufficient money has been raised to permit the continuance of the operations at the "Soo"—an encouraging indication that proper commercial enterprises and further development along conservative lines may go on safely. Perhaps the utilization of what have been huge wastes of power may be claimed as the greatest achievement of electrical engineering. Many processes commercially impossible otherwise have been grandly successful, and the boon of economical power has built up many a community.

Steam Turbines and Dynamo Design.

The most conspicuous growth of the year has been with another type of turbine—the steam turbine—as applied to the production of electric current. The year will no doubt be marked as the one in which the steam turbine passed the experimental stage, at least in the public estimation, and in which orders were freely placed for the largest units. The introduction of a young rival to the De Laval and Parsons turbines in the new Curtis turbine may also be credited to 1903. The difficulties connected with abnormally high speed have been overcome. The weight and size of the new prime mover are so much less than those of the reciprocating engine that the impression made in visiting a steam-turbine station for the first time is that it must be inefficient on account of the extraordinary number of boilers required to feed a single unit. Steam consumption per kilowatt output is roughly equal to the old indicated-horsepower consumption, a gain of about one-third in efficiency.

The introduction of this new motive power will bring about changes in dynamo design, since the development hitherto has been largely in the way of reducing speed to conform with direct-connected slow-speed engines. This will tend toward reduced first cost, and hence to increased demand. The elimination of all the troublesome steam-cycle problems in parallel operation of alternators is another great gain. Probably the most noteworthy of the many turbine installations of the year is that of the Commonwealth Electric Company at its Fisk Street station in Chicago. Here has been adopted a suggestion from the twin-screw ocean steamer—the installation of completely independent plants, side by side—to the end that no possible accident short of an earthquake could cripple two plants simultaneously. Some costly experiences by eastern companies have brought about this notable departure in plant design. The separation continues through the switch-rooms and underground-transmitting cables.

The Gas Engine.

A possible rival to the steam turbine is seen in the gas engine with gas producer. While gas engines have long been used for driving dynamos, no very large power stations in this country have been driven by gas power. The well-known thermodynamic efficiency of gas engines promises well for the future, and if a practicable gas turbine or rotary gas engine should be introduced the steam turbine might find a powerful rival. A recent plant has been started at Jewett City, Conn., using crude oil in Diesel engines for furnishing electricity. Remarkable economy is asserted.

Electric Traction.

The largest order for steam turbines yet placed is the recent purchase of eight units of 7,500 horsepower each by the New York Central and Hudson River Railroad Company for the electric equipment of all trains entering and leaving New York. This company decided to do more than eliminate the use of the steam locomotive from the Park Avenue tunnel approach to New York, and has now extended the plan to include the usual suburban points within a distance of 40 miles. The electric locomotive will be used also on all trains of the New York, New Haven and Hartford Railroad, completely banishing the objectionable coal-burning locomotive from the limits of Manhattan Island, steam traction having already given place to electric on the elevated roads of New York. The placing of this order may well be taken as the opening step in the abandonment of steam locomotives on all large suburban systems. The public has long been more sanguine of this accomplishment than have those in control of steam railways or even the electrical engineers engaged in railway work. The selection of direct-current motors of the usual voltage for operating the heavy locomotives ordered must not be considered as meaning more than that alternating traction is not commercially ready for the prompt acceptance of a contract involving $15,000,000.

It would seem perhaps that we are behind our foreign competitors in the development of high-speed electric traction. This is due to a reluctance to accept polyphase motors with their resulting complication of connections. Our engineers are engaged in what appears like a friendly contest for supremacy in developing the best single-phase system. Arnold has greatly improved and is now operating his very ingenious electro-pneumatic car with its storage ability to travel temporarily without electric connection. Lamme has designed a series motor for alternating current which no longer requires less than the standard frequency of 25 cycles; and Steinmetz promises us a repulsion motor of commercial efficiency for use with single-phase circuits. Any of these systems can use as high tension on the trolley wire as may be considered safe, and railway engineers are awaiting with great interest to learn which will be accepted as best meeting the demand for the abolition of the commutator. It is probable that this feeling is interfering materially with the placing of any but the most urgent orders for electric-railway equipment to-day.

The long cross-country electric railway lines are particularly anxious to have a decision reached, as the further extension of such lines would be greatly accelerated by a satisfactory alternating motor. It is perhaps wonderful that such lines have been built so rapidly under the recognized shortcomings of the direct-current motor. The scene of greatest activity, the storm center, as it were, of such railway building has moved decidedly westward, and may now be observed in Illinois instead of in Ohio or Indiana. That such railways are able to show good profits with little or no freight receipts and with a rate of fare deemed prohibitory by steam railways is suggestive of the probable extension of electric traction over complete steam-railway systems. The reports of the Manhattan elevated railway in New York since the adoption of electric traction more than justify the predictions of sanguine electrical engineers. The receipts of this company have so greatly increased as to furnish a larger percentage of returns than before, even with the augmented investment due to electrical equipment. Earnings have advanced 35 per cent. in three years, while operating expenses (proportionately to earnings) have diminished. Improved facilities have attracted traffic. The advantages of electric traction having been so clearly demonstrated to New Yorkers, it may not be too much to hope that they will soon drive the persistent horse car from their streets.

Renewed interest in the application of electric traction to canals is shown in New York and Ohio. Along the Erie Canal there has been built a monorail track, slightly elevated, carrying a locomotive, or "electric mule," provided with a 40-horsepower motor geared for slow speed. The experimental track is but half a mile long, yet tests indicate a great saving in expense of towing as compared with the genuine mule. Experiments heretofore tried on the Erie Canal for electrically driving propellers on canal boats were considered objectionable. In Ohio the Miami Canal has in operation 42 miles of surface track and double overhead trolley. The motors are three-phase, and the two motors on a car are coupled in cascade or tandem. A telephone line serves for despatching the electric tow-cars.

A "trackless-trolley" experiment has been tried at Scranton, Pa., recently for operating an omnibus line by overhead wires, of which there must be at least two. The gain lies in saving the first cost of the track construction, and the idea seems adapted to places where the traffic would not warrant the installation of a regular street-railway system.

The electric automobile, run by storage batteries, is regaining popularity with improvements introduced. It seems to be particularly desirable for the moving of heavy loads where the distance to be traveled is not too great and where the time required for loading and unloading is excessive, since the power costs nothing when idle. Electric runabouts are also more serviceable with increase in the number of places where charging current may be obtained. The Edison battery, with its diminished weight for a given radius, is helping the situation. It cannot be said, however, that electricity can be purchased as easily as gasoline, and until the practical radius of action of storage batteries is increased the gasoline car will remain in the field.

Storage-battery Patents.

There is renewed hopefulness in the ranks of storage-battery enthusiasts in the recent expiration of fundamental patents, throwing the field open so far as lead-pasted cells are concerned. A number of companies that were forced into temporary retirement have reopened their works. Just as the breaking of the telephone monopoly greatly increased the use of the telephone, so should the storage battery now come into greater prominence with inevitable reduction in first cost.

Illumination.

In lighting a general tendency to use an ever-increasing quantity of illumination should be noted. Reduction in rates and perhaps greater prosperity have caused meter wheels to turn faster and have increased the sale of the larger types of incandescent lamps. A remarkable demand for the reflector lamps put out by several factories under seductive names is evidence of this growth. These lamps are a strong rival of the Nernst lamp, especially as they may be used on direct as well as alternating circuits. There is no diminution in the sale of small lamps, the 16-candle lamp no longer remaining the only size necessary for a lighting station to carry in stock. A "self-smashing" lamp is now advertised, guaranteed to retire voluntarily from active service before its diminished brilliancy makes its presence objectionable. Another novelty of the year is the remarkable flashing-sign lamp, attracting attention without the intervention of any commutating device. It depends upon its own heat to operate a small thermostat in the base.

The Cooper-Hewitt mercury-vapor lamp has been placed upon the market. But no matter what its efficiency to attain popularity, some red must be introduced into its rays. There is good hope for an early announcement of success in this direction, when the lamp should at once take its place among illuminants. Very little change in its color value would be required for satisfactory use in street lighting, at least in competition with the Welsbach gas lamp. Since the mantle gas burners have superseded some arc-lamp installations for street lighting, electricians are desiring some further improvement in the arc lamp to enable it to meet this competition Where frequent lamps can be afforded, nothing could exceed the brilliancy and satisfaction of arc lighting, but where economy dictates that they be placed two blocks apart, it is no wonder that gas, with its more uniform if less brilliant illumination, has secured a foothold. Such an improved arc lamp is promised in the near future, having one electrode of copper, as in some focusing lamps, and one of a new lamp material, magnetite. A reduction of 30 per cent. in required power is asserted.

Systems of Communication.

Another year has passed without possibility of recording any marked improvement in the telegraph service offered to the public. Many inventions looking to more rapid transmission, if not delivery, of messages lie commercially untried. Delaney has recently made improvements in his synchronous telegraphy, hitherto promising, but he, like other inventors, has been unable to awaken the active interest of the ultra-conservative telegraph companies. A somewhat similar synchronous apparatus of very high frequency has been patented for multiplex telephony.

In wireless telegraphy our countryman, Fessenden, has increased still further the sensitiveness of his apparatus, with consequent reduction of operating power. He has also made progress in syntonizing his instruments for the prevention of interferences. The use of wireless telegraphy upon the Great Lakes has been begun, but, advertisements

to the contrary notwithstanding, the new method does not appear to be superseding wire methods of communication on land. One of the curious observations of the year is the fact that the extraordinary "electric storm" of the 31st of October, which made all land-telegraph lines accept messages "subject to delay," and interfered to a remarkable degree with the transmission of ordinary despatches, passes unnoticed, so far as reported, by wireless experimenters. The more extensive means of observation now possible should enable us to determine more accurately just what an "electric storm" is.

The continued growth of the use of the telephone under both Bell and Independent management is remarkable. Probably the greatest increase relatively has been among the farmers, who, with their rural free delivery of mail and their cross-country electric railways, are no longer isolated from the advantages of city life. Indeed, Senator Fairbanks has proposed that the Postoffice Department be empowered to deliver by telephone from the nearest postoffice any message sent by mail with a distinguishing stamp. This enlargement of the function of the postoffice is possible, since many telegrams are now delivered by telephone and replies accepted by the telegraph offices through the same medium.

The rapid introduction of telephones into our leading hotels has been a marked feature of the last year. It is now possible for a guest in nearly every large city of the United States to talk from his hotel room to any part of the country where the long-distance wires run.

The actual inauguration of automatic-exchange service in Chicago under the Strowger patents is noteworthy. This is by far the largest installation of automatic instruments ever undertaken. About 3,000 instruments are already in use, with additions every day. The limit of a single exchange as arranged is 10,000. Indicators are attached to every switch at the exchange to count all completed connections. There has been a rapid increase also in the number of private branch exchanges installed in large business houses.

The Gray telautograph has reappeared in a form convenient for use in banks or other institutions where prompt inquiry and answer without attracting attention are desirable, and this invention, although slow in making its way, is now finding a field of usefulness.

Miscellaneous Developments.

Many new plans for railway signaling have been proposed, especially to cover the needs of electric railways, but without the adoption of any single system as standard by these roads.

In the way of invention a somewhat interesting patent relates to the substitution of saucer-shaped for flat disks in armature cores, permitting a better location of the shaft bearing. This is of particular advantage in railway motors.

In the field of electrochemistry great advances are made before they are realized by the public. Possibilities seem infinite: accomplishment is astonishing. Metallurgical methods are altered, and chemical factories find their processes suddenly obsolete. An important legal decision by the Court of Appeals sustains the Bradley patent for the production of aluminum by electricity and may have far-reaching effects upon the companies interested.

The process of electric welding, at least as it applies to iron and steel, bids fair to be crowded out by the new "alumino-thermics" or "thermit" process for quickly producing any required quantity of heat in an astonishingly short space of time. The chief product of the combustion of the mixture is iron, hence it may be employed in a variety of ways, and doubtless additional uses will be found for it. For the welding of rails it is already largely utilized, and it is said that the process is at once cheaper and quicker than the use of fishplates and bonds. As a ready method of repairing broken shafts and even iron castings it will probably prove quite as much a friend of electricity as a rival.

Another item of interest indirectly connected with electrical engineering, and yet perhaps of surpassing moment to it, is the remarkable announcement concerning the wonderful properties of radium and allied metals. Radiations similar to the X-rays of Roentgen have been proved to emanate from radium and radio-active material, and it is possible that what have been accepted as electrical waves may after all belong to some other department of physics. Also what Lord Kelvin has called the question mark that has been set against the theory of the conservation of energy is of more than passing interest to the electrical engineer, for the entire theory of the transformer, the dynamo, and indeed all the apparatus employed in the transmission of power rests upon this theory. It seems probable that the heat manifestations of radium—continuing without apparent loss of weight or receipt of energy from without—will be explained in some way, and that the anomaly is really no greater than would be the continuous flow of a river if we were ignorant of rain. The theory that will adequately explain the wonders of radium will perhaps open the way for engineering achievements of even greater importance than those with which we are at present familiar.

Death List of the Year.

Among the electrical men who died during the year 1903 probably the most prominent, in the United States at least, was Luther Stieringer, who passed away in Southern California on July 17th. The list also includes the name of Ezra T. Gilliland, an American inventor of note, and of Edward Tremlett Carter in England. Eminent engineers and educators indirectly connected with electrical work who died during the year were Robert H. Thurston of Cornell University, Sir George Gabriel Stokes of Cambridge University and Sir Frederick Bramwell of London.

A list of the names of men connected in some sort with electrical development, either in this country or Great Britain, who died within the year follows:

January 6th.—Jackson I. Case of Racine, Wis., street-railway promoter, president of the Electrical Installation Company of Chicago, aged 38 years.

January 24th.—William Gray of Hartford, Conn., telephone inventor.

February 1st.—Sir George Gabriel Stokes, of Cambridge University, England, master of Pembroke College, and an eminent scientist and mathematician, aged 84 years.

February 3d.—Alfred T. Weightman of Surrey, England (Niagara Falls, N. Y.), electrochemist of the Electrical Lead Reduction Company and an enthusiastic investigator, aged 33 years.

February 4th.—James W. Plaisted of Portland, Maine, a well-known telegraph-construction man and for many years superintendent of construction and repair for the Maine district of the Western Union Telegraph Company.

March 8th.—James Reilly of New York city, president of the American Electrical and Maintenance Company, aged 65 years.

March 9th.—Everton Burritt Arnold of Chicago, Ill., who had charge of finances of construction of the Arnold Electric Power Station Company of Chicago.

March 13th.—Charles Burgher of Winthrop, Mass., superintendent of the Boston Automatic Fire Alarm Company and inventor of many fire-alarm devices, aged 45 years.

March 16th.—William Du Bois of Albany, N. Y., chief electrician of the Delaware and Hudson Railroad Company, aged 42 years.

March 25th.—Joseph Kavanagh of New York city, assistant treasurer of the New York Telephone Company.

April 2d.—Lyman T. Lawton of Meriden, Conn., formerly president of the Automatic Lighting Company and the Connecticut Telephone and Electric Company and well known as an electrical inventor.

April 16th.—Edward Tremlett Carter, London, England, editor of the London Electrician, aged 37 years.

April 20th.—S. Morgan Smith of York, Pa., president of the S. Morgan Smith Company and the Atlanta Water and Electric Power Company, and prominent in the manufacture of turbine appliances, aged 64 years.

May 13th.—Ezra T. Gilliland of Pelham Manor, N. Y., a pioneer telegraph operator and telephone inventor and the organizer of the first telephone exchange in Indianapolis, aged 56 years.

July 17th.—Luther Stieringer of New York city, an engineer and inventor of wide reputation, the foremost authority in the country in the field of effective electric lighting and managing this department in nearly all the large expositions of this country, aged 57 years.

July 26th.—Charles A. Morss of Boston, Mass., president of the Simplex Electrical Company, and a well-known manufacturer of insulated wire and cable, aged 80 years.

August 21st.—Henry C. Raney of Fairfield, Iowa, ex-president of the Interstate Independent Telephone Association, organizer of Independent telephone exchanges, aged 47 years.

October 25th.—Professor Robert H. Thurston of Ithaca, N. Y., a well-known mechanical engineer and instructor in engineering, author of over 250 papers on practical engineering subjects, and director of Sibley College of Engineering, Cornell University, aged 64 years.

October 25th.—John C. Daniels of Keokuk, Iowa, president of the Garton-Daniels Company, aged 63 years.

November 7th.—William L. Elkins of Philadelphia, a wealthy traction magnate and promoter of street-railway undertakings, member of the art commission superintending the United States Building at the Paris Exposition, aged 71 years.

November 30th.—Sir Frederick Bramwell of London, England, a prominent English engineer, at one time president of the Institution of Civil Engineers and of the Institution of Mechanical Engineers and arbitrartor in many electric-railway disputes, aged 85 years.

December 10th.—Albert J. Wise of New York city, president of J. H. Bunnell & Co., aged 34 years.

December 10th.—Thomas Cyprian Frenyear of Toronto, Canada, sales manager of the Canadian Westinghouse company, connected at various times with various large electrical companies, aged 38 years.

Electrical Exports of 1903.

Statistics of the United States Department of Commerce show that the total value of electrical exports from the United States for the year just closed almost equaled the excellent record of 1902. Following its usual custom, the Western Electrician is again able to present a classified statement showing the monthly exports for the year 1903. The figures are taken from advance sheets from the monthly summaries of commerce and finance, compiled by Mr. O. P. Austin, chief of the Bureau of Statistics of the Department of Commerce and Labor, and in the following table are official except for the month of December, in which case they have been carefully estimated.

Monthly Statement of Electrical Exports in 1903.

	Machinery.	Appliances.	Total.
January	$556,315	$239,234	$795,549
February	416,039	246,104	662,143
March	412,520	449,358	861,878
April	367,314	382,226	749,540
May	498,602	311,454	810,056
June	416,552	320,045	736,597
July	472,577	436,007	908,584
August	413,396	815,910	1,229,306
September	321,778	369,642	691,420
October	413,458	430,821	844,279
November	367,030	346,005	713,035
*December	370,000	390,000	760,000
Total	$5,025,581	$4,736,806	$9,762,387

*Estimated.

It is thus seen that the electrical exports for 1903 (with December estimated) amount to a total value of $9,762,387, or within $234,808 of the probable record year of 1902, when they reached $9,997,195. By looking over the figures for 1902 it will be seen that during the months of September and October the electrical exports reached a value of over $1,000,000, September figures being $1,188,591. On the other hand, July and August were the best months for the electrical exporter during the last year, the latter month with a total of $1,229,306, exceeding any previous month since the statistics have been compiled under the present classification.

A further comparison shows that the decrease for last year is due to the falling off in exports classified as electrical machinery, which show a deficit of $912,062, as compared with 1902. Goods classified as electrical appliances, including telegraph and telephone instruments, show a gain of $677,254. The figures are: Electrical machinery—1902, $5,937,643; 1903 (December estimated), $5,025,581. Electrical appliances—1902, $4,059,552; 1903 (December estimated), $4,736,806. The figures for the last four years for electrical machinery only are as follows: 1900, $5,286,224; 1901, $5,623,442; 1902, $5,937,643; 1903 (December estimated), $5,025,581. By this comparison it will be seen that 1903 has been the lowest in four years for electrical machinery.

It may be interesting to know the destination of the electrical product of the United States, but in this particular official figures are available only for the first 10 months of 1903 and only on electrical machinery. The six biggest buyers of American-made electrical machinery for the 10 months ended October 31, 1903, are as follows: United Kingdom, $1,515,474; British North America, $1,148,626; Mexico, $446,003; Japan, $251,168; Brazil, $167,061; British Australasia, $165,636.

Arcophone Gives College Yell.

Engineering students of Missouri University have been experimenting with a speaking arc which they have been able to perfect to such an extent that it was made to talk rapidly for several minutes during one of their lectures and later for the benefit of a party of friends, giving the college yell among other things. A phonograph was used in the experiments and the words, songs, whistling, etc., reproduced by it were made to affect the circuit of the speaking arc or arcophone and bring about the necessary fluctuations.

Municipal Ownership Defeated in San Antonio.

The election to vote on the proposition to issue $200,000 of bonds for the construction of a municipal electric-light and power plant at San Antonio, Texas, was held on December 19th and resulted in overwhelming defeat for the proposition.

THE ELECTRICAL INDUSTRY IN GREAT BRITAIN DURING 1903.

[From the London correspondent of the Western Electrician.]

More than one branch of the electrical industry has attracted a large amount of attention during the last twelvemonth, and to this extent has the year 1903 differed from a number of its immediate predecessors. Probably, however, the outstanding features of a somewhat uniform year have been the continued progress of electric traction, chiefly in respect to the application of electricity to railways, as distinguished from tramways, and to growing antipathy to municipal trading in electrical matters, albeit this has never been entirely absent in previous years. A general activity has to be recorded, however, in every section of the industry, and although in a few instances financial success has not been forthcoming, it would be unfair to form a judgment of the whole based upon these few. Industrial conditions are not all that they might possibly be, but even the manufacturers themselves have admitted that the reason for this lies not altogether beyond their ken. The old question, of want of standardization of parts, is not without importance in considering this branch of the subject, and the extent to which consulting engineers and others are responsible for this is the subject of a diversity of opinions. The application of electricity to mining operations has received something of an impetus during the year, it may be on account of the special inquiry into the matter which was conducted by the government. Foreign competition, for many years the bugbear of the British electrical industry, has achieved an almost fictitious importance by the tariff controversy at present going on, but nevertheless it is a serious element to be reckoned with, although one which, in the opinion of many, could be more satisfactorily counteracted if opposed in a more systematic manner than hitherto.

Municipal Electric Lighting.

The gas companies have been largely responsible for a big outcry in certain quarters against municipal electrical enterprise, and with the large financial resources at their disposal they have not hesitated to oppose, with all their might, any electrical scheme against which they could secure a locus standi before a parliamentary committee. It is notorious that the majority of comparatively small municipal electric-lighting undertakings are not financial successes during the first year or two of their existence. The policy of the gas companies in any district where an electrical enterprise was contemplated by the local authority was to appear before the parliamentary committee considering the bill, as ratepayers, in the particular district, and ask for a clause to be inserted which would provide that at the end of the first twelvemonth's working, the owners of the municipal electrical undertaking should so adjust their charges for current that the expenses and receipts balanced, thus preventing the undertaking being a drain upon the rates. It was unfair, they contended, that they should be compelled, as ratepayers, to contribute toward making good any deficiency which might arise in the electrical undertaking, which was, of course, a competitor with them. This was a very ingenious argument, and one which carried considerable weight in almost every instance where it was put forward, for the gas companies at the close of the session could point to one long series of victories.

Another outcry against undue municipal trading was occasioned by the action of a number of municipalities in attempting to undertake "free" electric wiring, the supply of fittings, and the hiring out of motors, etc., without having received parliamentary sanction thereto. And even when statutory authority was sought, the local electrical contractors, who were the opponents under this head, fought the issue with such vigor that even the London County Council abandoned the idea. This branch of trading would doubtless have continued unchecked but for a test case having been brought against the Barnstaple corporation, in which it was established that an ordinary provisional electric-lighting order granted by the Board of Trade did not give power to do more than give a supply.

Yet again the opposition to municipal trading was further complemented by the decision of a committee of the House of Lords, in connection with the "power" bills. Hitherto all towns of any appreciable size situated in the area scheduled by a company proposing to supply electricity "in bulk" in that area, have been absolutely excluded from the operations of the company if the said towns possessed an electric-supply undertaking. This year (1903), however, the precedent has been gone back upon, and all large cities have been included in the area of the company under certain conditions.

So much from the opposition point of view, but municipal trading in electrical matters is not in such a parlous condition as one might be led to suppose. A good deal of capital has been made out of the circumstance that the money market at present is in such an unfavorable condition, and that in consequence several local authorities have resolved to restrict capital expenditure for the time being. But a general look around reveals a great increase in the mileage of electric tramways owned by municipalities as well as a steady rise in the number of lamp connections to the supply undertakings.

Electric Traction.

In the midst of a universal period of rapid progress in electric traction, there has been one important factor of retardation, viz., the royal commission on London traffic, which has already for one year—and certainly will for at least another twelvemonth—prevented any new schemes of locomotion being promulgated for London. It is remarkable that the need for such an inquiry was not espied some years ago.

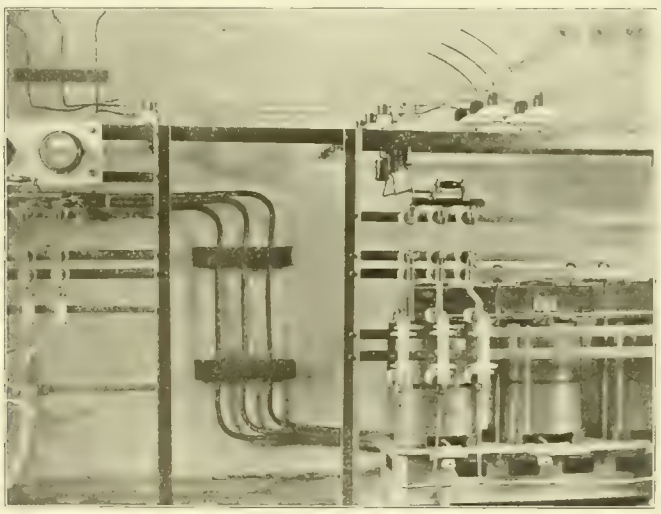
A notable activity has been displayed in the application of electricity to steam railways—a problem which a large number of managers are still viewing with caution as regards their suburban traffic, and entirely put out of court in connection with their long-distance main lines. But with the Mersey railway actually converted, and several other fairly extensive systems in process of electrification, sufficient data should soon be available to stifle all prejudices and reassure all the skeptics. With but few exceptions all our railway companies have secured parliamentary powers to apply electricity to the working of their lines, although to what extent these powers will be employed merely as a means to circumvent the competition threatened by new schemes, when these latter are being inquired into by parliamentary committees, it is not prudent to enlarge upon. In a number of cases, however, practical use has been made of these statutory powers, and as a consequence both the Northeastern Railway Company and the Lancashire and Yorkshire company are now engaged in the work of conversion of a certain portion of their lines. In both instances the third-rail continuous-current system has been decided upon, with motor carriages, and not locomotives. The Metropolitan District Company's power house at Lots Road, Chelsea (the largest one of its kind for purely traction work, so we are informed), is being worked upon night and day, and simultaneously the construction of a number of the tube railways now under the same jurisdiction—that of Mr. C. T. Yerkes—is being equally accelerated.

The one piece of material progress during the year in this line has been the completion and opening of the Mersey railway, and the satisfactory results only serve to emphasize the contention repeatedly put forward by all electrical men here, viz., that a feasible scheme of electric traction for suburban traffic is possible. In the case of the Mersey line we had an undertaking weighed down with heavy running costs, poor traffic receipts and the disadvantages of a sulphur-laden tunnel forming the greater proportion of its total length. Thanks to the enterprise of the Westinghouse company, a scheme was devised and carried out, with the result that in an incredibly short space of time the running expenses were reduced by 50 per cent. The equipment of the power station is interesting, inasmuch as double-current generators are installed, and in one or two other details novelties have been introduced.

Concerning tube railways, not a great deal has to be said. The Central London Railway Company has discarded altogether its locomotives for vibration reasons and now works with the multiple-unit system. The Great Northern and City Railway, the line with 16-foot tunnels, is almost ready for putting into the public service, and, as before mentioned, Mr. Yerkes' tubes are being rapidly pushed forward under favorable conditions, he being for the moment free from the worry of opposing new competing schemes, and doubtless when the royal commission on London traffic has reported he will be in a position to show a good case why no others contiguous to his domains are necessary. A deal of difference of opinion has been shown as to the precise size of tube-railway tunnels, and this question will probably be revived later on.

Several important additions have been made to our electric-tramway equipments, a notable feature being the increase of through communication, which has had the effect of allowing really long distances to be traveled by electric tramcar. The system of the South Lancashire Tramways Company is the most glaring instance of this. Parliamentary powers have been granted to this concern for the construction of tramways which will have the desirable object of bringing into communication over 500 miles of lines, and seeing that the company was only registered as recently as 1900, its feat of being already in the position of having connected Liverpool with Bolton, which has involved the construction of nearly 50 additional miles of line, is no mean one. The estimated population which it will eventually serve is put at 5,000,000. Two-phase alternating current is generated at one central power house, the pressure being 7,000 volts at 50 cycles per second, which is transformed down by means of motor-generators giving a voltage varying from 500 to 550 volts.

The opening of the London County Council's conduit system (already described in the Western Electrician) is none the less welcome, though so belated, and now that the construction of the council's huge



150-Kilowatt Three-phase Transformer.

Three-phase Distributing Switchboard.

ELECTRIC COAL-MINING EQUIPMENT IN ENGLAND.

generating station at Greenwich is being proceeded with, as well as the conversion of the track on the north of the river, the reproach which has for so long been hurled at the London County Council in this matter loses much of its sting. These lines, with a few short lengths at Bournemouth, comprise the only conduit lines in the United Kingdom.

Unlike the electric-lighting industry, electric tramways in the hands of municipalities in England have proved a uniformly remunerative speculation, and it was not surprising that an important authority, such as Birmingham, should fight strenuously to secure the control of the lines in that city. On the other hand, the city of Wolverhampton has created fame for itself by, if anything, acting too precipitously in the matter, and, apart from the advantages or otherwise of the system they have adopted, viz., the surface-contact system, it has isolated itself entirely from the point of view of intercommunication, for, be this technically possible, the relationship between the corporation and the owners of the neighboring trolley system puts a stop block to anything of this nature being approached. It cannot be denied, however, that the chief argument against the surface-contact system in Wolverhampton is wholely and solely on the score of greater running expenses—a defect which the exploiters of the system will do their best to remedy. There has been practically a complete immunity from accident. I believe the casualty list is merely one horse killed.

Several less important details deserve notice. An innovation has been the sanction to a system of trolley omnibuses in Gloucestershire as an adjunct to a scheme of tramways in the less populous districts until sufficient traffic is available to justify the construction of trams.

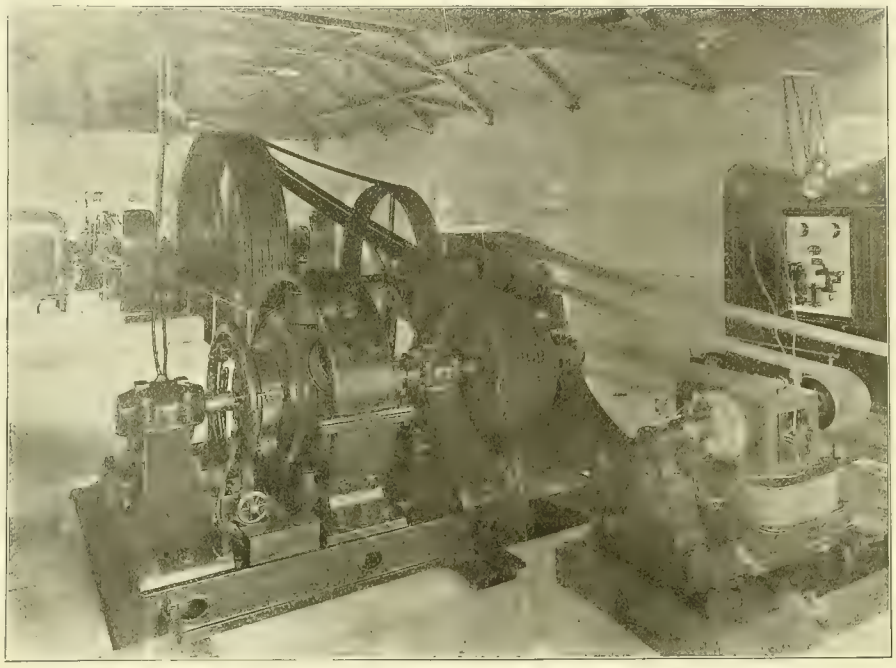
Electrolysis has been much to the fore, and many a discussion took place, owing to the opposition of the gas companies, but, generally speaking, they benefited but little. The great difficulty is to prove that a corroded gas main has been the victim of operations at the instance of an electric cable, and little tangible evidence can be produced. Usually parliamentary committees are composed of non-technical men, and the most ingenious technical arguments have not been sufficient to give the gas companies more than a conditional protection.

One purely technical matter should be mentioned before closing this section, viz., a system of automatic tram-car control, designed by Mr. J. S. Raworth, and put to practical use upon the Devonport tramways. This is only intended to act upon hilly districts, where the series-parallel system of control does not give satisfaction, and is extremely ingenious, although I am afraid its full possibilities will not be grasped by the following short notice: The alterations in the electrical equipment of a car on this system involve the field windings being changed from series to shunt with an auxiliary series winding in addition. The action of the power lever has been limited to the series notches. Interlocked with the power lever is a speed-control lever, and an automatic switch has been put into the emergency circuit to cut out resistances when the line current fails. Briefly, in practice, regeneration takes place on a descending grade, and, in addition, the car is automatically prevented from running away. It is said that 30 per cent. saving in current is obtained, and that, except for the purpose of absolutely stopping the car on a gradient, mechanical brakes are unecessary.

Power-house Equipment.

A gradual evolution is taking place toward high-pressure two and three-phase generation, and transformation down to continuous current for distribution to consumers' terminals. An important factor in this tendency has been the promotion of the large electric power-supply schemes, the promoters of which have, as is now well known, successfully argued before parliamentary committees the wisdom of dealing with this matter of electric supply "in bulk." Alive to the fact that, except in isolated districts, the days of the small generating station are numbered, and prominently putting these views forward, the founders of these power schemes have engendered like views in the minds of many municipal engineers in large towns, with the result that the year 1903 has seen the inauguration of several new and up-to-date municipal power houses, designed on these lines, the object being to foster a motor or power load. An indirect expansion of these same views may also be traced in the parliamentary notices for the coming session; quite an abnormal desire evidences itself on the part of municipalities owning electricity works to supply energy outside their own area.

Probably the most important station of this description is that which has been erected in Ireland by the Dublin corporation. Here the old works have been entirely shut down and the plant disposed of. A new and large plant has been built upon a breakwater in the harbor, where three-phase current is generated at 5,000 volts, with 20 sub-stations transforming down to 200 volts. There are four generating sets, two of 1,000 kilowatts and two of 500 kilowatts capacity, the machines being of the Oerlikon type. The frequency is 50 cycles per second. The exciters are six-pole and are driven by the main engine shaft. The Exeter corporation has also built a new two-phase plant. The works of the Central Electric Supply Company, which supply current generated some miles away, to a couple of London companies whose loads have outgrown their capacity, were also opened during the year. The generating pressure is 6,000 volts three-phase, and the current, when delivered at this pressure at the sub-stations of the two companies in question, is directly transformed by means of induction motors coupled to continuous-current generators down to the required pressure for the consumers. In these works, too, the generators are of the Oerlikon type, and there are two 1,560-kilowatt sets and one 780-kilowatt set, directly



COMBINED THREE-PHASE AND CONTINUOUS-CURRENT PLANT IN AN ENGLISH COLLIERY.

coupled to Willans engines. The frequency in this case is 46 cycles per second. A type of water-tube boiler new to this country is also used in the works, viz., the Climax, the tubes being of a horseshoe pattern interlaced. These will serve as typical examples of present-day central-station design in Great Britain.

Dealing with individual details, mention may be made of the increasing popularity of the steam turbine, and of endeavors to successfully apply high-speed gas engines to dynamo driving. With regard to the former, success is already assured. The Parsons turbine has at last vindicated the excellence of its properties, and is in use in a large number of places. Although the particular machines have not been made in England, there will be no other type of prime mover than the Parsons in the Lots Road power house now under construction for the purpose of supplying all the railways which are now famous as having been taken in hand by Mr. Yerkes. The advent of the Curtis turbine from America, also, has added a fillip to the adoption of these machines, and already two of the large power companies have adopted them.

Gas-engine problems still attract much attention, but practical application is slow. Even the Westinghouse engine, in public electricity works, has not forged ahead to any remarkable extent.

The combination of refuse destruction with electricity works as a remunerative means of steam supply has been much criticised, and except under the most favorable conditions does not induce quite so much enthusiasm as it formerly did. From the coal-saving point of view, experience has not proved much advantage, and there is the disadvantage of a very dirty generating station to contend with.

Power-supply Schemes.

If the promotion of "bulk" supply schemes, each mapping out a large area, proceeds at its present rate, the whole of the United Kingdom will before long be "claimed." There are actually in existence over 12 such undertakings whose square mileage totals up into tens of thousands, and several new applications are being made for next year (1904). Each year, however, sees a strengthening of the tendency of the smaller towns not to seek parliamentary powers to erect small works, but to await a supply from the company and to do their own distribution. If, as is being anxiously looked for, the present legislative restrictions concerning the erection of overhead wires for transmission over these large areas are relaxed, a very short time should witness great activity on the part of the power companies. The great expense of laying underground mains to considerable distances, must of necessity act as a deterrent to extensive works being carried out. Reference has been made elsewhere to the power-house equipment which one or two of the companies have adopted. None are yet at work to anything like the full extent of their areas.

Telphones and Telegraphs.

There is not a great deal to chronicle in respect of telephony. A few municipal exchanges have been opened, such as at Portsmouth, Brighton and Swansea, but these are equipped on the ordinary ring-through system and present no startling features. Tunbridge Wells sold its undertaking to the National company, but the whole business reflected little credit on the management. International communication has been added to by the opening of the London-Brussels telephone line. Probably the largest use hitherto made of the electrophone was in connection with the recent political speeches of Mr. Chamberlain at Birmingham and Glasgow, although it cannot be truthfully stated that the journalists who reported the speeches in London by this means covered themselves with glory.

The year has been an exceptional one as regards matters telegraphic, owing to the fact that the International Telegraphic Conference held its sittings in London. But these sittings having been held in camera, little of a technical character can be reported, and the official report already published gives all that is available. That vexed question of adequate and reliable communication with the North of England and Scotland from London has again largely obtruded itself, and only a few days since a report was made as to certain important underground extensions of a permanent character which have been made and of a number of others of a temporary nature for the time being.

Wireless Telegraph.

There is no need to enlarge upon the controversy which ensued owing to the friction between Professor Fleming and Mr. Maskelyne in connection with the former's experiments with syntonic wireless telegraphy and the Marconi system. The matter was well discussed at the time both in the American and English press, and it was one of those incidents which savor rather of personal than technical interest, in spite of the motives on either side. The time has now come when other systems than Mr. Marconi's are accorded a measure of public interest. The former company has not yet satisfactorily explained why at the end of 1902 a great ceremony was created concerning a daily news service across the Atlantic, which, however, lasted but two or three

days and then disappeared. Since then others have developed their ideas in no unmistakable manner, until to-day we have Dr. Lee de Forest demonstrating his system in Great Britain under identically similar conditions to those in which Mr. Marconi made his bow to the British public, viz., with the co-operation of the British postoffice. Dr. de Forest has now a station working experimentally across the Irish Channel, and a company to exploit his patents here has been registered.

Also of interest are the experiments being made with the Lodge-Muirhead system, for the exploitation of which a company also exists. The efforts of this company have been in the direction of temporary apparatus for short-distance inland work, and during the military maneuvers this year considerable success was achieved.

The International Wireless Telegraph Conference resulted in a greater proportion of disagreement than is usual in such matters and revealed the peculiar position that the present British law enables a government jurisdiction over all wireless telegraphic messages within the kingdom, but that the monopoly does not apply if the messages are sent to beyond the three-mile limit.

Miscellaneous

One of the chief of a batch of miscellaneous matters is the growth in the application of electricity to coal mining. During the proceedings before a government committee which considered this question the general consensus of opinion was that three-phase currents are the safest and best for the purpose. American readers may be interested in the illustrations accompanying this article, which show recent electric-mining equipments. Electric driving in workshops is now greatly in vogue, and in the case of large factories resident electrical engineers are employed, who take great pride in keeping down the generating cost to the lowest possible. In one very large works the generating cost has been kept as low as under one penny per unit.

Standardization is a question full of possibilities and great interest is being manifested in the doings of the Engineering Standards Committee, which has now published standard voltages and frequencies. A subcommittee is now busily engaged in getting together some standards for electrical machinery. In a similar manner, too, mention may be made of the standard wiring rules and conditions of contract, which have been evolved by the Institution of Electrical Engineers. There has also been a good deal of heartburning with regard to the adoption of the metric system, and the news that a bill to this effect will be promoted by the House of Lords next year will be received with mixed feelings generally, as it would appear to be not too popular.

Among other matters brief reference may be made to the development of the single-phase motor, one particular type of which is now being manufactured under the supervision of the inventor. Technical education has been much discussed, and the scheme of Lord Rosebery's, which will provide a universal home for students from all parts of the world, is now being matured.

Industrial Conditions.

A good deal has been said during the year in different places as to the stability of the electrical industry in Great Britain, and it cannot be denied that perhaps one or two firms are not as solid as could be wished. But the general state of the industry cannot be judged from this. The amount of electrical equipment which is now going on and has been going on all the year must put out of court at once any suggestion that the industry is stale or that a slump has set in. The cause of one very large firm of manufacturers' temporary financial instability has been set down by the receivers as being largely due to weak management. Personally I should be inclined to say that industrially things are as sound, if not more so, than they have ever been in the history of electrical engineering in Great Britain. Controversies arise at different periods owing to orders for foreign machinery for British towns being given, but it is the scarcity of these orders, comparatively speaking, that directs attention to them.

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The electric lighting and power plants in the coke regions of Westmoreland and Fayette Counties, Pa., and the Pittsburg, McKeesport and Connellsville railway system have been merged, and an application for a charter for the combined interests will be made at Harrisburg this month. It is said the capitalization will be considerably over $5,000,000. The new company will be known as the Western Pennsylvania Railways Company, and will control the entire lighting, power and street-railway system of Westmoreland and Fayette Counties, as well as part of the trolley system of Allegheny County.

ELECTRICAL PROGRESS ON THE CONTINENT IN 1903.

By Alfred Gradenwitz.

It is gratifying that last year's depression should have given way to a powerful advance everywhere. This is best shown by a glance at the reports of the great German electrical firms, which are far from showing any trace of the pessimistic tone of last year. As far as Germany is concerned this is evidently due in the first place to the consolidation of the leading firms which has taken place. The amalgamation of the Allgemeine Elektricitäts Gesellschaft with the Union Elektricitäts Gesellschaft has been followed up by a combination between the

FIG. 1. METHOD OF SUSPENDING TROLLEY WIRE ON SINGLE-PHASE RAILWAY ON THE CONTINENT.

Siemens & Halske and Schuckert companies. This "combine" is, however, only a partial one, as some branches are continued by the Siemens Company under the old firm, while the remaining ones have been united with the corresponding branches of the Schuckert Company under the name of Siemens-Schuckert Werke. Some of the foreign branch firms of both concerns are independent, but an amalgamation between the Austrian Schuckert and Siemens & Halske companies has just been arranged. On the other hand, it is anticipated that the amalgamation between the Allgemeine and Union companies will soon become a complete fusion.

The real competition in the field of electric lighting has partly been eliminated by the incandescent-lamp trust (glühlampenkartell) concluded some weeks ago between the leading continental firms concerned in the form of a limited liability company intended to regulate the prices which for years have been falling so as to ensure the necessary benefit to manufacturers through a fair charge to the consumer. The necessary increase in the price will be attended by an improvement of the quality of the goods.

As regards the reports of the leading electrical manufacturers, those of the Siemens & Halske Company state a dividend of four per cent., as last year, whereas the Allgemeine gives eight per cent., likewise the same as last year. The Elektrische Licht und Kraftanlagengesellschaft records five per cent., as compared with three per cent. for last year; the Berlin Electricity Works nine per cent, as against 7¾ per cent. last year. In view of these favorable figures the deficit of 2,500,000 marks shown by the balance sheet of the Union Company is quite surprising, though, as pointed out in the report, this may be accounted for by the peculiar character of the railway business, as the settling of accounts and realizing of profits in this line is mainly limited to the fall and winter, whereas this year's report, owing to the recent amalgamation with the Allgemeine Company, was confined to the first half of the year. The Aktiengesellschaft für Elektricitätsanlagen, Cologne, formerly connected with the Helios Company, has quite a satisfactory record, as the preference shares are granted a dividend of six per cent.

While nearly all the continental countries show unmistakable advance, I wish to point to the ever-increasing importance of some countries which some years ago were nearly negligible factors. It is safe to say, for instance, that nowhere on the European continent has electric lighting been so universally adopted as in Spain, where electric lamps have found their way even to the houses of the very poorest, owing on the one hand to the almost unlimited waterpower of the country and on the other hand to the prohibitory cost of gas. While by far the greater number of lighting and power plants and electric railways recently built in Spain are due to the enterprise of foreign firms, there are of late years unmistakable signs of the development of a national electrical industry in Spain, and many interesting inventions by Spanish engineers have lately been made public.

In the northern countries there is also a decided advance in the development of electricity. Whereas both in Sweden and in Norway this advance is favored by the wealth in hydraulic power, Denmark seems lately to have made up for the inferiority due to her less favored situation. The problem of the operation of electricity works by windpower seems, for instance, to have been solved in a satisfactory way by Professor La Cour's work, of which mention will be made later on. Telephony, as is known, has nowhere in the world obtained such popularity and universal diffusion as in the Scandinavian countries.

Electric Traction.

Efforts to use a single-phase alternating current in the place of polyphase current in operating electric railways are under way, and the Union Company of Berlin has for some months past performed regular trial runs on the Niederschönweide-Johannisthal-Spindlersfelde line, using a motor constructed by the company according to Winter and Echberg's data, designed for a pressure of 6,000 volts for 25 periods. The motor car, including the whole of its equipment, weighs 22 tons, the electric equipment being represented by six tons. It is fitted with two 125-horsepower motors, mounted on the same truck, one exciting system, and at each end one switching roller. The current is collected by two short arms, automatic-safety devices and fuses affording pro-

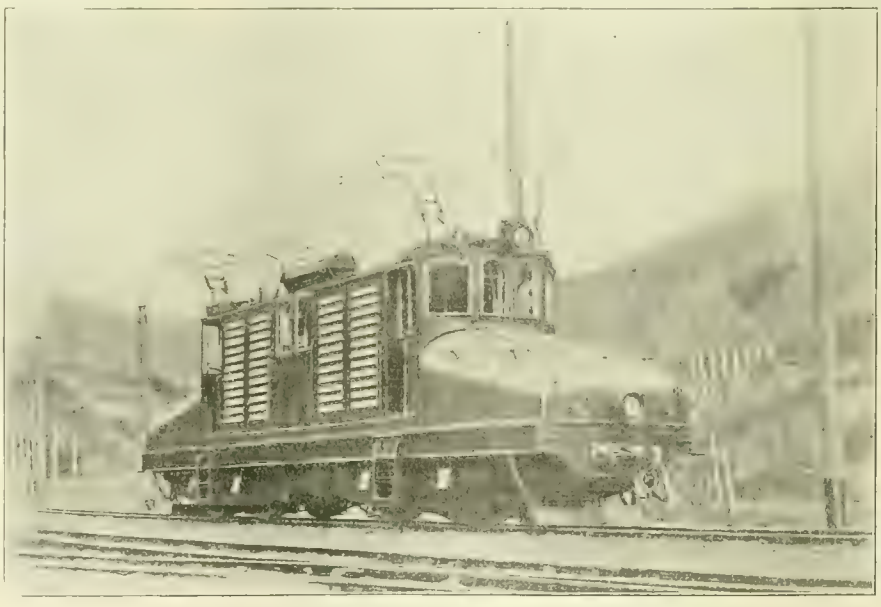


FIG. 2. NEW ELECTRIC LOCOMOTIVE ON THE CONTINENT.

tection against excessively high currents. There is in addition a small transformer in the car supplying the current for the pneumatic pumps as well as the steering and lighting currents. There are no shunt resistances. The motors are permanently connected in series, and though their efficiency at full speed is, as a matter of course, somewhat less than the efficiency of direct-current motors, the advantage of the latter is compensated by their great energy consumption in starting.

The overhead wire of the line conveys the electric energy at a tension of 6,000 volts, the track rails serving as return. Instead of transverse span wires, the working overhead wire is suspended by longitudinal wires in the form of nearly loose catenary curves. (See Fig. 1.) From these longitudinal wires thin vertical wires are suspended at distances apart of about three meters, supporting the working wire. Part of the track is fitted with one contact wire, as shown in the picture, while the remainder has two such wires. Experiment will show which is the better design. This arrangement of the working wire, where the latter has nearly no tension, will materially diminish the danger of a fracture of the wire, and as the ends of a broken wire would be beyond the reach of the railway personnel, the consequences of a fracture are at the same time notably diminished.

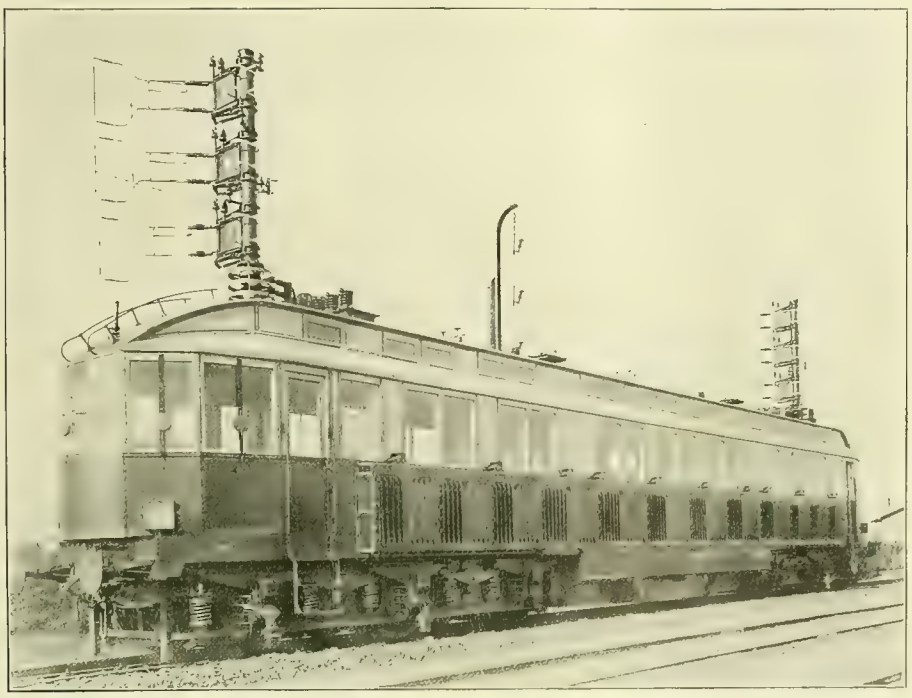


FIG. 3 SIEMENS & HALSKE HIGH-SPEED CAR.

Whereas with other types of single-phase motors, the electric energy has to be reduced to a low tension, the motor designed by the Union Company absorbed directly any desired tension, only a small portion, viz., about the sixth part of the energy, having to be reduced to low tension. These advantages will result in reduction of weight and an improvement in the efficiency, the first point being specially important in connection with narrow-gauge railway. As the narrow-gauge railway motor of the Union type is designed for about 40 cycles, no difficulties will be met with in lighting the carriages. The greatest advantage, however, is the fact that alternate current, according to the Union system, may be supplied direct from the same machines designed for supply of light and power, special plants and even machines being thus unnecessary in the case of narrow-gauge railway for light traffic

From these trial runs great consequences may be anticipated for the electric industry at large. In fact, in many cases where present systems do not indicate enough greater economy to justify "electrification," the Union system is likely to be used advantageously on account of the absence of substations that have to be superintended, the decreased cost of the equipment of the line, as well as of the favorable efficiency of the power transmission. The scheme will be especially advantageous in connection with mountain railways, including long-tunnel sections, metropolitan and suburban, as well as narrow-gauge railways.

The Anhalt suburban railway, "electrified" by the Union Company, which was the first electric standard-gauge railway in Germany, has since July been in full working order and given satisfaction. The same is true of the Berlin-Gross Lichterfelde (Ost) suburban railway, which has lately been converted. This line has a working length of 9.05 kilometers. A power station located at a distance of about 500 meters from Papestrasse station, in the immediate neighborhood of the Ringhahn, will, by means of a 1,600-kilowatt machine, aided by the remaining tramway dynamos and by a buffer battery, furnish the working current for the whole of this line. This suburban railway is operated with 550 volts direct, conveyed by means of three cables to a switchboard house located in the neighborhood of the working station. Four cables will thence lead to the two current rails, two to each of them; these current rails are insulated as third-rail along the two tracks, yielding the current to the 125 horsepower motors of the cars, whence it is led back through the running rails.

Railless traction, or the "trackless trolley," has lately been widely adopted, especially in Germany, the most important railless transporting plant being the one installed three months ago in Grevenbrück, Westphalia, for conveying daily up to 200 tons of stone over a distance of about one mile. In addition to similar lines intended for the carriage of goods, numerous trackless omnibus lines have been started.

In Sweden they are considering the problem of electrifying the whole of the State railway system in order to render the country independent of foreign coal. Owing to the inexhaustible amounts of waterpower and peat which the country possesses a solution of this problem should be easier than anywhere else.

Among standard railways lately electrified I may call attention to the Saint Georges de Commiers-la-Mure line, 31 kilometers in length, which so far had a rather dense steam-locomotive traffic. As the maximum output could not be increased on account of the numerous curves and steep gradients it was decided on electrifying the principal section of this line. The Compagnie de l'Industrie Electrique et Mécanique, Geneva, designed an electric locomotive (Fig. 2) capable of hauling 100 tons at a speed of 24 kilometers an hour. The locomotive, 13 meters in length, has a weight of 50 tons, the cab being 7.8 meters in length, 2.4 in breadth and 3.7 in height. There are low and extensive slopings on both sides of the cab, imparting to the locomotive the characteristic aspect of American high-speed locomotives. The electric energy is conveyed at a potential of 2,400 volts in a three-conductor system, the rails being the third conductor. The locomotive has four motors of 125 horsepower each, being connected in series at a potential of 600 volts each. The second and third motors are connected to the neutral conductor so as to reduce the pressure to 1,200 volts, using 185 amperes with 400 revolutions per minute. The locomotive is remarkable for its strength, with rather small dimensions. On both sides of the cab there are controllers capable of working synchronously and effecting the forward and backward run through mechanical coupling. There are special devices for producing interruptions of the current at any desired moment. The locomotive is provided with two brakes acting either on the axles of the whole train or of the locomotive alone. Experimental runs so far made are said to have given satisfactory results.

Marienfelde-Zossen High-speed Trials.

These experiments are another instance of the extensive co-operation between the leading firms. As the Western Electrician has kept its leaders abreast of the trials I need not go into details here. The small view of the Allgemeine car given in the issue of December 5th was taken immediately after the record run on October 28th, when a maximum speed of 210.2 kilometers was reached. As about the same speed had been attained by the Siemens car five days before, both cars have proved about equal in strength, and the respective qualities of either of them will have to be ascertained by the further course of the trials. (Fig. 3 shows the Siemens high-speed car.)

In addition to the rebuilding of the track, the roadbed of which (shown in Fig. 4) gave most satisfactory results, the mechanical part of the high-speed cars had also been somewhat modified before this year's experiments were begun. As former trials had shown the wheel-base to be too small, any irregularity of the track resulting in shocks to the cars, this distance was increased from 3.8 to five meters. The two cars are little different as to their exterior form, one being one meter longer and somewhat narrower than the other. The small differences are, however, likely to give interesting results as to the influence of the form of the carriage on the air resistance of the rapidly moving car, this resistance increasing most rapidly for augmenting speeds, and finally consuming by far the greater part of the energy.

As regards electric equipment, there are more essential differences, the four motors driving the Siemens car being mounted rigidly on the axles, whereas in the Allgemeine car they are placed on springs in a frame fixed on the axle box. The resistances necessary in starting are in the Siemens & Halske car made of metal, being operated through a controlling roller driven by compressed air. (Fig. 5 shows interior of motorman's cab in Siemens car.) With the Allgemeine car on the other hand, starting is obtained through a novel form of liquid resistances, allowing of the output being accurately regulated and an excessive heating of the resistance made impossible. The control of this apparatus is effected from the motorman's cab through a simple mechanical gearing.

After the record run the trials were continued for some weeks with the same satisfactory results,

FIG. 4. ROADBED OF MARIENFELDE-ZOSSEN HIGH-SPEED RAILWAY

the safety of working of the current collectors being particularly remarkable. Though both the track and the cars are likely to stand easily speeds as high as 230 or 240 kilometers an hour, the figures obtained have not been exceeded this year, as the necessary authorization had not been secured, and as, on the other hand, the main object of the trial, so far from consisting in record breaking, was the ascertaining of the working condition of high-speed electric railways at speeds between 150 and 200 kilometers.

The official report of this year's trials will no doubt contain many interesting data on this line. Meanwhile there seems to be one practical immediate result. As existing tracks have proved able to stand much higher speeds than those mostly used, the German railway authorities have decided on

performing in a few weeks hence a series of trials with steam locomotives on the same Zossen-Marienfelde line so as to ascertain the practical limits of the possibilities afforded by steam locomotives. The results of these trials are likely to be interesting also from the point of view of a comparison between the performances of steam and electric locomotives.

Train Lighting.

German railway authorities have long been opposed to adopting electric lighting for their trains, and it is gratifying that at last a step has been taken with a view to replacing the existing inadequate gas-lighting scheme by a more modern system. The "D" trains between Berlin and Hamburg have for some time been equipped with an electric-lighting plant installed by the Akkumulatorenfabrik Berlin-Hagen, according to the designs of the Prussian minister of railways. The current is generated by a dynamo located on the locomotive boiler and driven by a 20-horsepower De Laval steam turbine, the shaft of the turbine making 20,000, the dynamo 2,000 revolutions per minute. A storage battery is placed underneath each carriage, all the batteries being connected in parallel to the dynamo. Each compartment contains, in addition to the ceiling lamps, reading lamps capable of being switched on or off by the passengers themselves. In order to charge the accumulators the voltage of the dynamo is temporarily increased, an iron-wire resistance, surrounded by a glass bulb containing hydrogen, being connected to the terminals of each lamp so as to prevent any fluctuation of the light. The iron wire is brought by the current of the lamp nearly to a red heat, when the slightest increase in the intensity of the current will suffice to augment the resistance of the wire to such an extent that variable tensions will not produce any appreciable fluctuation in the luminous intensity.

Nernst, Osmium and Other Lamps.

Nernst lamps have been considerably improved in the course of this year both as regards durability and life of the burners, giving especially favorable results for higher tensions, such as nearly in universal use with modern plants. A new 250-candle type and a type intended to serve as standard-candle, as well as projction lamps have been turned out. About 2,000,000 complete lamps and burners have so far been distributed, and there is an increasing demand.

Osmium lamps, invented by Dr. Auer, have not been brought out before this year, though the work of the inventor had been begun about a year before. This lamp shows the advantage of a very high saving in current, consuming only 1.5 watts per candle instead of from three to 3½ watts. This advantage will be particularly important in great cities, where electric energy is expensive, in spite of the high cost of the filament and its fragility. This filament, as is known, is composed of rare earths and is expensive to manufacture. Another drawback is the fact that the lamp is designed only for low tensions—less than 55 volts; finally, this lamp cannot be fixed in any desired position, but has to be mounted vertically. According to Professor Wedding's recent researches, the absolute life of the lamp is much superior to 1,000 hours, figures upward of 3,320 being very frequent. The slower decrease in intensity of the osmium lamp as compared with carbon-filament lamps, the walls of which are soon darkened, embodies an additional advantage. An apparatus intended to facilitate the introduction of osmium lamps has recently been turned out by the Auer Company. This so-called "deviser" [divider?] is a simple tension-dividing apparatus intended to be used wherever the lamps are to burn independently, being fed from an alternating-current system. The "deviser" is a transformer having one single coil divided into three sections.

The Berlin Elektrodon Bogenlicht Gesellschaft has recently improved the existing processes for obtaining bodies conductive at ordinary temperatures and consisting of a mixture of about equal parts of the metal oxides of the earth alkali group as well as of oxides, salts or sulphides of the iron group. The conductors as obtained in the usual way are imparted a higher resistibility against high temperatures by adding oxides, salts or sulphides of the metals of the platinum group or of the metals themselves.

Regenerating incandescent lamps, where small amounts of solids or liquid-carbon compounds are enclosed in the bulb, being either volatile in the hot state or being decomposed into carbonous gases or vapors, have been known for some time. Scharff & Co. of Vienna, according to an invention by Dr. F. Blau, uses compounds boiling under normal pressures not below 300°, and possessing accordingly a low-vapor tension, for the purpose of precipitating carbon on the filament and repairing any losses which have taken place, the development of gases becoming more and more rapid as the lamp becomes warmer.

Telephony and Telegraphy.

In the field of telephony I wish to draw attention to the scheme invented by two Italians, Mr. Turcchi and Professor Brunè, with a view of employing existing telegraph lines for telephonic purposes. By an apparatus termed the "separator" the inductive effects of telegraph currents on telephonic currents are eliminated so as to allow of a simultaneous telephoning and telegraphing through the same wire. This system has been extensively tested by the Italian government, and is stated to have given full satisfaction.

The system of telephonic intercommunication between running railway trains, as invented by Basanta and Coutant, and repeatedly tested in the course of this year on the French railway lines, is based on the following principle: Each track is divided into sections of a given length, so that in normal service there cannot be any more than one train on each section. As soon as two trains are following up each other at distances smaller than the length of a section, there will be a moment when both trains are on the same section and electric bells are automatically rung, advising the conductors of both trains, and, if necessary, the officials of the nearest station. Electric communication being once

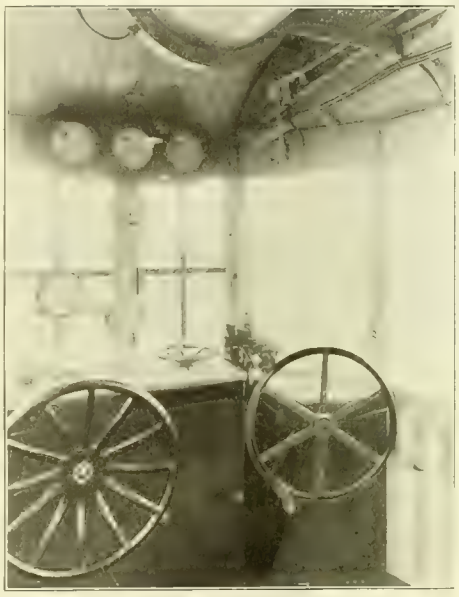


FIG. 5. MOTORMAN'S STAND IN SIEMENS & HALSKE HIGH-SPEED CAR.

established, the trains may communicate telephonically with one another and with the station.

Wireless telephony, according to E. Ruhmer's method, has been further developed in the course of the year. This method, as is well known, is based on the photo-electric properties of selenium, on one hand, and the phenomenon called the "speaking arc" on the other. The microphonic current at the sending station will result in luminous fluctuations being produced in an arc lamp installed in the focus of a parabolic mirror. This flickering of the lamp, corresponding with the sounds spoken into the microphone, is reflected by the mirror onto a similar parabolic mirror installed at the receiving station and containing in its focus a selenium cell, transforming the luminous fluctuations into fluctuations of current, which in a telephone are converted again into sound waves, analogous to those striking the microphone at the sending station. This system, after having been tried on the Wannsee Lake, has been put to trials over distances up to 15 kilometers and more this year in Kiel harbor. The satisfactory results obtained there will, it is rumored, induce the army and navy of several countries to adopt the system officially.

Meanwhile, the Siemens-Schuckert Werke has undertaken the manufacture of the Ruhmer apparatus on a commercial scale and has just brought out an application of the same system to wireless telegraphy. Like the telephone system above described, this telegraph system is an optical one. Differing from existing optical telegraph systems, where the flashes corresponding with Morse signals are liable to be intercepted by a third, this scheme is free from this danger, as the luminous flashes follow up each other so rapidly that the eye is incapable of distinguishing them.

In the field of wireless telegraphy, the Berlin preliminary conference, fully reported in the Western Electrician, should be mentioned, being the first step toward an international regulation of wireless-telegraph service. A novel wave detector, which was first exhibited in connection with this conference, being based on the sensitiveness of so-called polarization cells with respect to electric waves, has recently been brought out by Mr. Schloemilch.

A novel rapid type-printing telegraph has just been designed by the Siemens & Halske Company. The apparatus is analogous to the so-called automatical telegraphs where an apparatus similar to a typewriter pierces for each letter to be telegraphed certain holes in a continuous paper ribbon. The latter, on being drawn along through the rotating telegraphic sender will throw automatically corresponding currents into the line. As the Siemens apparatus is capable of telegraphing 2,000 letters per minute, the telegrams transmitted by quite a number of officials will be sent on the same wire. Two holes are pierced for each letter, the letter itself being printed immediately above in plain printing characters. The perforating may even be effected by the public itself. A disk where the various letters are cut out as in a pattern, rotates at a speed of 2,000 revolutions per minute between a spark gap and a continuous ribbon of photographic paper. Whenever a spark passes in the gap, a silhouette of the letter happening to be in front of the gap will be projected on the paper ribbon, which, on running through sponges impregnated with developing and fixing liquids, will complete the photographic process.

Power Transmission.

An interesting power transmission has been effected between St. Maurice and Lausanne, Switzerland. High-tension direct currents are employed in this case. This system allows of a greater simplicity of the plant without diminishing its efficacy, the total losses being no more than six per cent. [Details of this plant were given in Mr. De Courcy's article in the Western Electrician of December 26th.]

Another remarkable plant is building in Central Italy. The power station in this case is intended to supply the current operating the Castelraimondo-Camerino and secondary railway, on one hand, and the electric energy for lighting and power purposes to Camerino city on the other. The Potenza River yields the necessary power, about 600 horsepower, with a head of 17 meters. Three reaction turbines with horizontal axles for 200 horsepower each are installed at present, three alternating-current generators of the same output being direct-coupled to them and giving a pressure of 5,000 volts. Two separated high-tension lines will lead to the railway sub-station on one hand, and to the three sub-stations for lighting purposes on the other. The railway sub-station is fitted with transformers and rotary converters, converting the alternating current into direct current at 600 volts. The rotary converters are excited by special exciting systems, consisting of an asynchronous motor, coupled to direct-current dynamo. The track is about 12 kilometers in length, showing steep gradients and sharp curves. The average gradient is from six to seven per cent., whereas 9.6 per cent. is the mean figure for part of the track. The motor cars derive the electric current through two current-collector bows from the overhead line, the rails serving as return. For lighting purposes, the high tension is reduced from 5,000 volts to 130 volts, the system being designed for 2,500 incandescent lamps. This plant is being constructed by the Milan Società Italiana Lahmeyer.

Generating Electricity by Windpower.

The problem of using wind power in connection with electricity works has often been investigated, the principal drawback being the variable strength of the wind, resulting in corresponding variations in the speed of the dynamo. This difficulty, however, it appears, has recently been solved by Professor la Cour, who, on behalf of the Danish government, has for some years past been engaged in studying the question. In order to impart to the motors an approximately continuous speed independently of the strength of the wind, Professor la Cour uses an intermediate shaft placed in connection with a balance. The belt from the mill is led vertically on the disk of this shaft, its pressure on the latter being regulated by the balance bearing convenient counterweights. This arrangement results in the belt sliding on the disk as soon as the load exceeds a given maximum. A plant of this kind, feeding about 450 incandescent lamps, has for nearly a year been in operation at Askov, Denmark, petroleum motors serving as a reserve in cases of several days' calm weather.

A solution of the problem at issue will doubtless lead toward rendering electricity accessible at relatively low cost, even in small communities, and more especially in rural districts.

BUSINESS OF THE YEAR 1903 IN REVIEW.

The subjoined letters from representative men engaged in various electrical or closely allied industries speak for themselves. They review the history of the year just closed from a business point of view, from various localities and in diversified aspects. They show that while the high-pressure demand subsided during the latter part of the year, the condition of trade, generally speaking, seems to be a healthy one, with indications pointing to fair and steady, but not record-breaking, business in the presidential year now entered upon.

Automobiles.

Electric Vehicle Company, Hartford, Conn. (M. J. Budlong, president): We have noted a remarkable increase of popular interest in the product of both the electric and gasoline departments of our factory during the year 1903. Gasoline cars have come to stay, and will be successfully manufactured in increasing quantities in the future. These vehicles fill a very important place in automobiling, and at present there is nothing in sight which bids fair to interfere with them in their field. It is evident, however, that the electric is the most practical automobile for many pleasure drivers; that it is the best for city runabout use, for town carriage service, for the ordinary requirements of physicians, and for commercial vehicles. The outlook for large sales of our electric vehicles for 1904 could hardly be more promising.

Construction and Supplies.

Arnold Electric Power Station Company, Chicago (George A. Damon, managing engineer): The close of the year 1903 has been marked by a general depression along all lines of construction and a widespread tendency towards retrenchment in the development of industrial properties. As compared with the unparalleled activity of the past few years, the present appears to be nothing little short of a "slump." It cannot be inferred, however, that the present condition is financially unsound. Investors are becoming more conservative and are insisting on higher efficiency along all lines. This tendency affects the development of interurban propositions in two important points. At present many proposed lines will not warrant the investment necessary under the present system, and their construction will in many cases be held for the perfecting of the single-phase system. And, second, the high efficiency of the turbine generator will not allow of the design of stations without considering its use and will call for the redesign of many stations in which reciprocating engines are now installed. At present the delivery on turbines is very slow, and this, together with the delay in putting the single-phase motor on the market will delay the construction of many roads for which the engineering is now in the preliminary stages. Considerable activity is anticipated the coming year in hydro-electric installations. The recent developments in direct-connected turbines working under low heads make such propositions more attractive. While many large industrial plants are delaying in the matter of increased or improved power equipment, the amount of work of this nature being done at present, as well as the inquiries, promise well for the future. In general, the indications are that the coming year will be very satisfactory from the engineering standpoint, although the construction may in some cases be somewhat delayed.

Hodge-Walsh Electrical Engineering Company, Kansas City, Mo. (R. W. Hodge, president): Business in the electrical and kindred lines west of the Mississippi during 1903 has been even better than during the year previous. This is especially true of the section of the country lying southwest of Kansas City. The time has already come when business conditions in the territory named will not be materially affected by extreme eastern influences. The future prosperity of the West will depend largely upon the condition of agricultural productions. So long as conditions, such as have prevailed for the last few years continue, the demand for electrical products will be good. The outlook for 1904 is bright, enough work now being in sight to insure a good start.

Commercial Electrical Supply Company, St. Louis (J. P. Casey, sales manager): Our business has shown an increase of 33 1-3 per cent. over that of last year, and this indicates to us that the policy which we have pursued in the past has met with the commendation of our friends. Through the Louisiana Purchase Exposition, St. Louis proposes to demonstrate to the world her ability to handle the trade of the entire West and Southwest. We expect to meet and perfect a more cordial understanding with our out-of-town customers, and in this way be in position to handle their orders to better advantage. We look for a continuance of the recent prosperous conditions, made possible by the onward march of our science, hand in hand with a mutual feeling of confidence between manufacturer, jobber and consumer.

Dynamos, Motors, Electrical Machinery.

Bullock Electric Manufacturing Company, Cincinnati (L. Lowenberg): In spite of the slight financial depression, the year just ended will show an even more decided gain in the electrical industry than during previous years. New fields have been vigorously invaded and existing conditions more thoroughly exploited. Many electric street and interurban railways have been built, requiring not only railway motors, but also large direct and alternating-current apparatus. Waterpower plants for electric lighting, power and railway installations have been very largely developed, especially throughout the United States. Illumination is almost entirely accomplished by electric energy, gas apparently being used only through sufferance. The applications of the electric motor for driving machinery are legion, but so admirably is this motor adapted for direct-driven machine tools that it is creating a new era in machine-shop practice. Our share of this volume of business has kept our shops running 24 hours a day. On the other hand, large units seem to be growing in favor; among the machines at present building in the factory are several of 5,000 horsepower capacity. In fact, 1903 was a splendid year for us, and now at its close we find that the orders on hand and the immediate prospective business compel us to make further extensions to the factory. The plans for the additions have been prepared and include a new shop 175 feet by 100 feet. With these increased facilities, we will be able to give prompt attention to present and prospective business.

Hobart Electric Manufacturing Company, Troy, Ohio: Our business for the last year has exceeded that of any previous year and so far as our company is concerned we have not felt the effects of the widespread weakening of the market for all kinds of machinery. We still have all the work ahead of us that we can conveniently take care of. Regarding business for next year, we anticipate a slight reduction in the demand for electrical apparatus, but we do not look for any disastrous slump.

Holtzer-Cabot Electric Company, Brookline, Mass.: We have observed the year 1903 to have been one of great activity in electrical circles, the demand for all sorts of electrical goods having been quite phenomenal. One of the most significant as well as gratifying developments of the year has been a marked increase in the number of inquiries for motors to be used in lines in which heretofore other motive power had been used; also for generators to supply current for an almost endless variety of new purposes. We found it necessary during the present year again to increase our capacity, which we have done by adding a six-story building, which will be used entirely for getting out our heavy machine work. This gives us an additional floor area of 50,000 square feet, about doubling our capacity. During December there has been a slight lull in business, which, however, is believed to be the result in a great measure of the usual fall suspension of building. We think that with the opening of construction work in the spring a general revival of business will be felt throughout the country which will, without doubt, extend itself to all electrical circles.

Keystone Electric Company, Erie, Pa. (H. B. Coho, vice-president): We take pleasure in saying that the business done by this company in 1903 was nearly twice the volume that it has been in preceding years. In the year just past the company has been able to increase the size of machines it builds, and is now prepared to build direct current apparatus up to 1,000 horsepower capacity if required. While we have to a certain extent felt the general trade depression, we have no reason to feel otherwise than that the electrical business will keep on expanding and that we shall receive our share of the business. The efficiency of electrical transmission has become so well known a fact that it is difficult to see how any up-to-date manufacturer can afford to use any other method for transmitting his power, and it has been our experience that in times of business depression the successful manufacturers investigate all labor and power-saving devices, and in this way the electrical trade is apt to profit by a depression in other lines. The hopeful sign of the time is that the standard of excellence among all manufacturers is constantly improving, and manufacturers of electrical apparatus are being educated to a point where they realize that they cannot afford to turn out anything that will in any way cause the purchaser to regret having installed electricity.

Northern Electrical Manufacturing Company, Madison, Wis. (A. O. Fox, general manager): We are glad to be able to say that our past year has eclipsed all previous records; not only in the volume of business, but in its high character. The large additions to our plant built in 1902 and the early part of 1903 have put us in position to handle our work with greater expedition, and to make very prompt deliveries. It is perhaps early yet to make predictions for 1904. There is an evident tendency for business to quiet down. Much of this seems to have been incident to severe labor disturbances in various localities. There is, however, much business in sight in these same localities, and with the advent of better labor conditions, it is to be hoped there will be a considerable revival of these postponed operations.

Roth Bros. & Co., Chicago: The year 1903 has been a very good and prosperous year for us, with the exception of the last two or three months, in which business has dropped off considerably. However, the first part of the year was very prosperous, and we had a splendid business. Our moving in May into larger quarters and applying individual motors to our machinery put us back somewhat in filling our orders. However, after we got straightened out, with our increased facilities, we soon made up for lost time, and are now prepared to fill orders promptly. As regards the outlook for 1904, we think we shall have a very prosperous year.

Sterling Electric Motor Company, Dayton, Ohio (J. A. Gauthier, president): With us business conditions could not have been any better. The percentage of increase over the year before and total sales up to date are very gratifying indeed. In regard to the prospects for next year's business, while it is a hard thing to state just how far the recent reaction will work itself, we do not anticipate any such times like 1902 and 1903. The crops in the West have been extra good for the last few years, and therefore the purchasing power of that part of the country has increased rather than decreased. The financial condition of the West has never been any more prosperous than it is to-day, and that certainly will go a long way towards steadying adverse current against present business conditions. In our line we have reason to feel somewhat cautious owing to the reason of overproduction, during the last couple of years especially, and also for the reason that the East is a larger purchaser in proportion than the West in machines of that character. There has been a great deal of manufacturing done without any actual selling, manufacturers merely placing quantities of their goods here and there and elsewhere to be sold by the retailer as the opportunity presented itself. We believe that a readjustment will certainly take place, as it is almost impossible for the country to consume our present output. We have to look toward exports to relieve the situation, and the high scale of wages, added to the higher price of raw material, forbids any marked increase in that movement.

B. E. Sunny, Chicago (western manager for General Electric Company): A review of the electrical business for the year 1903 shows that it compares favorably in every way with that of 1902, and the indications for 1904 are that while the total amount of business will not be as great as for the two previous years, due to a falling off in the number of new enterprises, the net difference will probably not be very great. The development of the steam turbine as a prime mover in progressing so rapidly, both in this country and abroad, that I think we may confidently look for a very large amount of business in that line. I think, too, that we may safely look for a considerable amount of business in the line of improved arc lamps and devices for interior lighting.

Triumph Electric Company, Cincinnati (W. H. Jacob): So far as our own particular business is concerned during the present year, it will surpass any previous year's business something over 50 per cent. As for the outlook for the coming year, from the number of inquiries that we have had and the number of orders booked for delivery next year, we are of the opinion that business will be up to the standard.

Warren Electric Manufacturing Company, Sandusky, Ohio (C. C. Warren, president): The year 1903 has been one of surprises. The months of January and February gave us a good many orders and filled our works with business up to nearly the middle of the year. From March until the first of July orders were extremely scarce. July showed an improvement, and in August and September we were deluged with business. October, November and to date [December 15th] there has been a decided sluggishness. In fact, ever since the Wall street raids on overcapitalized industries the public has seemed to show a disinclination to undertake what would involve unusual expenditures. It is our opinion that the electrical business will outlive the rich man's Wall Street panic, and that there will be a gradual improvement from now onward.

Westinghouse Electric and Manufacturing Company, Pittsburg (F. F. Coleman): The results of the Company's operations for 1903 have been very satisfactory, in spite of the check to certain lines of work due to the slump of stocks in Wall Street. A company as large as this, with agents scattered all over the country, is in an unusually good position to appreciate the business situation. In the early part of December the annual meeting of the district office managers was held at Pittsburg, and at that time a very careful discussion of the business situation took place. It was the practically unanimous opinion of these close students of the situation that the outlook promises at least as good business as during 1903. The opinions that were given had been asked to enable the manufacturing part of the company to prepare itself accordingly. In the event of the anticipated improvement in the financial situation in the East and the ability to finance legitimate enterprises, the business for 1904 is already assured, and will be equal to any previous year.

Electric Heating Appliances.

Simplex Electric Heating Company, Cambridge, Mass. (James I. Ayer, manager): We are closing the year with a considerable increase over any previous year's business; the steady uniform increase in business has been very gratifying. Collections have been uniformly prompt and satisfactory, and there has been very little of the vicissitudes of the stock market, industrial trusts, or labor troubles reflected in our business in the last six months. We believe that the electrical industries in general, and especially central stations and supply dealers, are on a far more substantial and healthy basis than ever before. There is nothing in the business of the past few months or in the present outlook to indicate any adverse change in the immediate future.

Engines, Gas and Steam.

American and British Manufacturing Company (Corliss Steam Engine Works at Providence, R. I.): A request to express our views on the business outlook for 1904 finds us as steam-engine builders—particularly as builders of the Geo. H. Corliss engine in the location of the very cradle of the world's modern steam engine—finds us, we say, in what may be regarded as a very significant position. For the last year we have been turning out, on a settled-down manufacturing basis, an increasing number of Diesel engines, an internal-combustion motor that competes directly with our smaller steam engines. Furthermore, we are bringing out another type of internal-combustion engine for sizes below the field occupied by the Diesel engine. We have already turned out some 10,000 horsepower of Diesels and this, with the works full, necessarily reduces the output of steam engines. Power users have about got through watching to see if the Diesel engine is any good and are now figuring whether they cannot use one to advantage. For 1904 we, as a consequence, anticipate a rapid increase of business for the first six months and after that a grand hustle to get out goods fast enough. This is in the aforesaid cradle of the steam engine, and this prospective hustle is over internal-combustion engines. Where does the time-honored, first-mentioned engine come in? Well, we believe it comes in "scattering" and is destined to be more so. We anticipate seeing this epoch-making machine, with its beggarly ten per cent. efficiency, fade away gracefully down the vista of coming years, before the 20, 30, and perhaps more per cent. of the internal-combustion engine. O yes; we are going to keep right on building the "steam eaters" as long as anybody wants one. The above relates to the output of our Corliss Engine Works plant at Providence. At our Ordnance Works in Bridgeport, Conn., orders for guns and projectiles have been fairly good for the last year while the prospects for the coming year are for a steady increase, with a very satisfactory business. We don't find any incongruity between lots of gun building and electing a president during the same year; at least, not this time.

Buckeye Engine Company, Salem, Ohio (C. H. Weeks, vice-president): Our business for the year 1903 has been extremely satisfactory. A great deal of the business of 1903 carries us into the first five months of 1904. We are operating our plant double-turn, and with the work we have on hand and the prospective work we see no reason why we will not continue to operate throughout the year 1904 on the same basis.

Charter Gas Engine Company, Sterling, Ill.: Our results have been very favorable in 1903, and while not many of our engines have been ordered for electrical purposes, when compared with the total number, yet we have nothing to complain of in this line. Our expectations for 1904 are that there will be a continued increase in the inquiry for gasoline engines, for the condition of the country is prosperous, especially where the basis for prosperity is the farmers. There will be the weeding out of the inferior engines and the builders of gasoline engines that are not able to stand hard times—for it seems that we will have a taste of them during the coming year. All of this is favorable to the well-established manufacturer, and the final result is, if possible, better than were uninterrupted prosperity enjoyed.

Fitchburg Steam Engine Company, Fitchburg, Mass. (F. Fosdick, president): As last year, we have not made a special effort for electrical work, there being such sharp competition in that direction among the engine builders; still we have furnished engines for probably 50 per cent. more electrical plants than in any previous year. The extension of such work is simply enormous, with the consequent demand for steam power. We do not see any special let-up in the demand so far for such business, and while there seems a general feeling that business is to be less urgent for the coming year, we have not ourselves yet appreciated any such decline and have no reason to anticipate it for the coming months. We find the tendency is to larger electrical units supplying the place by motors of the smaller engines, and naturally we find also the call for direct-connected work more general.

Marinette Iron Works, Marinette, Wis. (T. C. Miller, president): Business with us during the last year has been very good, and would have been our banner year had it not been for the fact that our factory was closed for nearly three months on account of strike. We have installed a great many of our gas and gasoline engines during the past year in the electric-lighting service, in private as well as municipal lighting plants, office buildings, hotels, etc., both belted and direct connected to generators, and the outlook for 1904 is very bright. We anticipate doing a large business in the above line, and in order to take care of our rapidly increasing trade, we have been obliged to seek a more advantageous point of distribution as well as increase our manufacturing facilities, and with this end in view are now constructing a large and modern plant at Chicago Heights, Ill., which we have nearly completed and expect to have in operation by the first of January. We will then have one of the largest and most modern gas-engine manufacturing plants, we believe, in this country, which will be in keeping with the high merit of the Walrath engine. There is a growing demand for gas and gasoline engines for electric lighting plants, and having one that meets the demand fully, we can only anticipate a very prosperous business for the coming year.

Watertown Engine Company, Watertown, N. Y. (S. F. Bagg, treasurer): In our business the year 1903 has been marked by decided fluctuations, months of very active business being followed and preceded by periods of extreme dullness. This is probably due to building trades strikes in the larger cities and the financial stringency, which delayed the commencement of new enterprises. The aggregate of the year, however, has been good—perhaps 15 per cent. higher than the previous year. Our selling office report

considerable business in sight for the year 1904—a better outlook apparently than a year ago at this time.

INCANDESCENT LAMPS.

American Miniature and Decorative Lamp Company, New York (Richard S. Carrick, manager of sales): The year 1903 has been a very successful one with this company. Our telephone-switchboard-lamp business has increased over 100 per cent with every indication of a further increase during the year 1904. The general miniature business of the company has been extremely satisfactory, and it is making preparations for a much larger output for next year. A new departure for this concern is the manufacture of standard tipless lamps. There is a tremendous field for this lamp, and we venture to assert that in the very near future the standard tipless lamp will be well known.

Banner Electric Company, Youngstown, Ohio (N. L. Norris, secretary): Our business has been very satisfactory indeed during the last year and although market conditions in our line have been somewhat unsettled on account of the extremely low prices which have been offered by some manufacturers, still we have been able to maintain our prices and have also increased our business over last year a little over 65 per cent. We have also within the last few months brought out a line of electrical specialties, and we find our trade in this line steadily increasing and thus far are much pleased with the results. Although it is generally conceded that the business outlook for 1904 is not as encouraging in some lines as it was one year ago, still we do not believe that the electrical trades will be effected materially and we look for a continuance of the prosperity which we have enjoyed during the last seasons.

Rooney-Westbury Electric Lamp Company, New York (H. Westbury, sales manager): The miniature and decorative branch of the incandescent lamp business has been in a very flourishing condition for the year of 1903 and the prospects for 1904 are correspondingly bright. It is no exaggeration to say that the demand has exceeded the supply, and although the summer season was somewhat dull, the fall and winter months have more than made up the deficiency. The building strikes in various parts of the country temporarily checked the output of candelabra and fixture lamps, throwing the whole demand on the busiest months of the year. The call for novelty lamps is still on the increase, large numbers of them being exported, especially to South America and Mexico. Probably the Pacific Coast has developed the use of candelabra and fixture lamps more than any other part of the country in 1903. Very large orders have been booked ahead for 1904 for decorative lamps for the St. Louis Exposition and for fixture lamps for buildings held up through the recent strikes, in addition to which, the presidential election usually calls for considerable work of this kind. No especially new types of lamps have been placed on the market this year, but the old types have been developed in various ways and the usual small drop in prices consistent with an increased demand has been noted.

Shelby Electric Company, Shelby, Ohio (J. C. Fish, secretary): The business outlook in the various electrical lines appears, from our standpoint, to be hopeful. While it may be true that the increase in this particular field has not been as rapid during the last few months as in a corresponding period last year, still we believe that the threatened period of hard times has been headed off. With cotton at a high price in the South and with the extremely prosperous condition of the West, the country is sure to continue prosperous. During prosperous times the electrical industry thrives better than most other industries, and in spite of all discouraging conditions the growth of the business of our factory has continued.

INSTRUMENTS.

The Bristol Company, Waterbury, Conn.: Our business outlook for the coming year is very bright as the demand for recording instruments was never greater than at the present time.

Stanley Instrument Company, Great Barrington, Mass. (W. C. Andrews, sales department engineer): We can say, in brief, that the retrospect is exceedingly gratifying and the prospect exceptionally hopeful.

INSULATION.

Chicago Mica Company, Valparaiso, Ind. (E. H. Heilstedt, secretary): Our business up to November 1, 1903, shows an increase of 60 per cent. over the total business of 1902. This is due particularly to the change of policy which took place in this company in the early spring of the present year. Previous to this time the company had been associated with what was known as "the mica trust." This connection, however, proved unprofitable to this company, resulting in the withdrawal from the mica trust, with the above result. We have every reason to believe that the business during the next 12 months will show equally as good an increase over 1903 as 1903 has over 1902. This will depend of course, to some extent, on the financial condition of the country in general, but as stated above, the outlook at present is indeed gratifying.

Mica Insulator Company, New York (Franklin Brooks, vice-president): We are gratified to state that our business in insulating materials during the year 1903 has been extremely satisfactory. The demand for our goods in the latter part of the year 1902 was so large that, in order to fill our orders promptly, we were obliged to erect additions to our factory. These additions, together with the improved and special machinery installed, enabled us to greatly increase our output. Our business, of course, depends to some extent upon the activity of the manufacturers of electrical machinery, and, as this field is a constantly expanding one, we look forward to a larger volume of business in the year 1904.

NERNST LAMPS.

Nernst Lamp Company, Pittsburg (H. F. J. Porter): Our business for the last year has been very satisfactory. Our records show that we have sold over half a million glowers. This is equal to about 25,000,000 candle-power, and in our mind, goes to show that the Nernst lamp is undoubtedly a commercial success, and is now in service in all parts of the United States. Our recent reports from our various sales offices and salesmen show that the business for 1904 promises to exceed that of the last year.

POLES.

Francis Beidler & Co., Chicago: Our principal business is in lumber, lath and shingles, and the cedar poles and posts we ship are produced in connection with the lumber business. It appears that the cedar-pole branch of our business is quite different from any other branch, in that it is more affected by the money market. Therefore, when money is plentiful and can be secured at a reasonable rate of interest, the cedar-pole business flourishes, but those who have followed the finances during the past year will remember that numerous panics among the Wall Street brokers since the middle of July, all of which have either directly or indirectly had a tendency to curtail investments in Independent telephone securities or interurban railroad securities, these two industries being the principal market for our poles. Prior to July 10th we enjoyed an excellent trade [illegible] business has not equaled the same period in the previous year. Notwithstanding this fact, we learn of numerous proposed extensions to old lines in the telephone field, as well as among the interurban railroads, also a number of new incorporations which intend to build during the coming year. We cannot expect business to be as good in 1904 as it has been during the past two or three years, on account of the interest of the business public being divided between personal interests and the presidential campaign, but now that prices have settled down to a conservative basis, we feel safe in stating that values will not be lower in cedar poles than at the present time, and we can reasonably expect a fair amount of business.

C. H. Worcester Company, Chicago (W. P. Bowring, secretary): In reviewing the business done by us in connection with electrical industries, we find the volume of business has increased largely. The activity in telephone and trolley construction has been marked and the close of the year, we think, leaves the stocks of poles on hand about the same as last year. There has been a good demand for small poles, which would indicate that Independent telephone companies have been building lines in the rural districts, and existing conditions in the central and western states point to continued and perhaps increased activity in this branch of electrical construction. It is more than probable that the input of stock the coming season will be smaller than the production in 1902 and 1903. Fair stocks are being carried over and the weather conditions thus far have not been favorable in the northern country where the large proportion of cedar is cut. A heavier snowfall than usual has prevented the freezing of the swamps and operations have been hampered. We consider the outlook favorable for the use of large quantities of poles during the coming year.

POWER-HOUSE AUXILIARIES.

Green Fuel Economizer Company, Matteawan, N. Y. (A. H. Blackburn, general manager): As far as our business is concerned for 1903, it has been one of the best years we have had in the electrical business; and whereas in general lines of business we believe that the business done next year will not be anything like as great as it has been the last two or three years, at the same time we do not think it is going to affect the electrical business anything like as much as general business, and we are looking forward to a fair volume of business in this particular line.

Main Belting Company, Philadelphia (W. T. Plummer, secretary): The year 1903 has been a busy year for us, and while there have been, and are, unsettled conditions, we believe it is simply a leaning up process, and that business for 1904 will be the better and more stable, as a result.

Northern Engineering Works, Detroit (G. A. True, manager): The year 1903 has been the best year in our history, the demand for electric-traveling and hand-traveling cranes having largely exceeded that of any previous year. Recently there has been a tendency toward a more quiet market and lower prices. We are looking for a fair business next year at prices somewhat lower than prevailed this year. We expect a revival of business soon after the first of the year. There has been considerable money earned by manufacturers in the last two or three years, some of which will be spent on improvements and on facilities for cheapening costs. We think there has been a general expectation that the presidential year will bring increased labor troubles, but the present quiet spell will probably prevent this and may be the means of securing a fairly good, if not an extremely prosperous, year.

Replogle Governor Works, Akron, Ohio (Frank S. Replogle): Our business year ended October 1, 1903, and was the best since we have been in the business of building waterwheel governors. We are having numerous inquiries and think that the coming year will be a good, prosperous year.

SECOND-HAND APPARATUS.

Gregory Electric Company, Chicago (A. O. Kuehmsted, president): The year 1903 has been a very prosperous one for this company; in fact, the best year the company ever had. We have noted a gradual decrease in the price of apparatus since last July, caused largely by the decrease of the price of raw material, and think that an era of lower prices will stimulate business. It has been our experience that second-hand business is really better in times of tight money than in boom times, because purchasers do more shopping and are more careful in the way they spend their money. Business appears to be particularly good in the central, southern and western states, and we think that under these circumstances we can look forward to a fairly good year for 1904, although we do not think that it will equal [illegible] of 1903.

SPACE-TELEGRAPH APPLIANCES.

Thos. E. Clark Wireless Telegraph-Telephone Company, Detroit (Thos. E. Clark, general manager): Our business for 1903 has been very gratifying. We have received a large number of inquiries, as well as a large number of orders, and these have come from all parts of the United States, as well as from foreign countries. The outlook for our business for 1904 is certainly encouraging to a new company and a new industry. We have had the advertising to place our goods before the people, and we are now reaping the results and booking orders for our apparatus and instruments. We have just completed a nice new factory, which we are now occupying, and we will be better able to take care of any business which may come our way, as well as the increased demand for electrical specialties which we are now manufacturing.

SPECIALTIES.

Crouse-Hinds Electric Company, Syracuse, N. Y. (F. F. Skeel, Chicago representative): The year of 1903 has certainly been a very prosperous one, we believe, to all manufacturers. To us it has been particularly gratifying, and the outlook for as much of 1904 as seems to have given indication in the way of specifications seems to be very bright. We are most optimistic on this question of the coming year. There has been no falling off, which has been so prevalent in previous years during the winter months.

Cutter Electrical and Manufacturing Company, Philadelphia (A. Edw. Newton, president): During the year just closed we have enjoyed a very prosperous business. We began the year somewhat behind in our orders, and it has only been within the last month that we have been able to fill inquiries promptly. Our business has grown from a small one to the largest of its kind in existence, due, as we believe, largely to the fact that manufacturers are beginning to appreciate the wisdom of the use of electric current. As to the outlook for 1904, it appears to be quite certain that in certain branches of the electrical trade business will continue in the future, as in the past, to be excellent. Competition will bring this about. Those who have equipped their plants electrically have such an advantage over those who have not that they must either follow in the wake of their more enlightened competitors or go out of business. Not many are going out of business. Moreover, at least in the circuit-breaker line, with a lessened home demand, we will be able to secure foreign business that in the past two years has escaped us, not on account of price, but on account of delivery.

H. W. Johns-Manville Company, New York (J. W. Perry, manager electrical department): Our business in the electrical line this year has shown a very marked increase over any preceding year. This is particularly true of the enclosed-fuse devices, which are now being used universally throughout the country. During the year we have gotten out a number of new devices, very largely increasing the line of enclosed-fuse protective devices, which we believe will greatly increase the sale of this product next year. The outlook for 1904, we believe, is exceptionally good, particularly in all lines of electrical business.

The Lakon Company, Elkhart, Ind. (John C. Boss, president): We have been blessed with a very good business [transformers and high-potential fuse and junction boxes] during the year 1903, and it is our opinion that 1904 will make a very creditable showing.

TELEPHONE APPARATUS.

Central Telephone and Electric Company, St. Louis (Jas. S. Cuming, president): We have had the greatest demand for telephone instruments and telephone accessories in 1903 of any year since we started business, eight and one-half years ago, and we believe that the majority of our competitors have likewise been favored. We find a temporary check is being placed on the telephone industry by the fact that a great many exchange operators are beginning to realize that cheap construction is not a permanent investment, and such construction has not tended toward interesting capital in the Independent telephone field. This check, however, we believe is only temporary, and will result as a benefit to the Independent telephone industries, as even the smallest exchanges to-day are being installed on much more practical and sounder basis than they have been heretofore. We therefore look for a good business in the telephone field to all who are willing to invest on sound business principles, with a sure legitimate profit, instead of large profits the first year and no profits the second year, which characterized the business when first inaugurated.

Holtzer-Cabot Electric Company, Brookline, Mass.: The demand for telephone apparatus has been good throughout the year by reason of the great activity in the fields of telephone construction and installation.

WIRES AND CABLES.

Driver-Harris Wire Company, Harrison, N. J. (L. L. Driver, treasurer): Business for 1903 has been very satisfactory. Our sales have increased fully 25 per cent. over 1902, and we have enlarged our plant considerably. In addition to installing a great many new machines, we have built a new power house and put in a complete power equipment. We have prepared for a like increase in business for next year over the present year, and trust we will not be disappointed. Several weeks during the summer we were compelled to work nights, but since about the middle of September business seemed to have dropped off a little. While we have been very busy since that time we have not had the volume of business ahead that we usually have. At this writing we seem to be running from week to week on orders, instead of having a supply of six to eight weeks ahead. However, at the ending of every year, orders drop off and we expect a material increase after January 1st.

Standard Underground Cable Company, Pittsburg (J. W. Marsh, vice-president): We are glad to say that our business for the year 1903 has been much larger in the aggregate than for any previous year in the history of our company. This has been to some extent due to the opening (last December) of our large new copper rod and wire mills and weatherproof factory, but the business has been very satisfactory in all lines. We have observed some falling off in business for the last three or four months of the year as compared with the earlier months, but, while we can hardly expect the business in a presidential year to be quite equal to that of the last two or three years, yet we see no reason to anticipate any extraordinary depression or falling off in business for the year 1904.

X-RAY APPARATUS.

Rooney-Westbury Electric Lamp Company, New York (H. Westbury, sales manager): The developments in the X-ray apparatus field have not been very startling during the past year, although coils and machines generally have steadily increased in efficiency. The time of exposure for radiographic work has been considerably lessened by the advent of more powerful coils and Crookes tubes with water-cooled targets, which, although high in price, are coming into general favor. All the leading hospitals in the country are now fitted with X-ray outfits, and doctors in private practice are rapidly becoming behind the times, unless they are so equipped. Dr. Piffard's ultra-violet-light apparatus has brought the Finsen light in reach of every practitioner, the cost being nominal. As we are still only on the threshold of this business, new and startling developments may take place at any time. Meanwhile the prospects for 1904 are quite bright.

Steam Turbines for Manila.

An important export order has just been closed with the Manila Construction Company, an American corporation conducting operations in the city of Manila, P. I., for a complete power equipment for the city traction system. The order was secured through Westinghouse, Church, Kerr & Co., and comprises the following machinery: Three 750-kilowatt Westinghouse turbo-generator units, two compound-engine exciter units, one motor-driven exciter unit, three 500-kilowatt rotary converters, one 300-kilowatt rotary converter, four 250-kilowatt oil-insulated transformers, complete switchboard and one series booster.

The first turbo-generator unit will be delivered in about nine months. The turbine will operate at 150 pounds steam, 26-inch to 27-inch vacuum, and 150 degrees superheat. It is fitted with the usual by-pass for securing an overload capacity of 50 per cent. It is also equipped with a quick-closing throttle valve. The turbo-generators will furnish three-phase, 60-cycle current at 380 volts; part of the current will be converted to direct current by the power-house railway sub-station, and the remainder will go to transformers for supplying high-tension distributing system. The transformers are oil-cooled and connected in the two-phase, three-phase, or Scott system for three-phase transmission. The turbine machinery will also furnish current to the local light and power system.

The commissioners of the Dortmund suburban district in Germany have decided to build an electric railroad at the district's expense. The Allgemeine company of Berlin, whose bid of 1,640,000 marks ($390,320) has been accepted, will build the road and operate it, under a concession, for a period of 10 years.

Indiana Telephone Items.

The American Exchange Telegraph, Telephone and Money Order Company has filed articles with the secretary of state. The capital stock is $10,000 and the headquarters is Cumberland, Ind. The purpose of the company is to construct and operate telegraph and telephone lines between Cumberland, Ind., Cincinnati, Ohio, and Covington, Ky.

The Cumberland Telephone Company is putting forth extraordinary efforts to enlarge its service in Southern Indiana. The company is said to have agents out, inducing farmers to build their own lines, promising them immediate connection and service with the Cumberland under very flattering terms. It is said that a number of lines will be built by farmers under the promises held out by the agents.

The first year's report for the Knox County Home Telephone Company at Vincennes shows a growth of 1,300 connections. By January 10th the Princeton line will be finished. The Sullivan connection has been in operation for two months, and a long-distance line will connect Indianapolis in a few weeks.

All of the telephones of the Lebanon Telephone Company were burned out on December 22d and the plant badly damaged. Workmen were engaged in stringing new cables when the rope broke, letting the wire drop upon the trolley wire of the Indianapolis and Northwestern Traction Company. The cable burned in two, and all the telephone drops and practically every telephone in town was burned out.

At an early hour December 24th the entire interior of the exchange of the Home Telephone Company at Noblesville was set on fire, the result of the cable in South Ninth Street coming in contact with the trolley wire of the Indianapolis Northern Traction Company. The trolley wire was raised four feet to allow a house to be moved across the track, and touched the telephone wires. Over 200 telephones were burned out. Large balls of fire darted across the room of the exchange office, causing the night operators to turn in a fire alarm. A great deal of delicate machinery was totally destroyed, and the loss is estimated at $2,500. The Home Telephone Company is the oldest Independent company in the state, being the first to organize and build a plant.

The Central Union Telephone Company is dividing the state into four districts, with district headquarters at Indianapolis, Terre Haute, Logansport and Anderson. The officials say this division arrangement is being made with a view to the betterment of the service. They assert that the work of extension is being carried on so rapidly that it is no longer possible to handle it from one central point. Under the new plan, four division superintendents will work under the general superintendent, with headquarters in Indianapolis. The district superintendent for Logansport has not yet been appointed, but the other division superintendents selected are: R. W. Swan, Anderson; J. H. Sheppler, Terre Haute; M. D. Atwater, Indianapolis.

S. P. Sheerin, general manager of the New Telephone Company, has returned from a trip East. It is understood that the company is preparing to make large improvements and extensions to its plant in the spring. F.

Telephone News from the Northwest.

The Independence Consolidated Telephone Company of Weyauwega, Wis., has bought the exchange of the Citizens' Telephone Company at Waupaca, Wis., owned by H. G. Slater, and will take possession at once.

The Northwestern Telephone Exchange Company, in Minnesota, has reported gross earnings to the state auditor of $902,802. The state receives $27,084 on this amount. The Minnetonka Telephone Company reports $4,796 earnings and pays $143 tax. The Shakopee Telephone Company earned $2,186 and paid $65 tax. The Winona (Minn.) Telephone Company had gross earnings of $16,020, on which a tax of $480 was paid.

A convention will be held in Minneapolis on January 19th at which representatives will be present from the telephone companies operating in Southwestern Minnesota to reach a common ground for concerted action among connecting lines on certain matters.

The Maiden Rock and Esdaile Telephone Company of Maiden Rock, Wis., and the Farmers' Telephone Company have consolidated.

Farmers of Delton, Selma and Stately Townships propose a telephone line through Comfrey, Minn., to Springfield.

The Bayfield County Telephone Company of Washburn, Wis., is extending its lines to Bayfield and to Houghton, Mich., giving all points on Chequamagon Bay connection over the lines.

The Union Center Telephone Company will establish an exchange at Unionville, Iowa.

The Citizens' Telephone Company will begin work shortly on a new exchange which it will install at Spencer, Iowa.

The Graetinger Telephone Company has incorporated at Estherville, Iowa, with a capital of $10,000.

A mutual telephone system will be put in at Cedar Falls, Iowa. It is intended that this will in time supersede both of the systems now doing business there. R.

Southeastern Telephone Developments.

It is reported that a deal is on foot for the purchase of the extensive interests of the South Carolina Long Distance Telephone Company by the Bell company. This move is said to be a result of the failure of the American Contracting Company, which has been financing the South Carolina Long Distance company. It is understood that the Bell company will make many improvements on the local system in the city of Columbia where the Long Distance company has large holdings.

A law has just been passed requiring that all wires in the underground district of Richmond, Va., shall be placed below the surface within a period of six months. The ordinance came as a surprise to the local telephone and other electrical companies.

The Laurel Fork Telephone Company of Carroll County, Va., has been chartered with a capital stock of $5,000 by G. W. Alderman, president, and others.

The Southern Bell Telephone Company has applied for a franchise in Winchester, Va., and a strong fight is expected before the matter is over.

It is officially announced that the Bell Telephone Company has secured full control of the field at Winston-Salem, N. C., absorbing the Interstate company. The plant of the Interstate company at Goldsboro, N. C., is also absorbed by the Bell company. It is further added that the Bell company will extend its lines through the eastern part of the state, making many new connections. The Bell company has thus absorbed the entire Interstate company in North Carolina except the exchange at Durham.

The Capital City Telephone Company has been chartered at Raleigh, N. C., with an authorized capital of $200,000. J. S. Carr of Durham, N. C., and others are interested. The company has the right to combine with other companies.

A new system will be installed by the Newton (N. C.) exchange in accordance with the decision of W. T. Love of Castonia, N. C., president of the Piedmont Telegraph and Telephone Company.

The Bell Telephone Company has begun the work of placing its system underground in the central portion of the city of Augusta, Ga., where conduits have been laid. L.

Spring-jack Patent Litigation.

In the case of the suit for patent infringement brought by the Western Electric Company, Chicago, against the North Electric Company, Cleveland, relating to patents 357,538 and 552,729 (Scribner), and 488,033 (Scribner and Warner), covering long and short springs in spring jacks, the bill has been dismissed, with judgment for costs awarded against the complainant. The case was tried in the United States Circuit Court, Northern District of Ohio, before Judge Francis J. Wing. It was held that although the patents of the complainant are valid, the springs manufactured by the defendant present such radical differences that they do not infringe the patents.

GENERAL TELEPHONE NEWS.

A. C. Whidden, assistant manager of the Northwestern Telephone Exchange Company at Minneapolis, and M. L. Raige, auditor, have resigned their positions.

Strong inducements are being offered by the Jefe politico of Teplaca, Mexico, to any responsible company that will undertake the establishment of a system of telephones in that district.

An understanding has been reached between the city officials of Pasadena, Cal., and the Home Telephone Company by which the company will take out about one-half of the poles and will immediately lay conduits in Euclid and Worchester Avenues.

The holiday number of the Cumberland Telephone Journal, published at Nashville, Tenn., is neat and attractive. It contains a picture of the Cumberland Telephone and Telegraph Company's new exchange building in Hopkinsville, Ky., which is a handsome structure.

The Cumberland Telephone and Telegraph Company has issued a statement of its business for the month of November, showing a growth of 970 in the number of subscribers for the month. The total number of subscribers on November 30, 1903, is given at 102,706.

A telephone service without toll charge within five miles of the city is promised for Evanston, Ill., by the new company, of which James E. Keelyn is president and which is trying to obtain franchises in that city. It is also stated that if the company is established there a toll of only five cents will be charged within a radius of 15 miles of the city.

The city of Ottawa, Ont., has received another Independent telephone offer. This one comes from H. Waddington, president of the Stark Electrical System of Toronto, a new corporation. The company proposes to give a combined service of telephone, electric light and power over one circuit. Arrangements have just been completed to install a plant in the town of Toronto Junction, Ont., and Ottawa is asked to await the result.

It is stated that the high-speed electric railway between Washington, D. C., and Baltimore, with a branch to Annapolis, Md., already constructed from Washington to Laurel, Md., is to be completed by Cleveland capitalists. It is expected that at least $2,000,000 will be required to complete the property, and about $250,000 is needed to provide for debts due. The road will be 31 miles long.

A New Telephone Manufacturing Company.

Arthur E. Barker, sales manager, and William W. Dean, electrical engineer of the Kellogg Switchboard and Supply Company, having resigned their positions with that company, are the prime movers in the organization of a new company—the Dean Electric Company—to manufacture a general line of telephone apparatus, switchboards and accessories. The capital stock of the new company will be $300,000, and it will be incorporated under the laws of Ohio. The factory will be at Elyria, O., and the erection of the plant will be begun immediately after the first of the year with the idea of turning out the products with all possible dispatch. Interested in the new Dean Electric Company are a number of gentlemen already well known in the telephone field through their connection with the Rawson Electric Company of Elyria, O. The officers of the Dean Electric Company will be: President, Samuel Rawson; vice-president and chief engineer, W. W. Dean; secretary and general manager, Arthur E. Barker; treasurer, Theodore Brush. Among the gentlemen interested are those who control Independent exchanges in Albany, Schenectady, Niagara Falls, Lockport, Tonawanda and other points in New York state. The same group is also interested in several small exchanges in Ohio.

Mr. Dean has made for himself an enviable reputation as an electrical and telephone engineer with the Western Electric Company and also with the Kellogg company. Mr. Barker likewise goes to his new position well equipped to exploit its apparatus and accessories. His brilliant work in Cleveland for the Kellogg company earned for him his appointment as manager of sales, in which position he has been successful.

NEW COMPANIES.

The farmers east of Havana, Ill., have organized a telephone company which is to be known as the Frankenfield Farmers' Telephone Company. The telephones will connect with the Havana central office.

The Smithville Telephone Company has been organized at Smithville, Texas, with a capital stock of $10,000. It has acquired the telephone system at that place, which was owned by A. L. Hills & Son. Extensive improvements and extensions will be made.

A new telephone company is about to make application to the civic authorities of Toronto for permission to do business in that city. The company is the Canadian Telegraph and Telephone Company, which received a Dominion charter from the federal Parliament a few months ago. This company, which will have exchange connection with Independent telephone companies of the United States and which also has the right to construct long-distance lines from the Atlantic to the Pacific, intimates that it is prepared to give service at a rate much lower than that now charged in Toronto.

EXTENSIONS AND IMPROVEMENTS.

J. R. Thorp of Phœnix, Ariz., has secured a contract to construct a telephone system from Mesa to Tonto Basin, Ariz.

The Michigan (Bell) Telephone Company is about to install an exchange in the village of Tekonsha, starting out with about 25 telephones.

The Sonora Telephone Company is installing a complete new telephone plant and equipment in Guaymas, Mexico. It will be ready for operation about February 1st.

E. T. Injams of Safford, Ariz., president of the Gila Valley Telephone Company, has been conferring with C. W. Hinchcliffe of the Sunset company with regard to the establishment of long-distance connections between the two companies. The Gila Valley Telephone Company is preparing to extend its lines to Globe Ariz., and from there communication can be had to Phœnix over the government line, which the engineers of the Geological Survey will build.

MANUFACTURERS AND DEALERS.

The Kellogg Switchboard and Supply Company announces that Mr. R. H. Manson will be temporarily in charge of the sales department of the Kellogg Switchboard and Supply Company, in place of Mr. A. E. Barker, resigned. Mr. Barker's new connection is noted elsewhere.

Contractors will be interested in the descriptive matter issued by the Electric Appliance Company, Chicago, telling of its latest things in telephones of all kinds. Circulars can be had for the asking, giving full details of the new Dinsmore automatic telephone for intercommunicating work.

The new common-battery multiple switchboard of the Home Telephone Company at Chillicothe, Ohio, will be in operation within a few weeks. It will have an ultimate capacity of 1,500 lines, with 1,200 installed. The work is being done and the material furnished by the Sterling Electric Company of Lafayette, Ind. This company is also installing a 7,000-line board for the Springfield-Xenia Telephone Company at Springfield, Ohio.

CORRESPONDENCE.

London Letter.

London, December 19.—One of the first public discussions as to the possible effects of a policy of protection, which Mr. Chamberlain is now expounding throughout the country, with regard to the electrical industry took place on the 12th instant at a meeting convened by the Tramways and Light Railways Association. A lecture was given by Mr. Atherley Jones, K. C., M. P., having for its title "Protection in Special Relation to Tramway and Light Railway Enterprise;" but the speaker, in advocating free trade, diverged considerably from the precise title of the lecture, but in the discussion which followed some very emphatic remarks were made on the other side by Mr. Byng of the General Electric Company (not the United States company of the same name) and Mr. Garcke of the British Electric Traction Company. Mr. Atherley Jones contended that from the fact that there were 44 millions of money invested in the electric-supply industry, that in 95 per cent. of supply stations foreign machinery is unknown, and that between 1900 and 1902 our imports had increased, any material change in our fiscal policy was obviously only necessary in the interests of manufacturers and not the working classes. On the other hand, Mr. Byng said that his 5,000 workmen would soon be in the workhouse if he did not get protection. His remarks that the electrical-manufacturing industry was not in a flourishing condition, however, was met with decided cries of "No!" Mr. Garcke, who, peculiarly enough, has always in connection with the many tramway schemes which he has developed, lamented the shortcomings of early legislation in electrical matters, took his stand for protection on general grounds and stated that whereas during the past few years our trade with foreign countries had doubled itself, our colonial trade had increased five times. Every foreign country, he maintained, was closed against British industry. Many other speakers took part in the discussion, and in the end out of over 100 present only 17 voted for protection.

Once again has the purchase of the Metropolitan Electric Supply Company's undertaking by the Marylebone Borough Council been the subject of a discussion in the law courts. This time the Borough Council made an application for an extension of the time within which it was to purchase, viz., December 31st next, the reason being that it has a bill coming before Parliament empowering it to raise the necessary money. The application was granted upon conditions. This matter is becoming a most serious one for the taxpayers, as in the event of Parliament refusing to pass the bill it would mean that a rate of 20 shillings on the pound would have to be levied in order to raise the necessary funds.

The postmaster-general has notified that arrangements have been made for the establishment of telephonic communication between Liverpool and the Continent and that these arrangements are awaiting legislative sanction in France. Under these arrangements postoffice telephones will be available between Liverpool and Manchester and Calais, Chartres, Dieppe, Orleans, Paris and Rouen. This result appears to have been due to repeated applications by the Liverpool Chamber of Commerce.

Municipalists have been afforded some food for reflection during the last few days by the transfer of one large London municipal electricity works to a company and the proposed transfer of another municipal undertaking near at hand also to the same company. Both the undertakings come within the scope of the area allotted to the North Metropolitan Electric Power Distribution Company, which has not built any extensive works of its own yet.

The sales of the Nernst lamp in England have shown a considerable increase during the year ended September 30th, and the company reports that the working expenses have also been reduced. G.

New York Notes.

New York, December 26.—If reports be true a skyscraper to eclipse any now in existence will be erected on Lower Broadway. Contracts, it is said, will soon be let for the building, which will be called the "Broadway Cortlandt." It will have a total height of 615 feet, five stories being below ground. The outside is to be finished in white marble for 15 stories, the rest of the way being white porcelain brick. The estimated cost will be about $10,000,000. It is asserted by its promoters that the building will be the central or union station for all transportation lines. It is said that a double tunnel to the Jersey City and Brooklyn branch subway will meet in an arcade in the new skyscraper.

The receipts of the Williamsburg bridge from tolls on the single roadway open for vehicle traffic indicate that the bridge will pay more to the city from tolls than the Brooklyn Bridge. The receipts for tolls on the first day amounted to $86, and on the second day advanced to $106.

Justice Scott, in the Supreme Court a few days ago, issued a temporary injunction restraining Jacob A. Cantor, president of the borough of Manhattan, and his successors from entering into any contract for the furnishing of material and the construction of pipe galleries in connection with the Rapid Transit subway on Broadway between Fulton and Morris Streets, and also from opening bids for any such contract on any portion of Broadway. The injunction was the result of an application of the firm of McElheny & Bennett of 15 William Street, attorneys for Rhinelander Dillon. The reason for the injunction is not apparent and President Cantor is much surprised. The plans for pipe galleries under Broadway for carrying gas and water pipes and electric wires have been approved by many prominent engineers as an efficient means for preventing the continual tearing up of the streets.

The Interurban Railway Company has made an important change in routes. Cars of the Sixth and Eight Avenue lines now run to Brooklyn Bridge. Heretofore one of the down-town termini of these lines has been at Canal Street and Broadway, but cars now continue across Broadway on Canal Street to Centre Street and along the latter thoroughfare to the bridge and postoffice. As the addition of these cars to the already congested traffic on Centre Street might result in considerable delay the Second Avenue cars will be withdrawn from Centre Street and sent down over the Third Avenue tracks from Grand Street. These changes all lead to the realization of plans long contemplated for continuous trips along the routes of heavy travel without the necessity of transfers.

Among the new companies recently incorporated is the Economic Electric Company of New York, capital $200,000. The directors are I. L. Roberts and Edmund Tweedy of New York and William Newcomb of Tenafly, N. J. O.

Canadian Intelligence.

Ottawa, Ont., December 26.—The minister of the interior for Canada contemplates sending a commission to Europe to visit the places where the electric smelting of iron ores is carried on and to report whether the several processes in vogue there would be commercially feasible if adopted in Canada. The question is of very great importance to Canada, as there are in Ontario and Quebec huge deposits of iron ore which at the present time cannot be developed with profit, owing to the cost of fuel for the smelting process.

It is quite probable that the Canadian Department of Marine will adopt for use at the more important outlying light stations on the Atlantic coast a system of submarine sound signaling which has been in use in the neighborhood of Boston, Mass., for some time. Hon. Raymond Prefontaine, minister of marine, has already made a thorough inspection of the apparatus, which he thinks has been brought to a degree of perfection that is little short of marvelous. Following the testing of the system, which was made on board the steamer H. M. Whitney, between Boston and New York a few days ago, Mr. Whitney has come to Ottawa and submitted a proposition to the Dominion government for the use in Canadian waters of the submarine alarm bell. If the government is satisfied as to the perfection of the device, several of these bells will probably be installed along the St. Lawrence route next year.

A company of Toronto (Ont.) capitalists has a proposition before the City Council of St. Catherines, Ont., to construct an electric railway from St. Catherines to Niagara-on-the-Lake, thence along the river road to Queenstown and back to St. Catherines, making a belt of 28 miles in length and embracing the richest fruit lands in the district. The town of Niagara will aid the enterprise to the extent of $15,000, and loans from Grantham and St. Catherines aggregating $45,000 will be asked. The road is capitalized at $250,000.

There is every probability of the proposed electric road betwen Montreal and Ottawa going through. The finances, which have heretofore been a stumbling block to the enterprise, are said to have been satisfactorily arranged. One waterpower has already been secured, and others along the proposed route will also shortly be obtained. The company has a capital of $500,000, and has been granted a subsidy of $128,000 by Dominion Parliament. The road must be commenced within six months and be completed in three years. The head office will be in Montreal. The board of provisional directors includes Edgar McMullen of Boston, Mass., the president of the company, and J. Douglas Wells of New York, first vice-president. W.

Southeastern Developments.

Charlotte, N. C., December 26.—The plans and specifications for the new electric line from Athens to Carnesville, Ga., have been prepared by the Westinghouse company, and the figures will be given out when the contract is let. E. H. Van Wey and others are financing the new concern, which will be known as the Georgia Traction Company.

The Knoxville Traction Company of Knoxville, Tenn., has been granted a franchise to build extensive additions to the present lines in the city.

An electric line from Money Point to Great Bridge, Va., is being worked up. The line will be six miles long. A connection with Norfolk will likely be made.

Notice has been sent to the electric-railway companies of St. Louis, Mo., informing them of the new law going into effect January 1st, requiring a tax of one mill to be paid on all cash fares, the tax to go into the city treasury. The ordinance will raise the city revenues about $125,000 annually.

The Virginia Construction Company of Richmond has just completed a new electric-light plant at Culpeper, Va., for the city and the system has been satisfactorily tested.

The city of Richmond, Va., has decided that the Passenger and Power Company must pay damages for injury done the city pipes by electrolysis, before the city passes upon a system that will prove nondestructive. Should the company have to install an underground or double-wire system, it would cost over $250,000, and, it is said, would bankrupt the company.

Millions of dollars are expected to be invested in electric lines in Kentucky during the next year. The Louisville and Eastern railway will issue bonds and will build to Shelbyville, and the Kentucky Traction Company will float $4,000,000 bonds to build a line from Louisville to Nashville, Tenn. This is the result of a recent court decision opening the way for capital to invest in Kentucky traction lines.

The Supreme Court of North Carolina has just handed down an opinion of importance to the effect that, for a city to buy or establish a plant for light or water is a necessary improvement, and therefore does not require a vote of the people.

The Fountain Head railroad of Knoxville, Tenn., may be built into the city and the power changed from steam to electricity.

It is reported that S. Davies Warfield, president of the Continental Trust Company of Baltimore, has completed arrangements for the associating of very substantial local interests with the company in the United Electric Light and Power Company of Baltimore. About a year ago the Trust company bought all the common stock of the United Electric Light and Power Company, a consolidation of all the electric-light companies of Baltimore. This syndicate was formed by Mr. Warfield, who has arranged for the sale to new interests.

It is possible that the Virginia Passenger and Power Company of Richmond, Va., will build a five-mile branch from Fulton to Fort Lee, representing an outlay of about $30,000.

The Madisonville (Ky.) Traction Company has secured an amendment to its charter allowing the company the right to build a 12-mile addition from Madisonville to Nortonville. J. M. Huffaker is president of the company. L.

Information from Indiana.

Indianapolis, December 28.—The Fountain-Warren Traction Company, promoted two years ago, to build a line from Covington to Danville, has made arrangements to begin construction work immediately. The contract has been let to a New York construction company, by the terms of which the work is to commence January 15th, and the line completed October 1, 1904. This includes the building of a bridge across the Wabash River.

The Indianapolis and Southern Traction Company is making a thorough examination of the old Wabash and Erie canal bed, with a view of using it a part of the way through Daviess, Pike, Gibson and Vanderburg Counties, using the canal entirely from Hosmer to Evansville, thus saving much expense in securing right-of-way through farms, and being assured of a good, solid roadbed from the start. The line will pass through a fine farming country and many valuable coal fields.

The promoters of the Indiana and Ohio Traction Company, who are building a line from Hamilton, Ohio, to Richmond, Ind., via Oxford and Liberty, are now seeking an entrance for a branch line into Connersville. All the franchises and rights-of-way have been secured for the main line, the survey completed and the road financed.

The rights-of-way for the Shelbyville, Hope and Columbus traction line were all secured last week and a number of wealthy farmers have agreed to take stock in the company. The line will be 26 miles long and pass through a rich country void of railroad facilities.

The Indianapolis-Cincinnati Traction Company failing to procure right-of-way at reasonable prices has filed instruments of appropriation in the courts against a number of land owners in the southeastern part of Shelby County for the Greensburg extension. This company has a corps of engineers surveying a direct line from Rushville to Hamilton, Ohio.

The Holland Palace Car Company has received another large interurban sleeping car, to be put in service between Indianapolis and Columbus, Ohio.

As the result of the storm on Christmas night, the new Evansville and Princeton electric railroad, which has been in operation two weeks, is tied up, and the damage is so extensive the line will not be opened for two weeks. A number of large trees fell across the trolley wires, causing the burning out of a transformer in the power house. The company has provided for duplicate machinery, but the duplicate set has not been installed. The loss will amount to thousands of dollars.

The Lake Erie and Western railway has made a rate between points where the electric interurban lines through Indiana compete with it, considerably cheaper, when the baggage allowance is taken into consideration, than the electric-line rate. During the last few months the company's local business has fallen away to almost nothing, and the present step has been taken to regain lost business.

The Indiana Union Traction Company will soon open ticket offices in the towns through which the lines pass. A slight reduction in fare will be made as an inducement to those who buy tickets at the offices. The company is also arranging to sell tickets over its line, in connection with steam lines, to the St. Louis World's Fair next year.

The interurban roads entering Indianapolis have placed on sale tickets for the use of students. The rate is such as to enable farmers and village residents to send their children to the city schools.

The lighting specifications for the new 10-year contract for the city of Indianapolis have been com-

pleted. The minimum charge for private lighting has been reduced from $1 to 50 cents. Bids will now be advertised for, and it is understood a number of bids will be made. F.

From the Buckeye State.

Cleveland, Ohio, December 26.—Chief Engineer C. E. Perkins of the State Board of Public Works, in his annual report, refers to the equipment of canals with electric power and says that with the same speed and number of boats mechanical power possesses no advantages over animals. But where two or more boats are combined, as a tow, and greater speed is secured than with mules, the minimum cost of transportation will be had. He recommends the improvement of the Miami and Erie and the Ohio canals by making them five feet deep and putting them in condition to be operated. The total cost will be something like $1,600,000.

The car barns of the Cleveland and Southwestern Traction Company at Berea were damaged by fire a few days ago when the Sprague carriage works were burned. The entire loss is placed at about $50,000, but what proportion of this is borne by the railway company cannot be learned at this time.

New schedules have been made by the Western Ohio Traction Company by which the time between Lima and Dayton is reduced 35 minutes. Stops will be made only at Wapakoneta, Sidney, Piqua and Troy. Four new cars will be put on the line for this rapid service, which will compete with the steam-railways.

Cincinnati stockholders of the Detroit United Railways Company are interested in the report of the officers for the last year to be made at the annual meeting on January 19th. About $2,000,000 stock is held in Cincinnati. The net earnings for 11 months of the year are $1,682,461, and the surplus is $769,571. improvements the last year have cost $800,000, and $250,000 has been paid for new cars.

It is claimed that the People's Rapid Transit Company of Toledo has been financed to the extent of $6,000,000, in New York. President J. N. Morgan has just returned from that city. The purpose of the company is to build a line from Toledo to Cincinnati, through Defiance, Greenville, Van Wert and some other important towns. The construction work will be begun next spring, and it will probably require two years to complete the entire line.

J. W. McClymonds of Massillon, Ohio, one of the principal owners of the Syracuse Rapid Transit Company of Syracuse, N. Y., has been in Syracuse the last week negotiating with the receiver of the Syracuse, Lakeside and Baldwinsville Railway Company with a view, it is said, to merging the properties. Should the deal be made the Rapid Transit company may build a line to Oswego. For some time there has been trouble in the courts over the matter.

A. L. Rich & Co., J. P. Hornaday and other Cincinnati men are building an electric line between Salisbury and Spencer, N. C. The company is capitalized at $400,000. The two cities are within a short distance of each other and have a combined population of 20,000. Several large cotton mills are located in that section. C.

Michigan.

Detroit, December 28.—The Village Council of St. Johns has granted a franchise to E. M. Hopkins, representing the proposed Ionia and Owosso electric railroad, giving the new road a right-of-way through the village of St. Johns. The proposed road forms a link in the projected electric line across the state, and similar franchises have been granted by other villages along the Detroit, Grand Haven and Milwaukee railway, which the new road is to parallel in this part of the state.

Regular service from Rockwood to Toledo has been inaugurated by the Detroit, Toledo and Monroe Short Line.

The Village Council of Lyons has granted a franchise to a company, which, it is claimed, will run an electric line through from Ionia to Owosso. It is said that the cars will be running inside of 18 months.

The water has been shut off at the new dam of the East Jordan Power and Light Company's plant at East Jordan and it is expected to have the whole plant in operation by the first of the year. The machinery is now on the ground. About 240 horsepower will be furnished at first and power for the new grist mill and for the city lights will be furnished.

Charles H. Strong & Co. of Cleveland, Ohio, have contracted to build the Traverse City and Peninsula railroad, which was incorporated in Lansing, Mich., with a capital of $500,000. Alderman L. K. Gibbs of Traverse City, who has been interested in giving that city a street-railway franchise and who has worked to that end for two or three years, was elected president.

The Bay City council has adopted a resolution instructing the city attorney to prepare ordinances permitting the city to engage in commercial electric lighting. It is hardly considered probable that the council will carry such a step through, but it is intended as a club to force the gas and electric companies to furnish better light. The gas company last week furnished an average of 10-candlepower gas light instead of 18, as required by the franchise.

Lake City has a new electric-lighting plant, which has just been completed, and will be put in operation this week. It is built in with the old waterworks station, which was erected in 1888. C. G. W.

Texas and Mexico.

Austin, Texas, December 26.—The company which has been organized at Port Arthur, Texas, through the efforts of John W. Gates for the construction and operation of an electric railway from that place to Taylor's Bayou will soon file its charter for record in the secretary of state's office at Austin. It is stated that Mr. Gates owns a controlling interest in the company. It is reported that the Beaumont and Sour Lake Construction Company will be awarded the contract for building the new line.

The Waxahachie Gas and Electric Company has been organized with a capital stock of $100,000 for the purpose of installing an electric-light and power plant and a gas plant at Waxahachie, Texas. The incorporators of the company are J. F. Strickland, Osce Goodwin, W. C. Ross and M. B. Templeton, all of Waxahachie, and R. C. Vickery of Fort Worth.

A company has been organized for the purpose of constructing an interurban street railway from Puebla, Mexico, to the town of San Francisco Totimehuacan, a distance of nine miles. The proposed road will pass through a number of thriving suburbs. The cars will probably be operated by electric power.

The new electric-light and power plant at Tehuacan, Mexico, will be completed and formally inaugurated some time in February. The event will be celebrated by the people of the town.

The Federal District Electric Tramways Company of Mexico has decided to construct an electric line from Tlalpam to Tuipucco and Xochimilco. Work will be commenced soon.

The construction of a large electric-light and power plant near Ocatlan, Mexico, is contemplated, the primary object being to provide power for operating the mines of this district.

The Mexican government has granted a concession to the El Paso and Juarez Traction Company authorizing it to build its lines and operate its cars over the streets of Juarez, Mexico, for a period of 85 years. The company obligates itself to construct an iron bridge across the Rio Grande, to replace the wooden structure now in use.

The municipal authorities of the City of Mexico have approved the plan submitted by the Mexican Traction Company for extending its line into the Nueva Colonia del Paseo. The models for the crossings over the other electric lines in the city have also been approved.

It is announced that the Federal District Electric Tramways Company of the City of Mexico will build a line from Tlalpam to the towns of Tuipulco and Xochimilco. This line will open up a new agricultural district and will give the road an increased freight traffic.

The Mexican government has granted a concession to Filiberto Romero for the establishment of an electric power plant on the River Tanocco, at a place called Chorro Grande, in the state of Vera Cruz.

The Mexican-American Company, which was recently organized under the laws of the state of New York with a capital stock of $2,000,000, has acquired all of the concessions, franchises and property of the Jalisco Development Company of Guadalajura, Mexico, with the view of constructing an extensive system of electric railway in the southern part of Mexico. The new company is composed of Ernesto Mora, a wealthy banker of Guadalajura; J. N. Zormeno, a wealthy attorney of the City of Mexico, and a number of other Mexican and American capitalists. E. H. Talbot of Chicago is president of the company. It is proposed to build more than 200 miles of electric railway.

James Kilton has obtained the contract to supply Matehuela, Mexico, with electric lights and power and to establish and operate a system of waterworks. He has already begun the development of extensive plans, which include the construction of four electric generating stations which are to obtain their initial power from water which is to be piped from large natural springs situated on the top of a mountain at a height of 1,000 feet above the city and 35 kilometers distant. The water of these springs will be piped to the power stations and thence conveyed to the city and used to supply the mains of the waterworks system. H.

Northwestern Notations.

Minneapolis, December 26.—The Minnesota Power and Trolley Company has been granted its petition for the old right-of-way of the Great Northern railway, from Excelsior to Hopkins, and will commence the construction in the spring of a double-track trolley line from the former place to Minneapolis, where connection will be made with the local street-car lines.

The Eastern Wisconsin Railway and Light Company of Fond du Lac., Wis., reports gross receipts for the last year amounting to $133,665, an increase of 62 per cent. over that of the previous year.

A new electric road is planned from Beloit to Elkhorn, Wis., by the capitalists who control the Rockford, Beloit and Janesville line.

A street-car franchise for C. A. Beebe is being considered by the council at Fond du Lac, Wis.

The Milwaukee Electric Railway and Light Company's gross receipts for the year were $3,016,425. Those of the Milwaukee Heat, Light and Traction Company amounted to $420,352.

The Abbotsford (Wis.) Electric Light and Telephone Company has incorporated with a capital of $25,000. A. J. Young heads the list of incorporators.

A request for an electric-light franchise has been filed at Woonsocket, S. D.

The Milwaukee Electric Railway and Light Company will put in a double track to South Milwaukee.

George Teubner has resigned his position as superintendent of the electric-light plant at Winnebago City, Minn.

The street-car company's property at Sault Ste. Marie, Mich., was attached by the creditors and the service is being controlled by them until a settlement is made.

Frank McDonough of Eau Claire, Wis., is putting in an electric-light system at Frederic, Wis.

The gross receipts for the year of the Sheboygan (Wis.) Light, Power and Railway Company was $92,589.

J. A. Soper has resigned as manager of the Western Union Telegraph Company at Owatonna, Minn.

The Oconomowoc-Watertown (Wis.) Heat, Light and Power Company has been incorporated and will build trolley lines connecting Oconomowoc, Watertown, Lake Mills, Jefferson, Koshkonong and Janesville. R.

Among the Rockies.

Salt Lake City, Utah, December 26.—The generation of electrical energy to the amount of 100,000 horsepower from the Falls of Shoshone, Twin Falls and Auger on the Snake River, Idaho, is planned by a company which will be organized under the laws of Maine within a few days. The proposed plant will be established at an expense estimated at $750,000. The power will be distributed through the three states of Idaho, Nevada and Utah.

A trust deed of the Cœur d'Alene and Spokane Railway Company, to secure an issue of bonds of $500,000 to the Title Guaranty and Trust Company, has been filed for record with the county auditor at Spokane. The company has almost completed its system, which is expected to be in operation within the next few weeks.

The Utah Light and Power Company has established an additional power plant at Garland, Utah, on the Bear River, with a capacity of 5,000 horsepower.

It is the intention of the management of the Utah Light and Power Company to concentrate all of its main generating plant at the Jordan station, Jordan, Utah, and use the central station as a distributing plant. The company is preparing to install, as fast as may be desired, a distributing plant to cost $100,000.

Work has been commenced on the new power dam at Carlsbad, New Mexico. The dam will be constructed throughout of concrete, and will be several feet higher than the old one.

The city of Huntsville, Utah, is to have a lighting system installed in the near future. A franchise providing for the work has been applied for. G.

On the Pacific Slope.

San Francisco, December 26.—M. P. Schell, a dealer in electrical supplies, and an expert model maker, has removed from 529 to 507 Mission Street.

The electrical installation at H. S. Crocker & Co.'s large printing establishment is now complete and is working satisfactorily. No shafting is used at all, all the presses and other apparatus being directly connected to individual motors of various sizes. The motors number over 60 and are of the General Electric Company's make, the installation being engineered by the Century Electric Company, 18 Second Street.

The General Incandescent Arc Light Company now has offices in the new Crossley Building, on New Montgomery and Mission Streets, with W. A. Ekberg as district manager.

The Butte County Railroad Company is now in the market for a large quantity of small electrical goods.

The Western Electric Company, through its Pacific Coast branch, the California Electrical Works, has been awarded the contract by the town of Santa Clara for 60 series alternating arc lamps and three 25-light regulators, in addition to the necessary switchboards and hangers.

The Board of Public Works has been requested by the Board of Supervisors of San Francisco to make provision for the placing of permanent conduits for pipes and wires under the streets which may hereafter be paved or repaved, in order that the tearing up of pavements may be avoided.

Sealed proposals will be received in San Francisco until January 12th for the construction of a frame gymnasium and post exchange building, including plumbing, electric wiring, etc., at Ord Barracks, Cal.

The Stockton Electric Railroad Company of Stockton, Cal., is arranging to reconstruct its lines on Main, California and El Dorado Streets. W. R. Clark, present manager of the road, will resign from that position after the first of the year, and Frank Webster will take his place.

An application is to be filed with the City Council of Stockton for a franchise for operating an electric system inside the city limits by what are believed to be the representatives of H. S. Huntington, who is to construct an electric road from Bakersfield down to the San Joaquin Valley, through Fresno to Stockton, and probably on to San Francisco. Robert G. Paddock of San Francisco, who is interested in the work, is at present in Stockton for the purpose of securing data and making preparations for the application of the franchise. The principal object in se-

curing the franchise is to bring a new electric current to a power station in which an auxiliary plant will be installed.

Advices from Alhambra state that the Pacific Electric Company has a new lighting franchise drawn which will be advertised for sale, and it is expected that the same company will be the only bidder.

The Portland General Electric Company of Portland, Ore., is preparing to erect a new power house and install a plant near the North Portland waterfront. The new improvements will cost in the neighborhood of $850,000. A 48-inch water main, to tap the river opposite the new plant, is among the items on which bids are being asked.

The supervisors of San Joaquin County have voted to advertise the new application of H. H. Griffith for a franchise for an electric railroad to extend along various thoroughfares north, east and south of Stockton, the principal roads being along the Lower Sacramento Road to the Calaveras River. These lines will connect with those for which Mr. Griffith has already secured franchises from the river to Lodi and Woodbridge. Another branch will extend to the baths and glass works south of the city, and there will also be a line run through the Gambette and Fair Oaks additions.

The bid of $500 made by the Oakland Transit Company for a street-railway franchise on Alcatraz Avenue, Oakland, and College Avenue, Berkeley, has been accepted by the Board of Supervisors. It is the intention of the company to extend its lines into North Oakland and Berkeley, and work and will be begun at once.

Amended articles of incorporation of the Fresno City Railroad Company have been filed in order to reduce the number of directors from 10 to five. Among the directors are W. G. Kerckhoff of Los Angeles and H. E. Huntington of New York.

The North Shore Railroad Company is to equip its cars with electric heaters. The work will be done in the company's car shop at Sausalito.

The Edison Electric Company has secured a franchise for an electric road between Santa Barbara and Summerland, eight miles south. This is to be a part of a system contemplated between Santa Barbara and Los Angeles.

Material for the construction of the Los Angeles and Santa Ana electric line is arriving on the ground and contracts for ties and rails have been let.

Work on the Petaluma electric road is to commence at once under the direction of Hunter Smith. The engineers are through with the surveys, and all is now ready for grading.

C. E. Summer, who is representing the Empire Construction Company at San Diego, states that he will commence work on his lighting plant as soon as the franchise is granted.

The power station of the Bakersfield Electric Light Company at Bakersfield, Cal., is to be equipped with new apparatus.

The Gas and Electric Light Company of San Diego, Cal., is negotiating with the city authorities of National City in regard to furnishing power for lighting purposes.

Work on the new electric railway from San Mateo to Halfmoon Bay, Cal., is being pushed by Chief Engineer E. F. Haas. This franchise is held by H. B. Bowie and C. W. Clark.

The California Gas Fixture Company of 330 Post Street, carrying gas and electric fixtures, is to move to 515-519 Mission Street, by January 31st.

John A. Yeatman & Co., located at 13 First Street, San Francisco, are to move to 330 Market Street soon. This firm makes a specialty of large municipal contracts, mining machinery, and installations in Alaska.

George Henderson of Eureka has contracted with the Westinghouse company for the apparatus for a power plant on the Klamath River and an auxiliary plant in East Eureka.

The Bush & Mallett Company at 338 Post Street is to remove its store to 618 Mission Street in the Crossley Building. A.

PERSONAL.

Oscar K. Currier of Lawrence, Mass., died on December 18th in that city, aged nearly 59 years. He had had a varied career in electrical occupations, and had held many important positions.

W. J. Bourne, president of the San Francisco Gas and Electric Company, has just left on an extended trip to Europe. Mr. Bourne has worked hard to bring about the consolidation of the various electric companies in San Francisco and in getting the new company in running shape, and he feels entitled to a rest.

The death of F. H. Sweet, president of the Fond du Lac (Wis.) and Northeastern Railway and Light Company is reported. Mr. Sweet was appointed receiver for the Little Wolf River Telephone Company of Weyauwega, Wis., some time ago and had not quite closed up the affairs of that company at the time of his death.

W. G. Ross of Montreal has resigned as second vice-president of the Montreal Light, Heat and Power Company, and has become managing director of the Montreal street railway. Mr. Rudolphe Forget, who resigned from the first vice-presidency of the power company to make way for Mr. McLea Walbank, was appointed to succeed Mr. Ross.

James B. Randol, a prominent mining engineer, well known throughout the West, died at his home in New York last week. He was well known in engineering circles, being a member of the Engineers' Club of New York, Metropolitan Club, American Society of Mechanical Engineers, National Arts Club, and American Institute of Mining Engineers.

Hugh J. McGowan, president of the Indianapolis Traction and Terminal Company, has returned from a trip abroad greatly improved in health. Mr. McGowan has been absent from Indianapolis for five months, during which time he traveled in Europe, principally in France and Italy. While abroad he spent a portion of his time in a careful study of the methods of the systems of European rapid transit.

General Alfred P. Rockwell of Boston died suddenly of heart disease on December 24th. Mr. Rockwell graduated from Yale in 1855 and afterward studied engineering in the Sheffield Scientific School and in London. After the civil war he returned to the Sheffield school, where he became professor of engineering, and later was made professor of engineering in the Massachusetts Institute of Technology.

ELECTRIC LIGHTING.

A five-year contract for city lighting has been let by the city of Eureka, Cal., to the Eureka Electric Light Company.

Plans submitted to the City Council of Augusta, Ky., for a proposed electric-light plant call for an expenditure of $11,000.

John Leslie of Hopkinsville, Ky., has purchased the electric-lighting plant at Lapeere, Mich. He will enlarge the plant and install some new machinery.

Manager Garfield of the Guthrie (Okla.) Electric Light Company announces that the old plant is to be abandoned and a new one to cost $70,000 will be erected to take its place.

The North Shore Electric Company will soon supply electricity for Highland Park, Ill., and vicinity in the daytime from its Evanston plant. A new power house in Waukegan is planned by the concern.

The Consolidated Gas and Electric Company of Batavia, N. Y., has been placed in the hands of E. C. Atwater as receiver, the foreclosure of a $20,000 mortgage on the company's property having been ordered by the court.

The Kilbourne & Clark Company of Seattle, Wash., has been recently awarded the contract for an electric-lighting plant to be erected at Port Angeles, Wash.; also for one at Leavenworth, Wash. Next week it will begin the work of installing a complete lighting system for the state capitol building at Olympia, Wash.

The municipal lighting plant at Sydney, Australia, is soon to let contracts for an additional plant. A 1,000-horsepower engine with a complete condensing plant and a large alternator will be installed. It is the intention of the Sydney authorities to further increase the capacity of the plant by adding two more 1,000-horsepower alternators. T. Rooke is the consulting engineer.

The city of Kewanee, Ill., has abandoned the idea of municipal ownership for the present at least. At a special meeting of the City Council the plan for installing a municipal electric-lighting plant was discussed by the aldermen, and on taking a vote the proposition was defeated by a vote of seven to one. Both of the daily papers of Kewanee opposed the plan for the present and suggest that the Kewanee Light and Power Company continue to light the city.

City Electrician Ellicott of Chicago, who has charge of the installing of the electric plant for furnishing light and power to the St. Louis exposition, suggests a plan to Mayor Harrison whereby the city will have a chance to get a large lighting plant for perhaps half its value. He suggests that the City Council appropriate $100,000 for the purchase of electric-lighting machinery that will be exhibited at the exposition. With this amount he thinks it will be possible to purchase $200,000 worth of the best electrical machinery and almost double the city's present facilities.

ELECTRIC RAILWAYS.

Some progress is reported in the plans for financing the proposed extension to the South Side elevated railroad in Chicago. Several million dollars will be required.

The electric interurban line extending from St. Louis and East St. Louis eastward has now been opened to Lebanon, Ill., about 22 miles from St. Louis.

George E. Macomber and Governor Hill of Maine were at Decatur, Ill., recently, where, it is reported, they effected a consolidation of the interurban electric road, extending from Decatur to Riverton, the Decatur Gas and Electric Company, and the Decatur Traction Company, the property aggregating $1,300,000 in value. Steps were taken to push the construction of the Interurban toward St. Louis as rapidly as possible.

The Tramway Board of Christchurch, New Zealand, will receive bids until March 17, 1904, for the complete installation of an electric street-railway system in that city. The specifications, which are divided into 16 sections covering the various classes of work and equipment, may be had upon the payment of a fee of $15 for each section, or $125 for the complete set, to the agent-general of New Zealand, London, England.

The Public Service Corporation of New Jersey, which controls the street-car, gas and electric-lighting services in Passaic, Essex, Hudson and Union Counties, is said to have closed a deal by which the New Jersey and Hudson River Railway and Ferry Company line from Paterson to the foot of Manhattan Street, New York, passes into its control. This was the one independent trolley road remaining in the northern part of the state.

Two Zurich engineers, Messrs. Grote and Westermann, have applied for a concession to build an electric railroad in the Bernina Pass, Canton of Graubünden, Switzerland. This new road will run from St. Moritz to Pontresina, thence over the Bernina Pass via Poschiavinatal, to Tirano, where it will connect with the Veltlin electric road, a branch of the Adriatic Railroad Company. The new road will have a length of about 40 miles.

Officials of the local union representing the employes of the Chicago City Railway Company and President Hamilton of the company have signed a peace compact for one year on the basis of the agreement outlined in the Western Electrician recently. Only the question of wages will be left to arbitration, while the subject of routing the cars will be considered by a joint commission made up of the men and officials of the company.

A switching tower has been erected by the Los Angeles Railway Company to facilitate the movement of street cars at the busy corner of Spring and Fifth Streets. Dr. W. J. Bell of Los Angeles is the inventor of several of the contrivances that operate the switches from the tower automatically. At Fifth Street and Maple Avenue Dr. Bell has in successful operation an invention that enables the motorman to switch his car at will without stopping and without any aid from the conductor.

The financial difficulties of the Lake Street Elevated Railroad, Chicago, have at last been adjusted and the reorganization plan of the securities committee declared operative. A further extension of time to January 15, 1904, for the depositing of securities was made. The reorganization provides for an assessment of $2 a share on the present outstanding stock of $10,000,000. The capitalization of the new company will consist of $5,000,000 five per cent. first-mortgage bonds, $3,200,000 non-cumulative five per cent. preferred stock and $6,000,000 common stock.

POWER TRANSMISSION.

The prize of $20,000 placed at the disposal of the Parisian press syndicate by Mr. Osiris has been divided between Mrs. Curie, to whom $12,000 has been allotted to enable her to continue her researches in radium, and Mr. Branly, who received $8,000 for the discovery of the conductibility and nonconductibility of iron filings under the influence of Hertzian waves, which render space telegraphy possible.

Charles D. Walcott of Tucson, Ariz., has just received an order from Secretary Hitchcock which will at once start the work on the Tonto dam on Salt River, Ariz. Contracts for buildings will be let at once. A cement plant will be built, a saw mill erected and a temporary steam plant put in. A canal about two miles in length will be dug to convey water from the river to the power house.

An offer has been made, it is said, by the provincial government of Ontario, Canada, to pay the $1,500,000 necessary to complete the sum of $8,000,000 required for the reconstruction of the Consolidated Lake Superior Company. The government has promised to take the money from its exchequer if Attorney Tothermel can satisfy the provincial officials that that sum will place the company's affairs on a good financial basis.

SOCIETIES AND SCHOOLS

The second ordinary meeting of the Faraday Society was held Tuesday, December 8th, in the library of the Institution of Electrical Engineers, London. Dr. Lehfeldt gave a short résumé of his paper on "The Total and Free Energy of the Lead Accumulator," while J. A. Sutherland read a paper on "Bitumen in Insulating Compositions." (Part I.). Remarks were also made by several other members of the society.

At a recent meeting of prominent electrical engineers of Columbus, Ohio, a local branch of the American Institute of Electrical Engineers was organized. The following-named officers were elected: President, Professor F. C. Caldwell of the Ohio State University; secretary and treasurer, M. C. Hull of the Columbus Railway and Light Company; board of managers, F. C. Sessions of the Jeffrey Company, L. G. White of the Columbus Railway and Light Company, M. C. Hunter of the Kilbourne & Jacobs Company, Perry Okey and M. F. Brown of the Columbus Railway and Light Company.

PUBLICATIONS.

Circular No. 1,050 of the Westinghouse Electric and Manufacturing Company is descriptive of electric motor-vehicle equipments. The motors illustrated are of compact form, inclosed in cylindrical

casings. They range in weight from 90 to 381 pounds. A great variety of controlling apparatus is described, together with battery indicators, plugs, battery contacts and the like.

The December number of The Electric City, published by the Chicago Edison Company, appears with a handsome cover in colors representing a gay Christmas interior, the tree illumined with electric lights.

A list of the products of the American Steel and Wire Company of Chicago is given in a small booklet recently issued. The list embraces different sizes and grades of telephone and telegraph wire, trolley wire and insulated-copper wire and cables.

A leaflet from the Commercial Electric Company of Indianapolis, Ind., contains valuable information for those anticipating the construction of small electric-lighting plants in the matter of sizes of machines, voltages, switchboard equipment, etc.

TELEGRAPH.

The Warsaw district of the Imperial Russian Post and Telegraph Department has just begun work on a telegraph line to run from the city of Lodz to the Kolo district, a distance of about 50 miles. This new line is being built in order to handle the telegraphic communications between western Russia and the province of Posen, Germany.

S. J. Burke, one of the promoters and builders of the cable line from Belize, Honduras, to the Mexican frontier; B. Edelstein of Chicago, and R. C. Axling, formerly of Kansas City, arrived at New Orleans recently from Belize and announced that only a few more miles of the cable remained to be constructed to put British Honduras in cable communication with the rest of the world.

Judge Henderson M. Somerville of the Board of United States General Appraisers has overruled the claim of the Commercial Pacific Cable Company for free entry for the cable from Hawaii to the United States. The claim was made on the ground that the laying of the cable was a work of great public benefit. Such a claim, Judge Somerville said, might with propriety be made to Congress, but not to a judicial tribunal, which has no duty but to interpret the law as it finds it.

The Texas Supreme Court holds that telegraph companies are responsible for losses sustained by its patrons through information gained by the tapping of wires. The case was that in which the Uvalda National Bank of Uvalda, Texas, was given judgment and awarded $1,200 damages against the Western Union Telegraph Company for loss suffered through wire tapping, the court being of the opinion that the telegraph company was guilty of undue negligence in the transmission of the message over its line.

TRADE NEWS.

The General Electric Company has secured the contract for furnishing the incandescent lamps for the St. Louis exposition. This contract calls for 300,000 lights, costing the exposition something over $40,000.

It is said the Porter Battery Company, which now has its factory at Waukegan, Ill., will remove to Chicago, where it can secure better shipping facilities for its eastern orders. The firm manufactures automobile batteries.

The Central Station Engineering Company, 1430 Old Colony Building, Chicago, is a new company just formed for doing a general electrical-engineering and contracting business, including also gas-engine work. The company will make a specialty of re-equipping run-down plants, both in office administration and station management.

BUSINESS.

The Alleghany Pin and Bracket Company of Covington, Va., is about to install two-phase Westinghouse alternating dynamos to take the place of the recent installation of machines for operating motor load as well as city lights.

The American Conduit Company of New York city is producing a desirable article in its electrolysis-proof bituminized fiber conduit. This is made of especally prepared paper, saturated under pressure with a bituminous composition and built up, under pressure, of a number of laminations.

The Pardridge reflector, recently illustrated in the Western Electrician and manufactured by the Pardridge Shade Reflector Company of Chicago, is said to be giving satisfaction. The company is increasing its office space and will soon procure the agencies for several new electrical specialties.

The Phelps Company of Detroit is sending out to its customers a large bullseye sign reading "Electrical Supplies," and showing an accurate picture of the turn-bulb Hylo lamp. The sign is lighted with a self-flashing sign lamp, and is suitable to be hung in the window or fastened to the corner of the building.

The American Electrical Heater Company of Detroit, Mich., is sending to its friends a unique New Years gift in the shape of a miniature electric flat-iron about 4½ inches long and weighing perhaps a pound, to be used as a paperweight. The resemblance to the real article is complete, even to the insulated connecting wire. The souvenir is appreciated by recipients.

The Central Electric Company, Chicago, Ill., reports a very gratifying business for the outgoing year of 1903 and expects that 1904 will witness still further improvement and development of its business. The company states that it will continue to push the same specialties with which its name is already so well identified—viz., Okonite and I.X.L. wires, D. & W. enclosed fuses and safety devices, Pittsburg transformers and Columbia lamps.

The L. B. Allen Company of Chicago, maker of the well-known Allen soldering sticks, pastes, salts, etc., for electrical work, announces that it has placed on the market what it considers the best metal polish yet brought out. This polish is for use on all kinds of polishable surfaces, and the maker guarantees it to contain no harmful substance. The polish is in liquid form, in two colors. The green is for silver, gold, nickel, etc., and will not scratch. The red is for brass, and is designed for rapid work. The Allen company will send samples, etc., on receipt of postage.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) December 22, 1903.

747,345. Signaling Apparatus. James E. Allison, St. Louis, Mo., assignor to himself and George M. Seeley, St. Louis, Mo. Application filed August 30, 1902.

A drum, actuated by a driving spring, is made to operate the signal apparatus, the drum being in turn operated by an armature connected to it by a flexible connecting device.

747,354. Electric Welding Machine. George Baehr, McKeesport, Pa., assignor to the National Tube Company, New York, N. Y., and Pittsburg and McKeesport, Pa. Application filed August 6, 1902.

Two pairs of plain-faced current-conducting rollers bear on a flat plate, and these, together with a bending and welding die and endless mechanism for drawing the heated blank through the die, complete the invention.

747,358. Perforating Device for Music Rolls. Henry P. Ball, New York, N. Y., assignor of one-half to Samuel Insull, Chicago, Ill. Application filed April 18, 1902.

In combination with a perforating device for music rolls are a moving master-roll, a bath containing a conducting fluid, in which the roll moves, and a series of electrical terminals arranged in pairs in the bath, and so located as regards each other that when the perforations in the music roll lap the contacts selected electrical circuits will be closed, throwing the perforating device into operation.

747,367. Flexible Metallic Tubing for Armoring Insulated Electrical Conductors. William H. K. Bowley, London, England. Application filed November 17, 1902.

A corrugated strip of metal is coiled so that each turn is partially overlapped by the next succeeding turn, and a strip of metal is wound in the spaces between the corrugations of the tube so formed.

747,371. Trolley Wheel. Herbert W. Brockett, Hamden, Conn., assignor of one-half to the East Hampton Bell Company, East Hampton, Conn. Application filed June 23, 1903.

The trolley wheel is mounted between bushings, which carry projecting arms of insulating material, which serves to guide the wheel upon the wire.

747,394. Telephone Wall Set. Ernest B. Fahnestock, New York, N. Y. Application filed April 13, 1903.

A wall casing for the subscriber's set is described.

747,421. Multiple Switchboard. Carl M. Hedman, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed May 22, 1902.

A front vertical support for a bank of jacks is provided with plug openings registering with the jack contacts to the rear of the plug openings. Test thimbles, having screw-threaded engagement with the plug openings, are thereby removably secured in place, and test conductors with which the test thimbles have separable mechanical and electrical-clamping engagement are also supplied.

747,446. Electric-lighting Attachment for Gas Stoves. Samuel Lewellen, Philadelphia, Pa. Application filed December 9, 1902.

An electric circuit is made and broken in an attachment attached to the gas jet, lighting the gas.

747,454. Electric Conductor. Victor Löwendahl, Stockholm, Sweden. Application filed February 7, 1903.

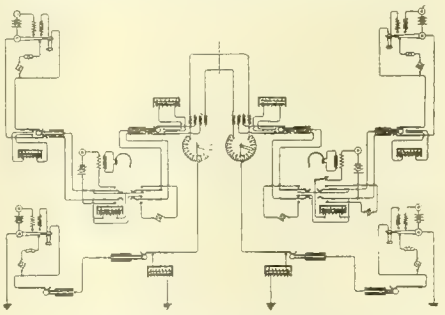
Grains of carbon are coated with metallic envelopes and are subsequently subjected to compressions, with or without the application of heat, so as to cause the grains to adhere together mechanically and form a compact mass for the body of the conductor.

747,470. Support for Electrical Conductors. Robert Orr and John Morrison, New York, N. Y. Application filed January 9, 1903.

Two members are connected together, one of the members being provided with a recess, having an inwardly extending flange, and the other member provided with a head, extending into the recess and surrounded by an insulating material. Each member is provided with a wedge-shape recess and a wedge-shape wire-gripping clip or clamp seated in the recess.

747,477. Rail Insulator. Leonard M. Randolph, Newark, N. J. Application filed May 4, 1903.

A non-porous insulating covering for rails consists of varnish residue and an absorbent substance laid around the rail and pressed into intimate contact with it.



NO. 747,491. TELEPHONE SYSTEM.

747,485. Electrical Typewriting Machine. William E. Roberts, Newark, N. J., assignor to Wyckoff, Seamans & Benedict, Ilion, N. Y. Application filed February 27, 1902.

Several electrical contacts carried by the hand of the operator and each corresponding to one or more particular printing devices of the machine, coöperate with a contact on the machine through electrical connections between the contacts and the selecting devices.

747,491. Telephony. Harry O. Rugh, Chicago, Ill., assignor to the Illinois Electric Specialty Company, Chicago, Ill. Application filed June 2, 1902.

A metallic circuit is employed in uniting telephone substations, and grounded telephone lines include the sides of the circuit in parallel. Means at each exchange end of the circuit, controlled by the respective exchange operator, for compensating for difference in resistance between the sides of the metallic circuit, to prevent cross-talk, form an important feature of the invention. (See cut.)

747,508. Regulating Device for Electric Arc Lamps. Aron N. Thorin, Stockholm, Sweden. Application filed August 2, 1902.

Resting against the carbon is a roller moving on an inclined supporting surface, movable with the carbon holder and arranged to direct the roller against the carbon. On the side of the roller opposite that upon which the carbon is located are means for freeing the roller from the carbon when the carbon holder moves down.

747,515. Telephone or Like Cable. Francis Tremain, Highgate, England. Original application filed January 25, 1901. Divided and this application filed November 1, 1901.

Four separate strands of insulating material are twisted together, each strand containing two wires, which are adapted to form a short-distance telephonic loop.

747,528. Fuse and Fuse Magazine. William P. Woodruff, Buffalo, N. Y., and Daniel J. McCarthy, Wilkinsburg, Pa. Application filed June 12, 1903.

The fuses are placed side by side between two end members, which contact with the opposite terminals of each fuse, the circuit wires being attached to the end members.

747,534. Automatic Signaling Device for Linotype Machines. John Burger, Providence, R. I. Application filed March 20, 1903.

An electric bell in a battery circuit gives a signal when a float in the molten liquid reaches a certain level.

747,537. Electrical Switch. George J. Crossland, Mobile, Ala. Application filed July 12, 1902.

Electromagnetic means situated between the switch rails operate them in either direction, the magnets being energized by a contact bar suspended from the car.

747,553. Connector for Electric Circuits. William H. Kelsey, Cambridge, Mass. Application filed September 24, 1902.

The device described comprises a support and a block having a number of dissimilar electric-coupling members movably mounted on the supports, so as to alternately present the members in coupling position thereon.

747,602. Battery Transmitter. John S. Goldberg, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill. Application filed November 17, 1902.

A sloping or inclined fastening device has engagement with the diaphragm, and a follower-ring engages the casing and presses the inclined fastening device into engagement with the diaphragm, the device being subdivided into radial legs provided with spring toes pressing upon the diaphragm.

747,607. Trolley Pole. Jonah R. Hollis, Brockton, Mass. Application filed November 7, 1902.

Details are described.

747,609. Rosette. Edward J. Hunt, Toledo, Ohio, assignor to the Yost Electric Manufacturing Company, Toledo, Ohio. Application filed June 3, 1903.

A base of insulating material is provided with a cap, a recess between the two being fitted with contact screws for the terminal wires.

747,631. Field-magnet Coil for Electrical Machines. Loyall A. Osborne, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed June 24, 1903.

A field-magnet coil for electrical machines comprises two concentric sections, each formed of edgewise-bent copper-strap sheets of insulating and heat-resisting material between adjacent turns. Shells of insulating and heat-resisting material surround the two sections of the coil, and a hermetically sealed metal shell incloses the coil.

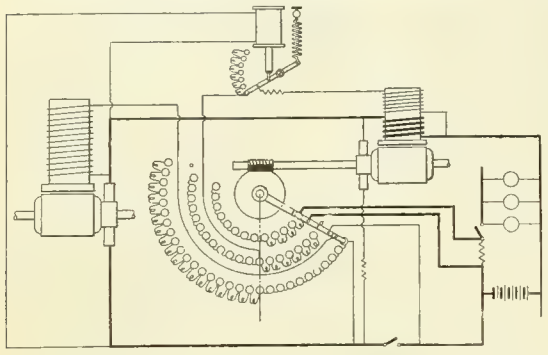
747,673. Electric Switch. Charles C. Badeau, Swissvale, Pa. Application filed August 12, 1903.

A switch has in combination a stationary contact, a movable member carrying a second contact, a lock for the movable member and an electromagnet controlling the lock. The coil of the electromagnet actuates the movable member.

747,686. System of Electrical Regulation. John L. Creveling, New York, N. Y. Application filed February 12, 1902.

In a system of electrical distribution are combined a generator, adapted to be driven at variable speeds, and a storage battery charged by it. A regulator maintains given charging currents throughout changes in speed of the generator. (See cut.)

747,696. Brush Holder. Henry Geisenhöner, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 17, 1900.

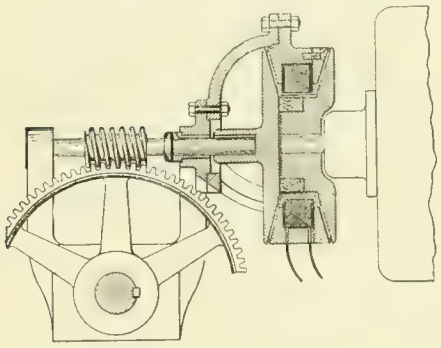


NO. 747,686.—SYSTEM OF ELECTRICAL REGULATION.

A bar is adapted to be mounted on a suitable support and is provided with a brush hole. A spring bears on the brush, and a longitudinally pivoted device carries the spring, which device is removably mounted on the bar, to bridge the hole.

747,697. Electric Fuse. Henry Geisenhöner, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 31, 1901.

In the fuse cartridge is a discharge opening. A fuse strip crosses the opening and threads the cartridge walls and extends along the outside of the cartridge, a heat-refractory packing being supplied for the outside parts.



NO. 747,706.—MAGNETIC CLUTCH.

747,698. Dynamo-electric Machine. Henry Geisenhöner, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 28, 1901.

An electric-machine element has coils between the core teeth and a filling of cement between the teeth outside of the coils and flush with the ends of the teeth.

747,701. Measuring Device. Charles Hald, Omaha, Neb. Application filed November 29, 1902.

An electromagnetic device opens a valve and allows the material to be measured or weighed to flow into the weighing vessel, the valve being automatically shut off when the scale beam moves up. (See cut.)

747,706. Magnetic Clutch. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 18, 1902.

Two rotary clutch members are arranged to be brought into frictional engagement with each other, a stationary member of magnetic material forms part of the same magnetic circuit as the rotary-clutch members, and an exciting coil is carried by the stationary member. (See cut.)

747,707. Elevator. Nelson Hiss, New York, and Harold S. MacKaye, Yonkers, N. Y., assignors to the Elevator Securities Company. Application filed May 31, 1902.

Electrically controlled operating means control the prime mover. An electrically controlled brake and a switch for operating either at will are combined, with means at each end of the travel of the car for throwing the brake-actuating means in multiple with the controller-actuating means and simultaneously breaking connection between the switch and the controller-actuating means.

747,755. Spark Coil. Charles P. L. Noxon, Syracuse, N. Y., assignor of one-half to the H. H. Franklin Manufacturing Company, Syracuse, N. Y. Application filed August 20, 1902.

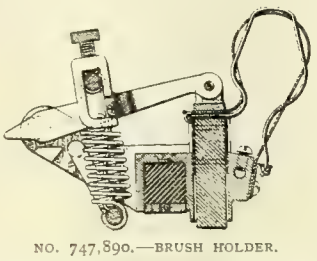
A pair of terminals are connected in a circuit in which a spark is produced, a secondary coil is connected in the circuit and a device is arranged in the circuit offering greater resistance to the current than the remaining part of the circuit. An electric conductor connects the terminals for making a shunt circuit, the shunt circuit offering a greater resistance to the current than the first circuit.

747,763. Registering Mechanism. William H. Pratt, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 24, 1901.

A register or counter on the meter tends to move backward, and gearing is supplied whereby the meter is required to overcome such backward tendency to rotation before it can produce registration on the counter or register.

747,765. Railway Motor. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 16, 1902.

A frame for railway motors is described, having bearings for the truck axle, and flanged or disk-shaped bearings for the armature axle detachably secured to the frame by transverse bolts, the frame being divided above the plane of the bearings and each part provided with means for peripherally engaging the flanged bearings.



NO. 747,890.—BRUSH HOLDER.

747,778. Express or Other Annunciator. Joseph H. Rusby, Nutley, N. J. Application filed November 15, 1902.

Oppositely located magnets are arranged in a casing. An armature extends between the magnets and is provided with a toothed end, a balance spring for the armature and a rocking shaft arranged in the casing and having a pinion adapted to be engaged by the toothed end of the armature, so that when the magnets are energized the shaft will be rocked. An incandescent lamp is mounted to rock with the shaft.

747,795. Automatic Apparatus for Controlling and Operating the Points of Electric Railways or Tramways. Thomas B. Stewart, William H. Turner and Rowland E. Dixon, Leeds, England. Application filed April 1, 1902.

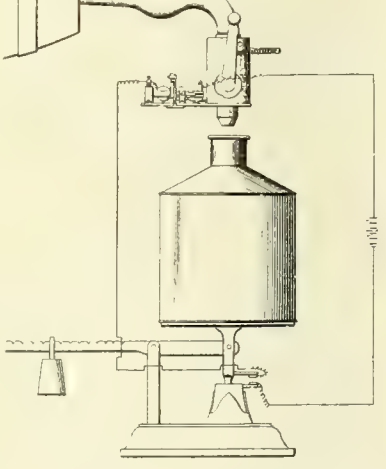
A large solenoid and plunger operate the switch, the current through the large solenoid being regulated by two smaller solenoids, according to the direction in which the switch is to be opened.

747,796. Apparatus for Controlling and Operating the Points of Electric Railways or Tramways. Thomas S. Stewart, William H. Turner and Rowland E. Dixon, Leeds, England. Application filed March 6, 1903.

A movable contact-hanger is carried by the car, which energizes the large solenoid, moving the switch.

747,821. Starting Rheostat. Howard B. Wilson, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 21, 1902.

Several contact segments are combined with a relatively movable contact device comprising two brushes, arranged one behind the other and connected in parallel, the leading brush having as much higher resistance than the one behind it as the drop in potential between the segments.



NO. 747,701.—MEASURING DEVICE.

747,841. Electric Apparatus for Welding Tubes. George Baehr, McKeesport, Pa., assignor to the National Tube Company, Pittsburg, Pa. Application filed January 31, 1902.

In apparatus for welding pipes or tubes electrically are combined two current-conducting devices adapted to bear on opposite sides of the tube joint, each of the devices comprising a planetary conducting ring. Two or more supporting rollers to bear on the inner periphery of the ring. The rollers are mounted on levers, and means for forcing the levers apart, whereby the rollers are held against the inner periphery of the ring, are supplied.

747,842. Electric Apparatus for Welding Tubes. George Baehr, McKeesport, Pa., assignor to the National Tube Company, Pittsburg, Pa. Application filed January 31, 1902.

Conducting rollers mounted to move along the tube on opposite sides convey the heating current.

747,847. Street-railway Switching Mechanism. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, Los Angeles, Cal. Application filed May 7, 1903.

The switch is moved by fluid pressure, the valve controlling the fluid being in turn electrically operated by a circuit, which is closed by a contact-making element on the car.

747,853. Retarding Device for Electric Circuit-breakers. Algernon R. Cheyney, Philadelphia, Pa. Application filed April 16, 1903.

A cylinder in the coil of a solenoid contains a liquid. Valves control the emissions of liquid from the cylinder during the entrance of the solenoid core, and means for resisting the opening of one of the valves, whereby the valves are rendered successively operative, are further specified.

747,871. Electrical Measuring Instrument. Earl C. Eldredge, Springfield, Mass. Application filed October 3, 1903.

A small ammeter or voltmeter is placed in a pocket case and provided with a long flexible contact cord.

747,873. Commutator. Hermann F. T. Erben, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 10, 1901.

The sections of the clamping rings are of sufficient length to prevent tipping in being seated. Straight flanges on the rings hold them to the frame, and flanges on the rings hold the bars on the frame, the latter flanges being beveled to engage corresponding portions of the commutator bars, to permit the proper seating of the long clamping-ring sections.

747,889. Electric-lighting System. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company, Albany, N. Y. Application filed October 21, 1902.

In combination with a variable-speed dynamo is a series-regulator magnet, lamps in groups, a storage battery in multiple with the lamps and adjusting devices for the regulator controlled by the lamp groups respectively, to decrease the effect of the regulator with respect to the current dominating it, upon the connection of the respective lamp groups to the circuit.

747,890. Brush Holder for Electrical Machines. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company, Albany, N. Y. Application filed March 5, 1903.

A guide for the brush, a follower, a spring, an anchorage or abutment for the spring movable over a dead-center with respect to the follower, and means to permit moving the follower over a dead-center with respect to the anchorage or abutment are the essential features. (See cut.)

747,892. Secondary-battery Separator. Hugh Rodman, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed May 17, 1902.

With the positive-pole plate or element is a wooden imperforate separator and means for keeping the wooden separator out of contact with the active portion of the positive-pole plate.

747,911. Connection Terminal and Plug. William W. Dean, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed December 26, 1900. Renewed May 23, 1903.

A connecting plug, having a portion adapted to enter a suitable socket and provided with a bore in the end, a resilient rod mounted within the bore and a tip mounted upon the end of the rod and normally maintained in an eccentric position, are the essential features.

REISSUE.

12,185. Connection Counter for Telephone Lines. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed November 21, 1902. Original application filed January 16, 1900.

A connection counter is associated with one of a pair of telephone lines. Circuit connections of the counter and means at the sub-station of the other line for rendering the circuit connections operative to actuate the counter are the main features of the invention.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on December 28, 1903:

354,892. Underground Conduit. Josiah S. Du Bois, Camden, N. J.

354,945. Dynamo Electric Machine. Elmer A. Sperry, Chicago, Ill.

354,946. Dynamo Electric Machine. Elmer A. Sperry, Chicago, Ill.

354,996. Telegraphic Switch. John Absterdam, New York, N. Y., assignor to Jeremiah M. Pelton, New York, N. Y.

355,024. Electric Motor. Henry M. Paine, Newark, N. J.

355,032. Telephone Receiver. Hans A. Schneekloth, New York, N. Y.

355,055. Signaling Apparatus for Railway Trains. John H. Bickford, Salem, Mass., assignor of one-third to S. Fred. Smith, Salem, Mass.

355,063. Underground Electrical Conductor. Francis B. Crocker, New York, N. Y., assignor to the Edison Machine Works, New York, N. Y.

355,129. Electric Arc Lamp. James Brady, Brooklyn, N. Y.

355,140. Telephone Receiver. Amos E. Dolbear, Somerville, Mass., assignor to the Dolbear Electric Telephone Company of New Jersey.

355,164. Electric Heat Regulator. Richard L. Guion, Elmira, N. Y.

355,172. Electric Arc Lamp. Richard F. Jones, St. Louis, Mo.

355,189. Telephonic Apparatus. James F. McLaughlin, Philadelphia, Pa.

355,190. Telephone Appliance. James F. McLaughlin, Philadelphia, Pa.

355,226. Telephone Check Apparatus. D Johnstone Smith and Daniel Sinclair, Glasgow, County of Lanark, Scotland.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXIV. CHICAGO, JANUARY 9, 1904 No. 2

The St. Louis Boiler Explosion.

As stated in the Western Electrician of last week, a disastrous boiler explosion demolished a large portion of the Geyer Avenue power plant of the St. Louis Transit Company at 5 p. m. on December 21st. This station, which is one of the oldest operated by the Transit company, was running on a considerable overload when, without warning, a battery of seven boilers exploded almost simultaneously, completely demolishing one end of the building, wrecking the generator room and instantly killing five employes who were in that part of the building. Thirty others were injured, and two of these have since died. The accident occurred at a time when all of the stations were working above their capacity, and it therefore threw a load on the remaining stations which caused considerable anxiety to the Transit company officials. However, the peak was safely carried, and by noon of the next day a portion of the machinery was again put in operation.

The Geyer Avenue power station was built in 1891, when the wrecked boilers were installed. The station was almost entirely destroyed by the cyclone of 1896, but after extensive repairs the boilers were again put in commission. Several new boilers had been added to the station but a short time ago, but these were separated by a wall from the old battery and were not damaged to any great extent by the explosion.

Fig. 1 Wrecked Engines and Generators at Geyer Street Station.

THE ST. LOUIS BOILER EXPLOSION.

Steam was generated in this plant by three batteries of boilers. The first consisted of seven 250-horsepower Heine water-tube boilers, the second of two 500-horsepower and four 250-horsepower Heine boilers, and the third of four 250-horsepower Heine, four 375-horsepower Babcock & Wilcox and two 225-horsepower Babcock & Wilcox. Risers from these boilers were connected into a single steam header running the length of the engine room. This header served the following engines: One 36 by 48-inch Allis-Corliss, one 28 by 54 Hamilton-Corliss, one 36 by 60 Rankin-Fritsch, one 22 by 36 Porter-Allen, one 38 by 60 Allis-Corliss, one 22 by 36 Porter-Allen, one large twin consisting of two 36 by 60-inch cylinders, and one small twin consisting of 32 by 42-inch cylinders. The boilers were, of course, all under fire. A brick stack, located between the first battery of Heine boilers and the balance of the plant, marked the limit of the explosion. Just to the rear of the boiler room were the large car sheds of the company, the rear portions of which were completely demolished.

All of the boilers were blown skyward, the one shown in the accompanying view (Fig. 2) landing in the middle of the street, 50 yards away, completely demolishing a car standing on a siding. A portion of a boiler shell was found in the yard of the McKinley School, three blocks away, and several steam drums, boiler tubes and parts of shells were carried 100 yards or more. The force of the explosion was terrific, shattering glass in many of the near-by houses and badly shaking up their occupants.

The accident occurred at a time when the shift in the boiler room was being changed. The men were busy getting ready to go to their homes when there was a rumbling sound, and the seven boilers exploded in rapid succession. Hardly a foot of the brick walls of that end of the power house remained standing. After the arrival of nearly 100 police, who were rushed to the scene, the work of rescue began, but the force was greatly handicapped by the absence of lights, as the entire plant was out of commission and cut off from electric service. Officials of the company soon arrived and directed the work of putting the remainder of the plant into service. The great steam header, half of which had been torn from its fastenings, was capped, and by morning the entire plant, with the exception of the four units shown in the picture (Fig. 1) was feeding into the lines again. The loss is estimated from $60,000 to $100,000, and is almost entirely covered by insurance.

The investigation held by the city boiler inspector brought out some interesting facts: The boilers were 18 feet long, had two 30-inch drums and 113 3½-inch tubes. They were judged capable of standing a pressure of 125 pounds to the square inch, and the safety valves were set for this figure. The employes stated that the gauges showed but 120 pounds a few minutes before the explosion. The boilers had been inspected in January, 1903, and although they were old they withstood the test imposed and the valves were set to open at 125 pounds.

Several explanations have been offered to account for the accident, but they are mere suppositions and have no weight with the inspector. It developed during the investigation that the safety valves on all of the boilers had been removed since the explosion, and this will render it difficult to arrive at a decision unless the valves can be produced. The testimony indicated that the valves had been removed by the orders of the superintendent, although the exact status of the case is not clear. The appearance of the boilers indicates that they had been removed with the aid of a cold chisel, as it is very improbable that all had been blown off. The possibility of the valves having been screwed down has also been considered, and it is possible that charges of criminal negligence will be preferred against those responsible for the accident if the testimony develops the fact that the boilers were carrying over 125 pounds pressure.

The accompanying views were taken on the morning after the explosion and illustrate its destructive character. The plant will be reconstructed as rapidly as possible, as the Transit company is now taxed to its utmost for power.

At the several hearings before the city Board of Engineers held since the explosion, evidence was brought out detrimental to the Transit Company, and at one meeting held on December 31st Special Inspector Rutledge and D. A. Wall, formerly employed as water tender by the Transit Company, added to the damaging evidence already presented. Mr. Rutledge and Claim Agent M. A. Shipley of the Fidelity Casualty Insurance Company testified that they had been permitted to watch a test of the valves on the boilers in question on December 29th and found that they would not blow off at a pressure less than 142 pounds. The boilers were licensed to operate at a pressure of 125 pounds, and former testimony had brought out the fact that more than 130 pounds would be dangerous. Of the seven valves tested it was found that one blew off at 142 pounds, two at 155 pounds and one at 170 pounds. The other three had been taken apart and, as it was found that they were not in working order, no test was made.

Mr. Rutledge stated that the insurance company, which had a policy on the exploded boilers, had asked to be allowed to test the valves. Mr. DuPont had refused at first, saying that the Transit Company was going to have a test made by the professors at Washington University. The insurance company then made a formal demand, and its inspectors were asked to call at the office of the Transit Company.

Fig. 2. Boiler Blown 50 Yards by Explosion

Here Mr. W. T. Cook, superintendent of motive power, stated that there was no need of testing the valves, as the Transit Company had already made a test and found some of the valves stuck. Mr. J. E. Parker, chief inspector of the insurance company, refused to accept this test, and arrangements were made for another. The valves were taken from a closet in Mr. Cook's office and taken to the boiler house, where they were attached to the steam lines. When the steam pressure reached 128 pounds one of the valves, which was afterward found to have been tampered with, blew off, but refused to close after the pressure was reduced. The others refused to blow off at a pressure of 140 pounds. As it was impossible to produce higher pressure, the Transit officials suggested that a hydraulic test be made during the evening, and this was done, with the results mentioned above. Mr. Rutledge stated that there was no evidence that the valves which worked had been tampered with recently. He also stated that he had made a careful examination of the boilers and found no evidence of the tubes having been burned out, or of low water.

Mr. Wall stated that, while employed as water tender at the Geyer Street station, he found it was almost impossible to keep the water at safe height in the boilers during the peak load, which occurred from 5:30 to 6:30 p. m. At times, he stated, there would be no water showing in the glasses of some of the boilers and, in general, the firing was done so irregularly that the boilers had to be carefully watched. During the peak load, he declared, the boilers were worked considerably above their safe

capacity, the gauges frequently showing from 130 to 135 pounds. In general, he said, the boilers had been pushed above their capacity while he had been employed at the power house. It is expected that the board will make its official report on the accident within 10 days.

WORLD'S FAIR NOTES.

The Aultman and Taylor Machinery Company of Mansfield, Ohio, will have the heaviest individual exhibit on the exposition grounds, consisting of 16 boilers complete with stokers, the total shipment weighing 3,325 tons. The boilers will aggregate 7,200 horsepower and will contain over 14 miles of four-inch tubes, giving a total heating surface of two acres. One hundred freight cars, divided into three trains, will be required to transport the plant. The first shipment will be made next week and the boilers will be erected with all possible speed.

As was stated in a recent issue of the Western Electrician, several plans have been proposed for the treatment of the bottoms of the lagoons, and at that date it was decided to cover this area with heavy planking. At the suggestion of Chief Civil Engineer Phillips, however, the lagoon bottoms will be covered with macadam, and the work is now well advanced. At the cascade end of the Grand Basin crushed stone has been laid to a depth of 16 inches, but in the other waterways three inches will suffice. Approximately 6,000 wagon loads of macadam will be required, and the cost will be reduced 50 per cent.

The Birmingham iron district of Alabama will unite in what will be one of the features of the exhibits in the Mines and Metallurgy Building. This will be a statue of Vulcan 150 feet high, containing 100,000 pounds of Alabama iron. The model, built by G. Morretti of New York and 16 assistants, is now complete and will soon be shipped to Birmingham to be cast. This will be the most difficult and costly piece of iron work of this character ever done in this or any other country. If cast in 10 separate sections each part will weigh over five tons, and these must fit together perfectly. The statue will be a work of art as well as a gigantic piece of casting and will be removed to Birmingham at the close of the exposition, where it will be set up in one of the public parks.

An observation tower has been presented to the Department of Concessions by its inventor, J. C. Tutt of Kansas City, and is now under consideration. A tower of steel construction rises to a height of 250 feet, to which visitors are to be raised by a steel construction shaped like angle iron, the angle resting on the ground at the base of the tower. When one arm rests horizontally on the ground the other is vertical. On either end of this angle are cars for passengers so balanced that they always hang vertically, no matter what the position of the arms. An observation platform is supplied at a height of 200 feet, and visitors raised in the cars are discharged on to the platform, where they may remain as long as desired. The lifting portion of the machine is moved by means of a heavy screw shaft, meshing into the teeth of a quadrant. A steam engine or electric motor will supply power. The cost is estimated at $75,000.

HOWARD J. ROGERS, DIRECTOR OF CONGRESSES, ST. LOUIS.

The Navy Department of the United States has begun the erection on its space in the Government Building of a reproduction of part of a warship of 14,000 tons. H. E. Boucher, naval architect from the Washington navy yard, is in charge, and a large force of men from the navy yard is doing the installation. Only the forward or fighting portion of the ship will be shown. This section will be 118 feet long and will rise nine feet above the floor. The model will be equipped with guns and complement from ships in actual service. Two 10-inch guns will be installed in the turret, and these will be loaded and fired with dummy charges. One of the interesting features will be the figurehead, which will be the shield that occupied a place on the bow of the Olympia, Admiral Dewey's flagship at the battle of Manila.

The International Electrical Congress of 1904.

The great expositions, standing like milestones along the highway of human progress, have been chiefly characterized by their value as world educators. In the bringing together of peoples and products from the four corners of the earth, and the intelligent and logical display and comparison of the highest types of human endeavor, these expositions become clearing houses for the exchange and propogation of new and progressive ideas in all phases of the world's work.

ELIHU THOMSON, PRESIDENT COMMITTEE OF ORGANIZATION, INTERNATIONAL ELECTRICAL CONGRESS.

The educative value of the great expositions has become more and more marked with each succeeding world's fair, until to-day it is recognized as one of the most important factors in the development of such an enterprise.

That this idea has been uppermost in the minds of those engaged in the fitting together of the many and varied elements that will make the St. Louis Louisiana Purchase Exposition outstrip in almost every particular the expositions of the past, has been evident from the first. At St. Louis, for the first time, a building has been set apart for the exhibits of education and social economy, and in every department the one idea has been to secure exhibits of such character and worth as to make the tout ensemble an exhaustive encyclopedia, so carefully classified and arranged that the judicious observer will acquire in a few weeks a more rounded and profitable fund of information than could be gathered in many years of travel.

What, then, could be a more fitting and brilliant climax for the great educational scheme thus projected than a conclave of the master minds in the various branches of art and science, sitting in deliberation upon the questions of the hour, and disseminating the results of years of untiring study and investigation? Custom and usage have made such a congress a necessary adjunct to universal expositions, and, as a fit accompaniment of the St. Louis Exposition, there is every reason to believe that the international congress of 1904 will mark an epoch in the world's progress.

At this time there will be gathered together in St. Louis men from every civilized country, prominent in their respective walks of life; the juries of award will consist of specialists appointed by the various governments, and the efforts of the foreign commissions will be exerted to promote a large attendance of scientists from their own countries; thus the possibility of an organized and universal congress becomes apparent.

Plans for a comprehensive series of congresses took root early in the history of the St. Louis Exposition, and after a long period of preliminary deliberations, the first official action was the appointment of Professor Howard J. Rogers as director of congresses, and the selection of an administrative board, consisting of eminent educators and others.

Later, after a careful survey of the electrical profession, President Francis appointed a committee of organization of the International Electrical Congress of 1904. The officers of this committee are: President, Elihu Thomson of Swampscott, Mass.; vice-presidents, B. J. Arnold of Chicago, Professor H. S. Carhart of Ann Arbor, Mich., Professor W. E. Goldsborough of St. Louis, C. F. Scott of Pittsburg and Dr. S. W. Stratton of Washington; general secretary, Dr. A. E. Kennelly of Cambridge, Mass.; treasurer, W. D. Weaver of New York city.

This committee has taken up the arduous task, involving an immense amount of detail work, with a vigor that portends a universal and brilliant concourse of the electrical fraternity. A large amount of the labor has devolved upon Dr. Kennelly, general secretary, who, although one of the busiest of men, has thrown himself into the work with such enthusiasm that his efforts are, even at this early date, meeting with well-deserved success.

Up to the present time some 4,000 circulars descriptive of the scope of the congress have been sent out to American engineers and persons interested in electricity. These circulars contain a resume of previous international congresses, outline the plan for the coming meeting and include a tentative itinerary of the tour arranged for the foreign delegates and members. Accompanying this circular was an invitation to become a member of the congress, and it is indeed gratifying to learn that at the present time 789 acceptances have been received from Americans alone. It is interesting to note that the total membership of the Paris congress of 1900 was 933. Some 2,000 more American invitations will be sent out and approximately 6,000 to the various European countries.

Communications which have been received from time to time by various American engineers from acquaintances abroad indicate that the attendance from Europe will be large, and include many of the great engineers and scientists whose names are familiar to every American electrician. The technical press of Europe has devoted considerable attention to the congress, and advices have been received that many of the European technical societies will send semi-official parties to the congress. It is reported that two score members of the Italian Institute of Electrical Engineers will attend the congress and exposition under the guidance of their president, Professor Ascoli.

The hearty spirit in which the European engineers have taken up the congress movement has prompted the authorities to arrange for an elaborate plan whereby the visit of the delegates appointed by the European nations will be made as profitable and enjoyable as possible. This plan contemplates the reception of the foreign delegates in New York city from the 3d to the 5th of September, where, under the direction of a reception committee of the American Institute of Electrical Engineers, they will be afforded every facility to inspect the prominent engineering features of the metropolis and vicinity. Leaving New York on the 7th, the trip to St. Louis will be made via Niagara Falls and Chicago, at which places trips of inspection to the various points of interest will be made. The return from St. Louis will be made by way of Washington, where the party will participate in the dedication of the new laboratories of the National Bureau of Standards. Arrangements are being made whereby the president of the United States will meet the delegates at this point. Many suggestions regarding the entertainment of the party have been received, and it is hoped that all plans will be perfected in due time to be incorporated in the final programme. The General Electric Company has extended an invitation to the congress to visit its Schenectady works, and many of the largest manufacturing and operating plants will be thrown open to the visitors.

BION J. ARNOLD, CHAIRMAN EXECUTIVE COMMITTEE INTERNATIONAL ELECTRICAL CONGRESS.

Arriving in St. Louis on the 10th, the delegates will have two days in which to visit the exposition and points of interest in St. Louis. A general convocation of the congress will be called at 11 o'clock on the morning of September 12th, and on the four succeeding days, from the 13th to the 16th, inclusive, simultaneous meetings of the eight sections will be held. A general convocation will be called on September 17th, the final day.

The present plan embodies three distinct features.

First—A chamber of delegates, appointed by the various governments, essentially similar to the chambers of government delegates at the Chicago exposition, 1893, and of Paris in 1900.

Second—The main body of the congress will be

divided into eight sections, according to a scheme previously outlined in the Western Electrician.

Third—Conventions simultaneously held in connection with the congress by various electrical organizations in the United States. Prominent among the organizations from whom co-operation is expected are: The American Institute of Electrical Engineers, American Electrochemical Society, National Electric Light Association, Association of Edison Illuminating Companies, Pacific Coast Transmission Association, American Electrotherapeutic Association. The Institution of Electrical Engineers of London and the continental electrical societies are also expected to officially participate.

CONGRESS HALL AT ST. LOUIS EXPOSITION.

The work of the chamber of delegates will be to take action upon the question of international units and to formulate uniform rules for the testing and standardization of electrical machinery. It is the general consensus of opinion that sufficient matter has collected since 1900 calling for international action, to warrant the appointment by foreign governments of official delegates to the congress, and the State Department has been petitioned to issue invitations to the home and foreign governments to appoint such delegates. There is every reason to believe that it will accede to this request.

The main body of the congress, as before stated, will be divided into eight sections, in each of which the papers to be read and discussed are to be prepared. The present plan is to have about 20 papers for each section, or 160 in all. It is not intended or desired to exclude such good papers as may be offered, but uninvited papers must be submitted to the officers of the respective sections to which they will belong, and if there be room on the programme the section officers may decide to have them invited. If this plan were not to be followed, the experience of past congresses and other similar meetings has shown that there would be no check upon the papers presented, and objectionable or purely commercial papers might be introduced, to the detriment of the transactions.

In issuing the invitations, the section officers make out the list of all to whom they should be sent. The invitations are then signed by the president and by the general secretary of the committee of organization. The title of the paper is suggested to each writer invited to contribute, but the suggested title may be changed by the writer if he prefers some other subject. The programme will include papers from well-known writers in Europe, America and other parts of the world, and a special effort will be made to have the papers well distributed among the eight sections, thereby presenting collectively the most recent progress in science and applications of electricity and magnetism. The papers and discussions, when printed, will probably fill two large octavo volumes, and will constitute a most valuable addition to scientific and technical literature.

The building in which the various sections of the congress will meet, is the new Library Building of Washington University, a view of which is here shown. This magnificent structure, nearly 300 feet long, has been finished but a week, and is so eminently fitted and equipped for large meetings that it has been set aside for such purposes by the exposition officials, and is known as Congress Hall. The accompanying view shows the front facing the Administration Building, and a detail of the cloister construction is also shown. Passing through the arched entrance and vestibule, the main hall is reached. This is a room over 100 feet long, extending to the rear of that portion of the building shown. The beautifully chiseled ceiling of pure white is one of the features of the university group of buildings, and it is in this hall that the general convocations will be held. On each of the two floors are halls of various sizes in which the section meetings will take place.

CLOISTER IN CONGRESS HALL, ST. LOUIS.

The fee for membership in the congress has been placed at $5, the proceeds to be expended in printing, mailing, reporting and other miscellaneous expenses of the congress.

It is encouraging to observe how earnest are all the men who are engaged in the congress work. Sixteen busy men were appointed section officers by President Thomson, to serve at St. Louis at their own expense, and to undertake a considerable share of the work to be accomplished. None declined. With such co-operation the congress should certainly be successful in every particular.

OFFICIAL DELEGATES.

Since the above article was put in type it is learned that the State Department at Washington, in response to solicitations from the director of congresses at St. Louis and the President of the American Institute of Electrical Engineers, as well as the committee of organization of the International Electrical Congress, issued instructions on December 17th to the American diplomatic officers abroad that they shall invite the various foreign governments to appoint official delegates to the International Electrical Congress of St. Louis in September, 1904. The number of delegates requested to be appointed by each country is in conformity with the precedents established at the Chicago Congress of 1903 and at the Paris Congress of 1900.

Institute Property Destroyed by Fire.

The total destruction by fire on December 28th of the printing house of McIlroy & Emmet in New York city has resulted unfortunately for the American Institute of Electrical Engineers. The last two forms of the November number of the Transactions, which had just been placed on the presses, the forms containing the catalogue of membership and the mailing lists, are lost. All the electrotype plates of Volume XX. (a supplementary volume to Volume XIX., and containing the papers from September to December, 1902, inclusive) are lost. The electrotype plates of Volume XXI. (containing the papers from January to June, 1903, inclusive) are lost. In addition to these losses, there is the further loss in type of all the pages of Volume XXII. (containing the papers from July to December, 1903, inclusive).

The Institute office has on file final authors' corrected copies of all these papers, so that nothing has been lost that cannot eventually be reproduced. It will, however, involve considerable labor and time to straighten out matters before the papers and discussions can be reset, proof-read, properly paged, and electrotyped.

Members of the Institute can appreciate the delay and annoyance caused by a fire of this nature—a fire that affects not only the printed papers and discussions of the Institute, but also the mailing lists. The loss of the mailing lists will no doubt result in some of the Institute mail matter going astray, but it is hoped that under the circumstances the membership will not be exacting.

Means will be adopted immediately to recover from this unfortunate experience, and as soon as matters can be straightened out the Transactions and other printed matter will be issued promptly.

There may be some salvage from the wreck, but the amount cannot be determined until the insurance adjusters have finished their work.

Electrical Exports for November, 1903.

The electrical exports from the United States for the month of November, 1903, amounted to a total value of $713,035. This is an increase of $875 over November, 1902, when the total value was $712,160. Dividing the November, 1903, electrical exports into two classes—machinery and appliances—and comparing them with the figures for November, 1902, it is found that electrical machinery has fallen off to the amount of $64,308, while electrical appliances, including telegraph and telephone instruments, have increased $65,183. The figures are as follows: Electrical machinery—November, 1902, $431,338; November, 1903, $367,030. Electrical appliances—November, 1902, $280,822; November, 1903, $346,005. November, 1903, also shows a falling off from the figures of October of the same year in the total value of electrical exports, the figures for November being $713,035 and for October, $844,279, a decrease of $131,244.

The heaviest buyers of American-made electrical machinery for November, 1903, were the following: British North America, $113,342; United Kingdom, $94,863; Mexico, $41,097; Japan, $20,935; British Australasia, $18,592; British East Indies, $16,465; British Africa, $11,300; Philippine Islands, $8,427; France, $4,309; Cuba, $3,298; Hongkong, $2,026; Germany, $1,734.

PALACE OF ELECTRICITY, ST. LOUIS, FROM MAIN CASCADE.

One serious fault in steel poles is the fact that they rust near the surface of the ground, and if not strengthened at that point soon become unsafe. The St. Louis Transit Company is using a clamp at the base of the pole to give it the requisite strength after it has become partly rusted through. The clamp is in two sections, each 30 inches long, and fitting half way round the pole. Bolts are passed through flanges on the edges of the clamps, which, when drawn up, form a tight sleeve around the pole.

The Lachine Rapids Power House.[1]

By R. S. Kelsch.

The power house [near Montreal] is not only unique, but is a wonderful plant. This is said advisedly, for to the best of the writer's knowledge nothing like it exists to-day on this continent. By this is meant a power plant of such low head and large capacity for generating electric power for central-station distribution.

When the power house was projected, plans and designs gotten out for the generators, switchboards, etc., there existed very little data regarding the operating of such a plant. Furthermore, the three-phase system in this country was not very far advanced, and there was more or less uncertainty as to how the output of this plant would be disposed of.

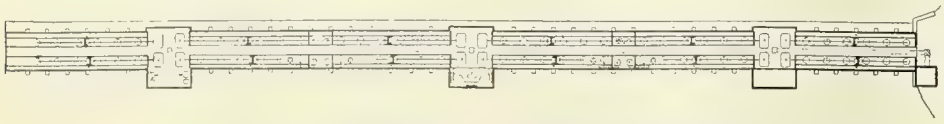


FIG. 1. LACHINE RAPIDS POWER HOUSE. PLAN OF STATION.

Under these conditions, considerable temporary work was done and the plant was operated under difficulties. However, after operating some time, it was self-evident that a widely different plan for controlling the machinery and electrical apparatus must be worked out.

The disadvantages of the first general layout were the poor regulation obtained, because of the exciters being driven direct from the main shaft; the speed of the exciters changing with changes in load, which multiplied the voltage regulation, made it impossible to obtain good regulation.

The position of the switchboard was such that the operator could not see the waterwheel attendants, who, in starting and stopping the generators, would be stationed at the waterwheel governor.

Owing to the considerable noise made by the gears, etc., it was found necessary to establish a means of signaling the waterwheel attendants, so that the waterwheels could be regulated, and this frequently required a lapse of time amounting to 20 minutes.

Considerable difficulty was experienced in operating the plant so as to give good service with the above arrangement, and several changes were made, which will be described. The waterwheel regulator has been changed and a different type installed—the new governors are of the Lombard make. These governors are controlled from the switchboard by a simple device, which will be described later on in the details describing the main switchboard.

The exciters, located alongside of the original switchboards in the dynamo rooms, have been removed and located midway between the three generator rooms, each exciter being driven by an independent waterwheel, so that any speed change of the main shaft due to change of load does not affect the exciter regulation.

Opposite the exciters, there have been installed, two 1,000,000-gallon fire pumps. These pumps are connected to a water-main system with hydrants located 200 feet apart. The old crane has been replaced by a modern three-motor electric traveling crane, and the overhead wires have been replaced by lead-covered cables placed in vitrified-tile conduits, which are located below the new steel-plate floor. The floor directly under the main shafts has been removed, leaving the flumes open, which permits ready inspection, facilitates making of repairs, and removes the possibility of the floor catching fire from hot bearings, etc.

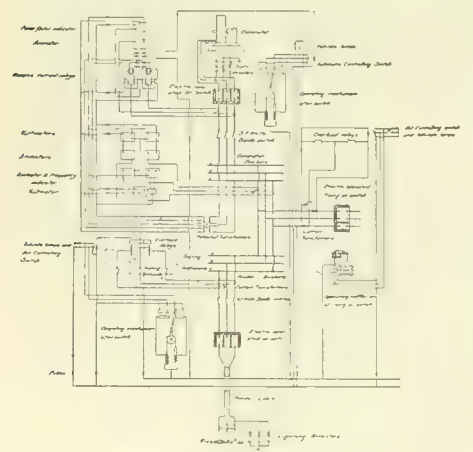


FIG. 3. LACHINE RAPIDS POWER HOUSE.—DIAGRAM OF CONNECTIONS.

Instead of the three separate switchboards, one main switchboard has been built in the center dynamo room, as shown on Fig. 1, and from the operator's position on the top gallery, a good view is obtained of the entire power house, including the generators, waterwheel governors, exciters, etc.

It is almost impossible to describe the difficulty in operating the power house, 1,000 feet long, and only 50 feet wide. The rumbling noise made by the gears and pinions was such that it was impossible to telephone from one station to another and impossible for the employes to talk to each other, unless they were standing side by side or by using a megaphone. This made it necessary for a system of signals, and a flag was used in the daytime, and a lantern at night. With the new switchboard, the attendant has complete control over everything, and the waterwheel attendants merely look after the oiling of the bearings, cleaning, etc.

Electrical Equipment.

Generators and Exciters.—The power house consists of turbine sheds and generator rooms. The power house is 1,000 feet long and 50 feet wide. The generator rooms are about 300 feet apart, and in each of the generator rooms there are four generators. They are the well-known type of revolving-field machine, made by the General Electric Company, and are of 750-kilowatt capacity each, having 40 poles and a speed of 180 revolutions a minute, the frequency being 60 cycles and the voltage 5,000. In each of the exciter rooms there are two compound-wound, 75-kilowatt exciters, furnished by the General Electric Company. They are four-pole and run at 660 revolutions a minute. These exciters are built to operate between 90 and 175 volts. The voltage varies considerably, depending not only on the load, but also on the head of water, which changes with the different seasons of the year. It was found necessary to use several small exciters, instead of two of larger capacities, on account of the low head during winter months, and the capacity of each wheel being limited.

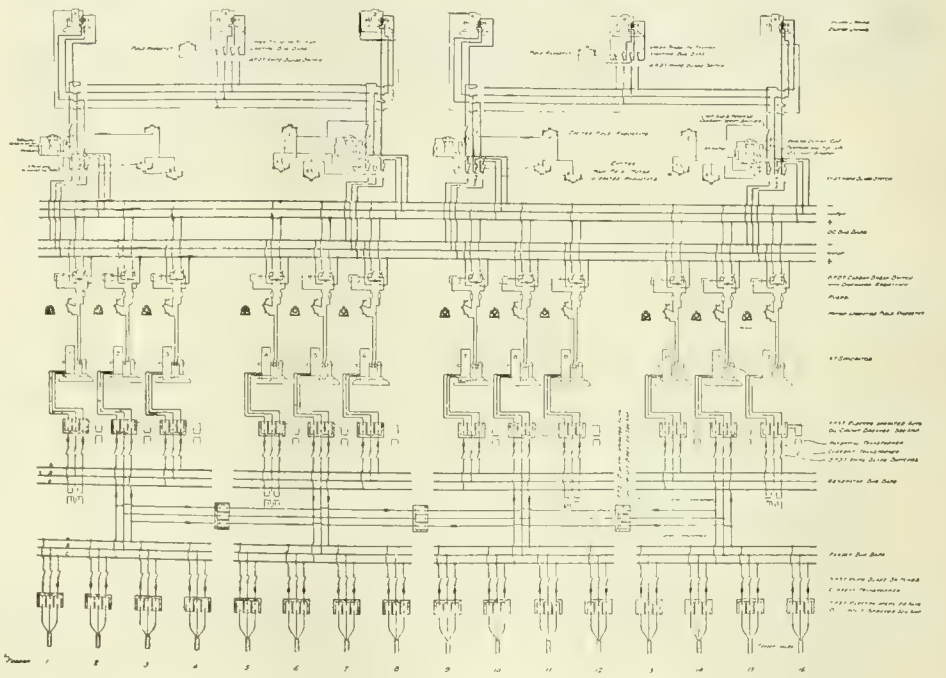


FIG. 2. LACHINE RAPIDS POWER HOUSE.—STATION DIAGRAM, SHOWING BUS CONNECTIONS.

The generators are constructed so that the fields are about three-quarters saturated under normal conditions, so that, in the event of low water in the winter time, the full voltage of the generators could be maintained when the head of water is reduced so that the speed of the generators is 10 per cent. below normal. In addition to these four exciters, there will be installed in the south dynamo room, in the space originally occupied by the first temporary switchboard, two 75-kilowatt, direct-current generators, direct-connected to three-phase motors which will supply the current for the electric traveling crane, electric heaters, and the station lighting. The method of operating, together with the details of the switchboard, diagrams, etc., present, on account of their novelty, many points of unusual interest to every engineer interested in central-station work.

Referring to the general diagrams of connections, Figs. 2 and 3, it will be noticed that for each set of three generators and for each set of four feeders there is a separate set of bus bars. Each set of generator bus bars is tied to the corresponding set of feeder bus bars by means of cables, forming one complete section, the tying switches being tapped off these cables, and not off the bus bars.

Both the generator and feeder bus bars form a separate switchboard, and are entirely independent and away from each other. This arrangement permits the entire system to be tied together and run as one system, or it may be run as separate systems.

In the event of an accident to any portion of the system, it can be quickly separated from the rest until repairs are completed. The arrangement is such that during light load on Sundays and holidays, nights, etc., any portion of the plant can be made dead throughout, permitting any repairs, cleaning, etc., that may be necessary, without the slightest chance of injuring an employe.

Of the four feeder switches on each section, only three are for transmission lines to the sub-stations in the city, there being thus 12 lines altogether. The fourth switches are for reserve and for transmission of power to the surrounding neighborhood, etc.

The plan adopted has sufficient flexibility with almost all the inherent properties of two sets of bus bars, and its great simplicity makes it very easy for the switchboard attendant to successfully operate the plant.

For the four exciters, there are two sets of bus bars; each exciter has a double-throw, four-pole switch, besides the other switching apparatus on the exciter panels, as will be described later. It may happen that one of the exciters will become disabled, and in such case one of the motor-driven direct-current generators installed in the south dynamo room, will take its place, utilizing the same exciter panel. This is clearly shown in Fig. 2. The direct-current generator No. 5 can take the place of either No. 1 or No. 2 exciter, and the other direct-current generator No. 6, that of No. 3 or No. 4 exciter. The diagram shows the two four-pole double-throw switches to throw the direct-current generator on to either exciter panel. These two switches are close together, and designed such that it is impossible to throw the generator on both exciter panels simultaneously. The fields of the alternating-current generators are also provided with double-throw switches to throw the field on either side of the bus bars.

The Cable Subway.—As has been stated, the power house is 1,000 feet long, and to provide means of conducting the cables through the power house to connect with the transmission line, a fireproof subway is run through the entire length of the power house, with manholes in each of the dynamo rooms and one outside of the power-house entrance, where the subway enters the tower. This subway consists of vitrified conduits laid in concrete, and the whole resting on three-eighths-inch steel plates, supported on the bottom flanges of the 16-inch and 18-inch I-beams, placed two feet four inches apart. These I-beams span the stone piers, which are 21 feet six-inch centers, and on top of these beams a three-eighths-inch checkered steel-plate floor is laid, which is fastened down with one-half-inch flat-head machine screws, and these form a steel-plate floor clear through the center of the power house, the width of the passageway being 10 feet six inches.

In order to preclude any possibility of moisture entering the ducts from below, which are exposed to the spray of the water, the interior of the beams and plates was given a heavy coating of plastic asphalt, on which was laid a heavy lining of burlap saturated with plastic asphalt, then another coating of the latter. The conduit system is partly in the water 60 days during the year, but so far no moisture has entered the ducts.

The Main Cables.—The generator and feeder high-tension cables are constructed for 10,000-volt working pressure. They are three-conductor, No. 0 B. & S. cable; each conductor has seven thirty-seconds-inch paper insulation, so that there is seven-sixteenths-inch insulation between the conductors, and the whole covered with a lead sheeting one-eighth inch thick. These cables run through the conduits to the middle dynamo-room manhole, then along the base-

[1] Abstract of paper read before the Canadian Society of Civil Engineers at Montreal, October 22, 1903.

ment-corridor walls to the cable-head cells. The cable rests here on Keystone cable hangers, supported by three-inch channels, placed two feet six inches apart. Wherever the cables are exposed outside of the conduits, they are covered with three layers of asbestos tape, each layer being three-sixteenths inch thick, and the whole fastened on with brass straps. The cable heads are all mounted in brick cells and consist of brass bushings, soldered to the cable, and the flared or bell-shaped cast-brass cable heads are then screwed on to the bushings and the whole filled with No. 66 Edison compound. The feeder cables, which run into the tower, have, at the latter place, a similar cable head and brick cell construction.

The exciter, generator-field and signal cables also run to the middle dynamo room, through the conduit system, thence along the ceiling below the basement and then up the walls to the second switchboard gallery, on to the main switchboard. It will be seen that by putting all of the high-tension cables in the basement and the direct-current cables in the sub-basement, they are entirely separated from each other. The exciter cables are 600,000-circular-mils single-conductor. The cables for the generator field are two-conductor No. 0 B. & S., and the signal cables are multiple-conductor No. 14 B. & S. They are all paper-insulated and lead-covered, made to success-

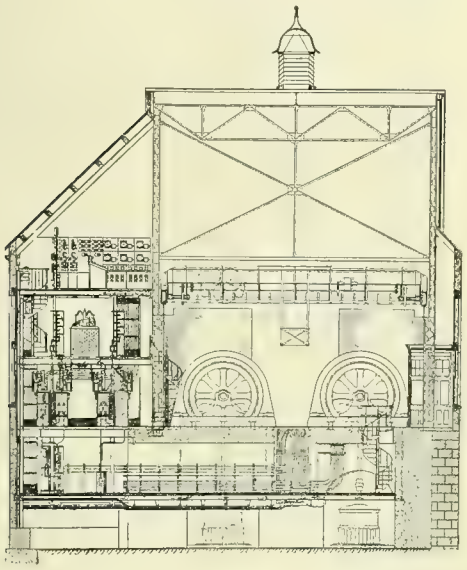


FIG. 4. LACHINE RAPIDS POWER HOUSE.—SECTIONAL VIEW.

fully withstand a breakdown-test pressure of 1,500 volts alternating current for one minute.

The General Arrangement of the Switchboard, Switches, etc.—The basement is used principally for the cable heads, static arresters and the potential transformers. These are all placed in buff-brick cells, with soapstone and brick barriers, as shown on the section views, Figs. 4 and 5. From the generator switches, lead-covered leads run up to the bus bars ers, placed back to back, corresponding with the groups and sections, as shown on the general diagram of connections.

The cable heads in the basement and the bus-bar panels on the first gallery are similarly grouped. This method of grouping has been extended even to the switchboard panels. It will be seen later that there is one panel for each set of three generators on the main switchboard and on the operating table. There is also one panel for each set of four feeders

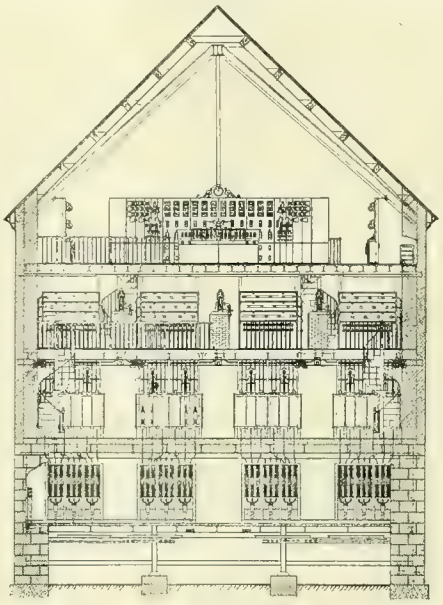


FIG. 5. LACHINE RAPIDS POWER HOUSE.—GENERAL ASSEMBLY OF SWITCHBOARD.

on the bench boards. This method of division not only makes the whole symmetrical, but obviously is also a great help to the attendant, for each panel represents a set of bus bars in the same way as the panels are placed.

Going back to the switches on the main floor, each block of three switches for the generators has two corner cells, in each of which is placed a 500-watt potential transformer with its primary and secondary fuses. These transformers are for operating the instruments of that section, and are connected to the 5,000-volt bus bars.

Details of Switchboard, Switches, etc.

Main Switchboard.—The main switchboard (Fig. 6) is constructed of two-inch blue Vermont marble panels, having a total height of seven feet six inches.

On the back of this board are two sets of exciter bus bars, mounted on fiber block insulators, supported by cast-iron brackets. These bus bars are one-half inch by two-inch copper, and they, as well as all the connecting strips, are insulated with oil linen and tape.

It is possible to disconnect the exciter bus bars into three separate sections, for repairs, etc. Each panel provides for three generators and each generator has on this board a power-factor indicator, one alternating-current ammeter, one direct-current field ammeter, two reverse-current relays and double-pole, double-throw field switch, with discharge resistance and an annunciator or signaling device. No overload automatic devices or fuses are provided for the generators, it being held that it is preferable to let the generators hang on in case of an overload, rather than interrupt the service.

In case of any short-circuit in the generator cable or in case of the field current failing by short-circuit of the collector rings, the other generators would, of course, pump back into this disabled machine, and thus reverse the current.

The reverse-current relays will then automatically cut off the faulty cable or generator from the bus bars. In case that the generators when in parallel fail to work together, then the power-factor indicator will indicate the trouble, and the reverse-current relays will again operate. These relays can be adjusted to operate at 10 per cent. reverse current.

On the back of this board are fuses for the field cables, and these fuses are set for three times the normal full load, so that they can only operate in case of a dead short-circuit on the field or cables connected thereto.

On each exciter panel there are a triple-pole, double-throw switch, a circuit-breaker, a Thompson astatic ammeter and the illuminated annunciator.

Operating Table.—The top (see Fig. 7) is divided into sections corresponding with the rest of the system. There are four panels for the generators, between each two of which is a panel for the control of the bus-bars tying switch. As each generator panel

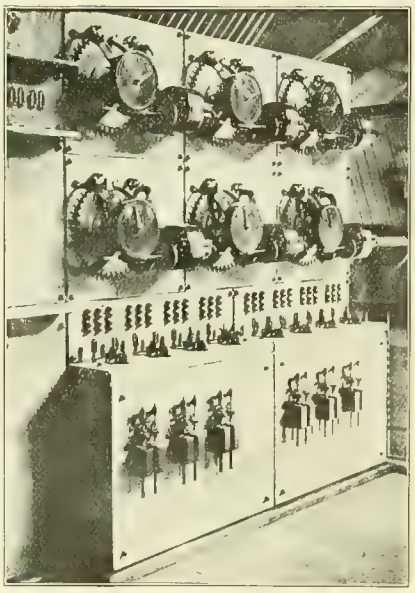


FIG. 8. LACHINE RAPIDS POWER HOUSE.—FEEDER BENCH BOARDS.

represents a set of bus bars, and the tying switch between them, by a simple inspection as to whether the controlling switch of the tying switch is closed or not, which is indicated by colored pilot lamps, it is an easy matter to see how the bus bars are connected. This arrangement makes the existing conditions as clear, if not clearer, than any device of dummy bus bars, or the like, could produce. On the two ex-

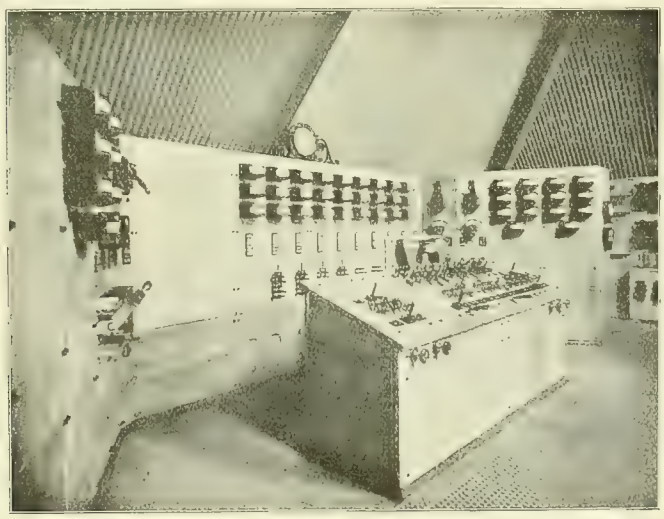


Fig. 6. Main Switchboard.

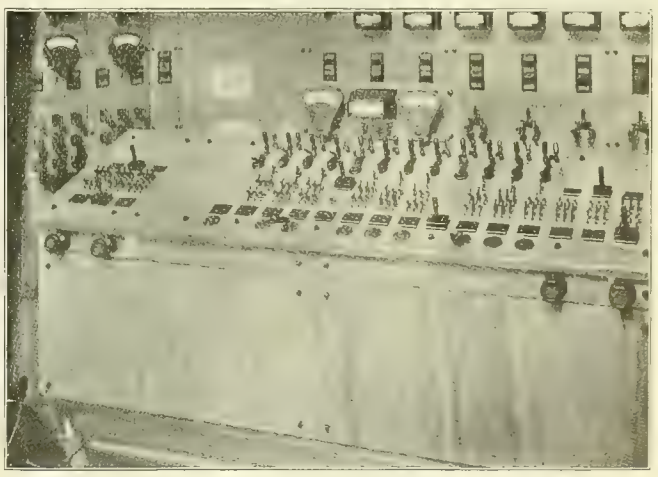


Fig. 7. Operating Table.

THE LACHINE RAPIDS POWER HOUSE.

cable heads, single lead-covered conductors run up to the oil switches on the main floor; from these on the first gallery, passing through the current transformers on the back of the bus-bar panels.

The tying cables, which pass through the totality instrument current transformers connect the generator bus bars to the feeder bus bars on the same floor.

The feeder cables connect to the bus-bar panels in the same way. There are on the main floor 28 electrically operated oil switches, grouped together in threes, for the generator and in fours for the feed-

treme ends of the table are the panels for the exciters.

The Feeder Bench Boards.—The two feeder bench boards (Fig. 8), as the name implies, contain all the apparatus necessary for the control of the feeder oil switches and are each seven feet six inches high and seven feet long. They are constructed of two-inch and 1½-inch blue Vermont marble, divided into two sections, each section for four feeders. On these are mounted the overload relays, the automatic con-

[Continued on page 35.]

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.

TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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THAT a fire in a printing office is particularly vexatious to all publishing interests doing business through the establishment the Western Electrician can testify from experience of its own several years ago. Therefore, we feel particularly sympathetic toward the American Institute of Electrical Engineers, which met a misfortune of this kind in the week between Christmas and New Years. As will be seen by the news account on another page, the "forms" of the catalogue of membership and the mailing lists and hundreds of valuable electrotype plates were destroyed. We hope that the loss will not entail so serious a setback as at first seems inevitable and that there will be a considerable salvage from the ruins. One lesson of the accident seems to be that the new Union Engineering Building, if erected, should be made as nearly fireproof as possible, with adequate storage vaults for the preservation of the societies' valuable records and plates from which books and pamphlets are printed. But even then, the societies will still be compelled to entrust much material constantly to the printers, unless, indeed, they combine to operate engraving, printing and binding plants of their own in the new building, which is, perhaps, hardly practicable.

PERHAPS a great good will come to Chicago from the stupendous sacrifice of December 30, 1903. To hope so, and, more, falling back on the "I will" motto of the city, to make a recurrence of such a calamity forever impossible—these are the things to be done now. But the experience has been heartrending. At this writing the record shows that 591 human lives were lost in the frenzied rush to escape from the billow of flame that burst out from the stage of the theater. And of these the greater part were women and children—innocent children, taken by parents or relatives for an afternoon's excursion into the Land of Make Believe as a holiday treat. And the deaths were not as that of him who draws the drapery of his couch about him for the dark journey surrounded by the tender ministration of his loved ones; the end came where the only draperies were swirls of flame that brought the madness of terror, where the only sounds from human throats were shrieks of despair or prayers of anguish, and where there was no soothing touch on troubled brow, but only the brute instinct to fight for life, the strong trampling on the weak, themselves to perish miserably. It was in such a scene as this that strong men, tenderly nurtured women and little children—ah, again the thought of the children!—to the number of nearly 600, met an agonizing death.

At first the appalling nature of the tragedy was not realized by the community, but in a day or two the full sense of the catastrophe penetrated the stunned consciousness. Everyone conjured up for himself irresistibly a horrid vision of the scene that must have been enacted within the walls of the ill-fated theater. Thousands mourned the death of kindred or friends, with the distressing added pang that it was such a death as it was. Women wept when they spoke of it, and they could speak of little else, and men were unnerved. In the case of some survivors or of some members of families nearly wiped out—and in several instances whole families, father, mother and children, were destroyed—reason was overturned. A profound feeling of desolation and grief hung like a cloud over the city for days. The merciful hand of Time and the blessings of work are dissipating this cloud, but the memory of the Iroquois Theater fire will ever remain as one of the saddest chapters in the history of the city.

And the bitterness of the thought that the terrible disaster need never have occurred! There seems no evading the conclusion that the calamity was due to negligence—not the negligence of one man or one set of men, but widespread neglect of the requirements of law in the City Hall and in the management of the theater, and not in the one theater, but in all the theaters, as is shown by the order of the mayor, after the fire, by which every theater in the city was closed as not complying with the requirements of the ordinance. Great cries of "Hysteria!" "Persecution!" "Throwing men out of employment!" and the like would have gone up if the mayor had issued that order before the holidays, but if he had Chicago would not now be mourning her dead. The conditions were then as they are now. But it takes a man of heroic mold to enforce stringent and necessary, but unused, laws in the face of lax public sentiment when powerful interests are at work to secure non-enforcement. This is a government of the people; if the people are aroused they can accomplish whatever they desire. They did not demand a strict enforcement of the laws in relation to the building and safeguarding of theaters. Perhaps they will now. If the lesson sinks deep enough into the minds of the responsible electors back of all city administrations and all licensed places of public amusement, the toll of lives may pay for so much greater security for the future as human ingenuity and human vigilance can insure. This is the gleam of hope in the present darkness. But what a price to pay to learn that Duty is greater than the Dollar!

Electrically considered, the fire does not teach anything that was not known before. Of course, open arcs should not be operated in the vicinity of inflammable curtains or draperies. Better still, the lamp should be enclosed in a case like that of a searchlight projector. In itself the electrical wiring or apparatus did not fail in any way, so far as we are able to learn. Of course, the curtain should have been removed from the neighborhood of the arc lamp, if not enclosed, as from any lamp. Or the lamp itself might have been moved. Or an encased lamp might have been provided. But to secure the effect desired with the apparatus at hand a risk, apparently slight, was taken. This hazard—this curtain and open-arc proximity—appears to have caused the fire. The blaze was a slight one at first, and if there had not been a long train of conditions just right for disaster, involving asbestos curtain, skylight flue, exits, outside stairways and the like, the fire would have been extinguished with little or no loss of life. But these were exactly the conditions which should not have been allowed to exist. Electrical men will be glad that the fire was caused by no inherent electrical defect. Any other open-flame lamp in place of the arc would be only more dangerous. Apparently the fire was caused by the disregard of precautions which should have been evident to anyone of ordinary prudence and which were quite apart from the use of electricity as the agent producing the illumination.

QUITE a remarkable statement was contained in Dr. Alfred Gradenwitz's article on "Electrical Progress on the Continent in 1903" in the New Years number of the Western Electrician. The writer points out the increasing importance of some countries which, in an electrical sense, were almost negligible factors only a few years ago. He continues: "It is safe to say, for instance, that nowhere on the European continent has electric lighting been so universally adopted as in Spain, where electric lamps have found their way even to the houses of the very poorest, owing, on the one hand, to the almost unlimited waterpower of the country, and, on the other, to the prohibitory cost of gas. * * * * There are, of late years, unmistakable signs of the development of a national electrical industry in Spain, and many interesting inventions by Spanish engineers have lately been made public."

It will be a distinct surprise to American electrical men, we think, to learn that electric lighting is more widespread in Spain than in any other country on the continent. The "very poorest" in the United States do not use electric lights in their homes; they use oil or candles, which are apparently not considered in Spain. Unless Doctor Gradenwitz is laboring under a misapprehension, American electrical exporters should give more attention to the land of the Dons than they have done.

ARBITRATION for labor disputes was criticized in an address on "Some Recent Phases of the Labor Problem" delivered by Mr. H. T. Newcomb before last week's convention of the American Association for the Advancement of Science in St. Louis. "Arbitration, to be arbitration at all, must be wholly voluntary," said Mr. Newcomb. "The term compulsory arbitration is self-contradictory. Arbitration—voluntary arbitration—is a term so grateful to the ear to which it comes as a substitute for the clash of bitter industrial struggles that it seems ungracious not to commend it without qualification. If men cannot agree, what can be better than to submit their differences to the settlement of a disinterested and impartial third party? A strong personal interest is the element which is most effective in preventing irreparable mistakes. Arbitration may be the smaller of two evils, but no one should fail to recognize it as an evil. Aside from the fact that it leaves the determination of matters of primary industrial importance to persons who will neither gain nor lose by the success or failure of the industry, it is evil in its consequences, because, when there is reason to rely upon its being arranged for, that fact constitutes an incentive to making and insisting upon unreasonable demands." We do not observe that Mr. Newcomb suggests any practicable remedy superior to arbitration for the settlement of labor disputes. Arbitration may not be ideal, but in the absence of any better method it seems to be a waste of time to point out its defects. The faults of the system inhere in the fact that arbitrators are but human, and, of, course, the same criticism would apply to judges interpreting laws or any other method of settling the disputes that arise among men. In international affairs arbitration is praised and welcomed by all lovers of peace. Similarly, all friends of industrial tranquillity should adhere to the principle in labor difficulties until something better is offered.

The Iroquois Theater Calamity.

All Chicago has been plunged into grief and mourning by the appalling catastrophe of December 30th, at the Iroquois Theater fire, by which 591 persons, principally women and children, lost their lives—some from actual burning, but more from inhaling smoke or hot air or from being crushed to death in the mad rush for escape. The fatality occurred at a thronged matinee performance, between 3:30 and 4 p. m.

Four weeks ago an illustrated article appeared in the Western Electrician containing a description of the electrical equipment of the new Iroquois Theater. At that time one of the features of the fine structure of which the builders and architects seemed especially proud was the fireproof nature of the construction. The frightful disaster thus came with overwhelming surprise and consternation to those who had previously believed that the new theater was as safe a place to while away a few hours as would be one of the city's parks. Now that all is over and nothing remains but the aching hearts of the mourners and the frightful memories and actual injuries of the survivors come the questions: Just how did the fire originate? Who is to blame? Were all necessary precautions taken? Did the construction and equipment comply with the law? Many answers have been given to these questions; the true ones will no doubt be arrived at by the thorough investigation now under way.

Origin and Spread of the Flames.

At the present time the prevailing opinion is that the fire was caused by the proximity (and consequent ignition) of the proscenium-arch draperies to an arc "reflector" light situated on a bridge above the stage switchboard. The rumors at first current that the blowing of a fuse started the flame were without foundation, as there was not an open fuse in the whole building. Neither was there a short-circuit of the wires or any failure in the electrical apparatus as installed.

By referring to the picture on page 437 of the Western Electrician of December 12th the location of the "reflector" light which caused the fire may be seen on the bridge above the switchboard. In the picture two spot lights are shown, one in the hands of the operator and one just above, and it was the latter, it is thought, with which the drapery came in contact. These two lights are both arcs, but are constructed differently. One is known as a "lens-box" light and consists of a powerful arc light placed inside of a fireproof box, the rays being projected through a lens in the front. With a construction of this sort it is evident that no danger could occur from inflammable material blowing into the arc.

The other light, however, the source of the trouble, apparently, was an ordinary "reflector" light, consisting of an open arc with a reflector behind. Flimsy draperies were blown by a breeze into this open arc, and it spite of the attempts of the operator to extinguish the flames with his hands, they rapidly spread to the rest of the highly inflammable stage scenery. Had these spot lights been calcium lights, the fire would have taken place just as quickly, unless both had been enclosed or of the "lens-box" variety. The primary cause of the disaster seems to have been the bringing of open lights of any kind within reach of the stage scenery. One of the unwritten rules of stage setting is never to bring a calcium or open light of any kind near the scenery, and if such a light is necessary at a certain point, it is the rule to remove the scenery near that point. By the violation of this rule, so far as can be judged, the fire was caused.

Once started, three things conspired to aid in the spread of the flames—the failure of the asbestos fire curtain to fall, the absence of an automatic sprinkler above the stage and an inadequate draft tube in the roof of the stage.

The failure of the curtain to operate seems to have been caused by a new "wrinkle" in stage lighting. This consisted of a novel mounting of the proscenium lights in a vertical trough reflector, carried on hinges, which allowed of the directing of the light at different angles onto the stage. When the trough was in its normal position and flush with the sides of the proscenium arch the lowering of the asbestos fire curtain was uninterrupted. But in certain scenes, such as the fateful "In the Pale Moonlight," the trough was turned upon its hinges and in such position prevented the fall of one end of the curtain. Moreover, the curtain was not provided with an electric hoist, but was operated by an old-style windlass device. Whether it was operated by wire ropes or not has yet to be ascertained. With an electric hoist, by the mere pushing of buttons located at different points on the stage, the curtain may be raised or lowered at any desired speed and to any height from the floor.

The absence of automatic sprinkling apparatus above the stage was a direct violation of the law. It is difficult to conceive of the immense amount of highly inflammable material which is to be found upon a large stage during a performance such as was being given by the "Bluebeard" company. Once ignited, the whole mass of flimsy drapery and stage hangings burst into flame almost in an instant. With adequate sprinkling apparatus, situated above the whole a deluge of water might have been precipitated, averting a serious catastrophe.

Inoperative means for producing a draft up through the roof of the building over the stage and thus preventing the smoke and flames from rushing out over the auditorium and balconies was the third cause contributing to the spread of the flames. Skylights were placed in the roof for this purpose movable by mechanism operated below, but whether these were opened during the conflagration or the next day, to cover criminal negligence, remains for the authorities to determine.

City Ordinances Ignored.

In Chicago there are on the statute books ordinances relating to theater construction and operation that should insure safety to the patrons during a performance if the law is obeyed to the letter. Among the sections of the city ordinance are the following:

That a theater must have direct fire-alarm connection with fire headquarters.

That all lights must be protected so adjacent material cannot touch them.

That suitable fire-extinguishing apparatus be on the stage.

That all exits shall be suitably marked with large signs.

That all galleries shall have independent entrances and exits.

That the number of auditors in a theater shall be limited by the size and number of its exits.

That no auditorium seating over 1,000 persons shall be connected with any building not entirely fireproof.

That automatic sprinklers shall be used over all stages.

That a suitable flue be in the roofs of all stages to carry out smoke and fire.

That the apparatus and fittings of all stages and rigging lofts be fireproof.

That all theaters must face on three open spaces.

That many of these rules—perhaps all—were ignored is known, and these various factors of negligence contributed more or less to the loss of life. That the first-mentioned section should have been disregarded seems impossible. It is specifically provided that all theaters "must have a fire-alarm telegraph apparatus, with proper wires, connected directly with the headquarters of the city fire-alarm telegraph." The Iroquois had no such apparatus. A still alarm was first received at engine house No. 13, followed immediately by an alarm from a fire box located two blocks from the theater.

Investigation of Causes.

After the first shock of the disaster people began to inquire where the blame should be placed, to the end not only that the guilty should be punished but that a recurrence of such a holocaust might be rendered impossible. Arrests were made and the principal officials of the theater and the "Bluebeard" company, besides operators of the various stage devices, now await the investigation of the authorities.

Another step has been taken in this direction in the appointment by the daily press of commissions to sift to the bottom the real causes of the fire. Among those on the commission appointed by the Chicago Daily Tribune are engineers of note, the electrical engineer being Frederick Sargent.

Personal Mention.

So far as known, no man engaged in electrical or mechanical pursuits lost his life in the fire. However, but too many electrical and mechanical men lost relatives or friends.

Charles T. Page, formerly manager of the Englewood Electric Light Company, which was absorbed by the Commonwealth Electric Company, was bereft of his wife and grandson. Mrs. Page was a sister of E. D. Alexander, superintendent of the Southern District of the Commonwealth company.

S. P. Wells, Jr., manager of the Chicago office of the Babcock & Wilcox Company, lost his son Donald, aged 12.

One erroneous report that caused some apprehension is dispelled by the following letter, dated January 2d, from Mr. W. A. Layman, general manager of the Wagner Electric Manufacturing Company of St. Louis: "In the list of the dead in the Iroquois Theater fire of Chicago appeared the name of Mr. Edwin W. Norton, purchasing agent of this company. The identification was in error, Mr. Norton being in St. Louis at the time of the fire. The only explanation we can offer is that some traveling salesman who had recently visited us still carried in his pockets one of Mr. E. W. Norton's business cards."

Mr. and Mrs. Michael Schalck, parents of Frank R. Schalck of the advertising department of the Western Electrician, were in the theater at the time of the fire, but fortunately managed to escape without serious injury.

Mrs. William Mueller and Barbara Belle and Florence Mueller, wife and daughters of William Mueller, went through the terrible experience, but succeeded in escaping from the building with but slight hurts. Mr. Mueller is vice-president of the William Mueller Company, pole dealer.

The report that F. H. Tubbs, district superintendent of the Western Union Telegraph Company, had lost his wife and daughter in the fire is, happily, incorrect. It is announced at Mr. Tubb's office that the report gained circulation through the newspapers, but that both he and his family are safe and well.

S. L. Donaldson, a loop chief for the Western Union Telegraph Company, had a sad experience. He handled a long telegraphic report of the fire and upon returning home learned that his wife had gone to the matinee at the Iroquois Theater. Hurrying down town his search resulted in his finding the body of Mrs. Donaldson at one of the morgues.

Frank Howard, an inspector for the Chicago Edison Company, lost his mother and a cousin.

C. A. Biegler of the statistical department of the Chicago Edison Company, mourns a sister, who was among those killed.

B. V. Swenson of Madison, Wis., assistant professor of electrical engineering at the University of Wisconsin, attended the performance and nearly succumbed to the smoke and gases which he inhaled. He was confined to the Samaritan Hospital for several days, but has returned to Madison.

Precautions Suggested.

In discussing the subject of protective devices Francis B. Badt, the electrical engineer, points out that it is necessary to avoid the use of automatic apparatus and manually-operated safety devices as much as possible, relying, rather, upon "something that is there all the time," like a sentinel on duty.

Writing to a Chicago daily newspaper, Mr. Badt elaborates his idea as follows:

While your idea concerning emergency lights is all right, from an engineering point of view I think it would be a most difficult matter to have gas pipes or electric wires so arranged that they would not be attacked and put out of use in case of a fire, and, at any rate, if your suggestion were followed it would place the lighting of these electric lights or gas jets in the hands of somebody on the stage, who, as is usually the case, may not be there or may fail in his duty just when the emergency arises. I may furthermore say that electric-light wires are easily put out of service by fire. Gas pipes may last longer, but in order to light gas jets automatically from the stage it would require a very delicate system of what is called "electric gas lighting," which would not withstand heat or other disturbances and which would be almost sure to fail in a case of emergency. An explosion or draft of flame or hot air would break the incandescent lamps or blow out the gas burners.

It has been stated that in the Iroquois no exit signs were over the doors, and it has been suggested that this was one of the causes of loss of life. The question arises, What would signs have been good for if the theater was thrown in darkness? The signs would not have been seen any more than the doors underneath the draperies. In order to avoid such trouble I should propose the following:

Have over each door a transparent sign made out of metal with glass crystal letters and have it illuminated from the outside of the building wall by means of a lantern attached on the outside, and have this lantern supplied by a source of light independent of the theater-lighting system, either electric or gas. This sign would be illuminated at all times during the performance. It would not be an objection during dark scenes, because there would be practically no light thrown through the glass letters to interfere with the darkness inside. At the same time the sign would stand there glaring the word "Exit" no matter how dark the theater or how light the theater. The main point I am trying to raise is that any device which has to be operated in case of an emergency is liable to fail, but an illuminated sign that will be illuminated at all times will be there, no matter what trouble may happen, because nobody can forget to light it during the excitement, as it was already lighted before the performance commenced. This, in my opinion, is the keynote for all devices which are intended to prevent panics in theaters. An automatic device is dependent upon certain conditions, usually rise of temperature near the ceiling. A manually operated safety device depends upon the presence of mind and cool-headedness of a certain employe, and, in my opinion, all these features should be eliminated. Everything should be ready for an emergency and not be dependent upon somebody or something to make it ready. All exit doors ought to be unlocked and swing open toward the outside, and this, in connection with the per-

manently illuminated sign above the door saying "Exit," in my opinion, would prevent much of the calamities heretofore experienced in theater disasters.

Mr. Badt also suggests that there should be a distinction in labeling exit doors, those leading directly through the outer walls to street or alley being indicated by the word "Street." This might give an added element of safety.

EFFECT ON TELEPHONE SERVICE.

The experience of the Chicago Telephone Company during and since the fire was exceptional. Within 10 minutes after the fire broke out the company was aware from the tremendous number of calls which flooded the Central exchange that something unusual had happened. Soon the rush spread to the other downtown exchanges, crowding the system as it had never been tried before. The operators handled the calls well under the circumstances and in the first few hours completed more connections than were thought possible by officials of the company. People who knew that friends or relatives had gone to the Iroquois were anxious to hear of their fate, and the first impulse was to use the telephone. Many would rush into booths half frenzied and in their excitement forget the number they wanted. This was the cause of considerable delay and inconvenience to the operators.

It is also interesting to know that the alarm was turned in by telephone almost as soon as that from the department fire-alarm box, and this fact, together with the rush for telephonic communication which followed, proves anew the value of the telephone.

A. S. Hibbard, second vice-president and general manager of the Chicago Telephone Company, is of the opinion that the amount of business done by his company in the hours following the disaster was never equaled in a similar space of time in any city in the world. The first rush of calls came from the business district, but toward evening on the day of the fire it spread to the residence districts, and the entire force of operators was kept working at top speed until midnight. The night force, under normal conditions, is about 20 per cent. of the day force, but on this occasion the entire force of 2,200 operators was necessary to handle the business, which is estimated in the three days following the fire, at about 55 per cent. greater than on any previous occasion of corresponding length of time in the company's history.

The great rush began to subside on Thursday evening, but the normal condition was not reached for four days. During all this time the company kept its subscribers on the long-distance lines informed of the latest developments in the harvest of death.

The officers of the Chicago Telephone Company are justly proud of the record made and are pleased with the way their operators handled the rush.

In discussing the matter Mr. Hibbard told of the experience of one of the company's trunk-line operators. The young lady in question operated on the trunk line connecting the Central and Main exchanges. As trunk operators are never in direct communication with subscribers, she was unaware of the cause of the rush and stuck to her post until the regular hour for relief. She was requested to remain for the evening, but informed the chief operator that she had arranged to meet her mother after the matinee at the Iroquois and wished to be relieved. Then she was informed of the cause of the unusual number of calls, but her fears were soon dispelled when the news came that her mother was among those who escaped uninjured.

The rush of business in the five-cent pay booths of the company throughout the city was the greatest in the history of the service. As the delay in securing change only increased the excitement and anxiety of the patrons, the company instructed operators to demand no pay from those seeking information from friends, and for some hours after the fire these booths were thrown open for the free use of the public.

TELEGRAPH LINES GREATLY TAXED

Telegraph companies felt the effects of the great anxiety for news concerning the fire almost as much as did the local telephone company. Mr. C. M. Baker, assistant general superintendent of the Postal Telegraph-cable Company, stated that, though the actual percentage of increase of business over the company's lines had not been computed, it was enormous, thousands of calls coming in from all parts of the country. As an illustration of this, Mr. Baker said that among the dead at the theater was a woman bearing the same name as his daughter. Anxious friends seeing this name on the death list sent him over 50 telegrams of inquiry. This is but one instance. If Mr. Baker answered all the messages 100 messages would have been sent concerning this one person besides all those sent to and from the real relatives of the missing one.

W. J. Lloyd, assistant district superintendent of the Western Union Telegraph Company, made much the same statement as Mr. Baker. No figures could be given, but the lines were crowded to their utmost capacity, as was the messenger service. Messages were received from all parts of the civilized world.

American Association for the Advancement of Science.

The American Association for the Advancement of Science and 23 affiliated societies met in convention in St. Louis during the week beginning December 28th. About 500 delegates were in attendance, including members of all the societies represented.

The retiring president of the American Association, President Remsen of Johns Hopkins University, gave an address on "Scientific Progress and Investigation." This dealt in a general way with the benefits of such gatherings of large numbers of scientific men, interested in many subjects. He called attention in particular to the larger benefits to mankind which have come from the development of chemistry since the days of alchemy.

President Jordan of Stanford University gave a public lecture on "The Resources of the Sea," in which he described the commercial and scientific benefits of fish study and culture, especially as exemplified in the salmon industry, and also in the fur-seal trade.

Professor E. Rutherford of McGill University, Montreal, gave a lecture on "Radium," which was illustrated with interesting and novel experiments with radium and radio-active substances. He explained the way in which radium is obtained from pitchblende. The rays emanated are of three kinds. The α-rays are deviated one way, and the β-rays in the opposite direction by a magnet, while the γ rays are not deviated at all. The α-rays are positively charged and seem to be of the most importance. The β-rays are negatively charged and resemble cathode rays, while the γ-rays are similar to X-rays. The α-rays are either helium, or else these change into or produce helium, as helium is always found near radio-active substances. The production of X-rays requires the continuous expenditure of a large amount of energy, while the energy from radium is given out continuously and spontaneously. Radio-activity is studied by means of its property of discharging electrified bodies. The emanation contains a large quantity of heat energy, which, however, we cannot so far control.

The convention was brought to a close with the Shaw banquet. The trustees of the Missouri Botanical Gardens invited the entire body of visiting scientists to this celebrated annual event. Nearly 300 attended the banquet.

It was decided to hold the next meeting of the American Association for the Advancement of Science in Philadelphia, one year from this time. Representatives from all parts of the country were in attendance at the present meeting, though, naturally, the Middle West was most largely represented. The meetings, in every respect, were very successful and profitable.

The papers presented before the various sections were fully up to the average, both as regards number and quality. Those on electrical subjects were given only in the sessions of Section B, Physics, and of the American Physical Society. In these sessions, which occupied three days, about 35 papers were read, a third of them being on electrical subjects. Three papers were read concerning radium. Eight of these papers are given herewith in abstract.

E. S. Johonnott, professor of electrical engineering at Rose Polytechnic Institute, Terre Haute, Ind., read a paper entitled "A Simple Alternate-current Frequency Indicator." A light armature is fastened to one pole of the magnet of an ordinary electric bell. This armature is kept at a little distance from the other pole by a flat spring. The passage of an alternating current through the magnet sets the armature in vibration, with a frequency twice that of the current. By attaching a style to the armature, it may be arranged to make a trace, together with a tuning fork, on a smoked paper, from which the frequency is directly counted.

"A Method for the Determination of Mutual Induction Coefficients" was the title of a paper by Augustus Trowbridge of the University of Wisconsin, Madison. By the usual methods, the self-induction of the two coils may be determined when the currents flow through the two coils in the same direction, and when it is reversed through one coil. By elimination the value of the mutual induction is found with a high degree of accuracy.

Another interesting subject was discussed by A. S. Langsdorf, Washington University, St. Louis, who described "A New Form of Frequency Meter." The instrument indicates the frequency of alternate-current circuits. The readings are independent of the fluctuations of voltage on the line, and the connections are similar to those of an indicating wattmeter.

Arthur L. Foley of the University of Indiana presented a valuable paper on "A Remarkable Distribution of Carbon on the Bulb of a Hylo Incandescence Lamp," in which he gave a description of the lamp with the two filaments of opposite polarity and the queer distribution of carbon which takes place on the inner surface of the globe. The theory of molecular shadows and the Edison "effect," so thoroughly worked out by Fleming and others, explains the general character of the deposit, but seems to fail to explain the definiteness of it. In general, the deposit is of uniform density and quite dark, while the clear places are perfectly clear, the line of separation being as definite as if the deposit had been laid on with a brush.

The relation of the magnetic field to light waves was well brought out in a paper "On the Effect of a Magnetic Field on the Interference of Natural Light," by John Mills, Western Reserve University. The conception of natural light as an elliptical vibration and our knowledge of the Faraday "effect" would give as a criterion for an analogous rotation of natural light the disappearance of interference fringes, previously observable, upon the formation of a magnetic field capable of rotating plane polarized light through an angle of an odd multiple of 90°. The apparatus consisted of a Michelson interferometer. In the path of each beam was placed a tube of carbon disulphide surrounded by a solenoid. Natural monochromatic light was used and the current varied. Observations were taken at the points of disappearance and of reappearance of the fringes. The mean of these current readings was taken as that for which interference was impossible. These values of the current would have produced in plane polarized light a rotation of 95.8°, 256.8°, 447.5° and 613.6°. The apparent invalidation of the results obtained because of a partial polarization of the entering light by the reflecting surfaces was also discussed.

The paper entitled "Hertzian Waves Since Hertz," by A. D. Cole, Ohio State University, described the various forms of exciters and detectors that have been devised, and called attention to the diminishing gap between infra-red light waves and electric waves, the latter having been reduced to a length of one millimeter.

An interesting description of "The Differential Telephone" was given by William Duane, University of Colorado, Boulder, Colo. Two separate coils of wire are wound on the bobbin of a telephone receiver. The coil where self-inductance is to be measured and a variable self-inductance standard are placed in series with the two receiver coils, respectively. A non-inductive resistance is connected in series with the unknown, or with the standard, according as the resistance of the latter is greater or less than that of the unknown coil. The two entire circuits are joined in parallel and an alternating electromotive force is applied to the branch points. By suitable adjustments it is possible to cause the sound in the telephone to vanish. From the relations of the known quantities involved, the unknown self-inductance may be computed with great accuracy.

E. Rutherford of McGill University, in a paper on "The Heating Effect of the Radium Emanation," described some interesting experiments which prove that radium gives off heat at such a rate that one gram would liberate a hundred calories an hour. By heating radium, it loses its power to radiate energy, but there is obtained a material emanation which has the energy within itself. This emanation radiates the heat, and becomes less active, losing its property entirely in about a month, while the radium regains its former power at the same rate.

The following-named officers of the American Association for the Advancement of Science for 1905 were elected on December 31st:

President—Professor William G. Farlow of Harvard University.

Vice-presidents of sections—Section A, mathematics and astronomy, Professor Alexander Ziwet, University of Michigan; section B, physics, Professor W. F. Magee, Princeton University; section C, chemistry, Dr. L. P. Kinnicutt, Worcester Institute of Technology; section D, mechanical science and engineering, Professor David S. Jacobus, Stevens Institute, Hoboken, N. J.; section E, geology and geography, Professor E. A. Smith, University of Alabama; section F, zoology, Dr. C. Hart Merriam, United States Department of Agriculture, Washington, D. C.; section G, botany, Dr. B. L. Robinson, Harvard University; section H, anthropology, Dr. Walter Hough, United States National Museum, Washington, D. C.; section I, social and economic science, Hon. Martin A. Knapp, chairman of the Interstate Commerce Commission, Washington, D. C.; section

K, physiology and experimental medicine, Professor H. P. Bowditch, Harvard University, re-elected.

General secretary—Dr. Charles S. Howe, president of Case School of Applied Science, Cleveland, Ohio.

Secretary of council—Professor C. A. Waldo, Purdue University.

German Rules for Electrical Plants.

In a paper read before the Verband Deutscher Elektrotechniker it is announced that in the new edition of the official rules the "medium tension" is abolished. Low-tension plants are defined as those having not more than 500 volts between wires or 250 to earth. The insulation resistance is required to be 1,000 ohms multiplied by the voltage for each section between two fuses or beyond the last fuse. This rule does not apply to wiring in damp places, for which special precautions are prescribed, but no minimum insulation resistance. A scale of current densities is given as in previous editions—ranging from 5.33 amperes per square millimeter for a section of 0.75 square millimeter, to one ampere per square millimeter for a section of 1,000 square millimeters. The smallest section allowed is one square millimeter, or in fittings 0.75 square millimeter. Special rules are given for places containing explosive gases, for shop windows, theaters and mines. High-tension plants are defined as those in which the voltage to earth may exceed 250 volts. Traction plants are excluded from the regulations. A scale is given for the minimum installation resistance between two fuses ranging from 1,000 ohms multiplied by the voltage for 250-volt plants to 500 ohms multiplied by the voltage for plants working at 1,000 volts or over. The test is to be made, if possible, with the working tension, or, failing this, with at least 100 volts. The insulation of wires is required to stand a test tension, after 24 hours' immersion, of double the working tension when this is 500 volts or under, 500 volts excess tension for working tensions from 500 to 1,000 volts, and above that 50 per cent. excess tension. High tensions are not allowed in wet places, theaters or shop windows. Tensions above 1,000 volts are not allowed in places exposed to acid fumes, and in damp places only if run in cables. The regulations for the working of electrical plants relate chiefly to precautions for the safety of workmen, such as posting notices of dangerous points. No eating, drinking or smoking is allowed in accumulator rooms, and men are to be specially cautioned as to the dangers of acids and of lead poisoning. For the working of high-tension plants rules are given as to the switching out of circuits before work is done on them, and the special precautions necessary where this is impossible.

COMMUNICATION.

A Physician's View of X-ray Treatment.

To the Editor of the Western Electrician:

On the editorial page of the December 26, 1903, issue of your journal you discuss the question whether any but qualified medical men should be allowed to make radiographs or give X-ray treatments. Being a physician and at the same time making a specialty of electrotherapeutics (which includes the X-ray in all its phases) and also having taught this subject to physicians for nearly six years, I can say that at the present time there are enough physicians who are expert in this line of work (and many more who are willing to learn) to do all the work demanded, so that there is now no excuse for the employment of non-medical X-ray operators.

The assertion of the non-medical operators, namely, "that the best members of the medical profession have neither the time nor the inclination to perfect themselves in this art" is not borne out by facts. I have personal knowledge of instruction received in this "art" by over 1,000 M. D.'s in Chicago alone during the last five years. To-day there are enough physician experts in this city to take care of all the X-ray cases which nature may thrust upon them.

As for the patient, it is only necessary for you to put yourself in his place to get the usual answer. Of course, it is only natural that he should prefer to be treated by a physician.

In the present light of things, the X-ray is a diagnostic and therapeutic agent, which belongs strictly to the medical profession, and although mechanical as far as its control is concerned, the operator should know much about anatomy and pathology, in addition to a knowledge of electricity, in order to give mutual benefit.

There is, therefore, no valid reason for the existence of the non-medical X-ray operator, and, according to a natural law, he is rapidly becoming extinct. EMIL H. GRUBBE, B. S., M. D.

Chicago, December 28, 1903.

[Our correspondent is engaged in teaching physicians the method of using X-ray apparatus, and is, therefore, perhaps, not altogether disinterested. We can still see no harm in experienced non-medical operators making the exposures when acting under the direction or prescription of physicians. Some of these operators have been engaged in the work for years and have become recognized experts. It does not seem fair that they should be driven out of the field. But it might be well to restrict medical cases to medical supervision, as suggested in our editorial. —Ed.]

OBITUARY.

Frank H. Clark.

Friends of Mr. Frank H. Clark, a receiver for the Helios-Upton Company in Chicago and a man of prominence in electrical circles for many years, were shocked to learn of his sudden death on January 4th. Most of them were entirely unprepared for the sad news, as only a few days ago Mr. Clark was about as usual, calling on his friends and apparently in good health. Death resulted from shock following an operation at the Presbyterian Hospital for the removal of gall stones. The funeral services were held at the family residence, 1310 Judson Avenue, Evanston, on Thursday afternoon.

Frank Hodges Clark was born in Lawrence, Mass., in 1849. His early life was spent in Andover, Mass., where he graduated from Andover Academy. In 1869 he was associated with General Benjamin F. Butler, under whom he began the study of law. A year later, however, he received and accepted a presidential appointment as paymaster in the United

FRANK H. CLARK.

States Navy, in which capacity he served for 19 years. During this time he traveled extensively and acquired a wide acquaintance, particularly among naval officers, numbering Admirals Dewey and Sampson and others nearly as prominent among his friends.

In 1889 Mr. Clark accepted the position of district manager for the old Thomson-Houston Electric Company in Washington, D. C., afterward merged in the General Electric Company. Subsequently he filled a similar position for the Westinghouse Electric and Manufacturing Company, and at another period he was for several years manager of the United States Electric Lighting Company of Washington. During this time Mr. Clark extended his acquaintance and became intimate with many men in public life.

Forming a connection with the Electric Storage Battery Company, Mr. Clark removed to Chicago in 1897. He had charge of the Chicago office of that company and was connected with a number of important contracts. For the last two years or more he was associated with the Chicago branch of the Helios-Upton Company, being appointed a receiver for the property less than a year ago.

Mr. Clark leaves a wife and seven children. The latter are: Lieutenant Frank H. Clark, U. S. S. Alabama; Lyman Clark, New York office of the General Electric Company; Dr. J. W. Clark, Calumet, Mich., and Mary, Alice, Charles and Lydia Clark of Evanston.

The deceased gentleman was a well-read, well-informed man of affairs, with a genial, hearty manner that made him welcome in any circle. He had been all over the world, knew many famous men and was a delightful raconteur and conversationalist. He was fond of the society of his friends, who were many in number and warm in attachment. His death has caused widespread and genuine regret.

Other Deaths.

James D. McAvoy, first president of the Norfolk Suburban Street Railway Company, and at one time president of the Hyde Park Electric Light Company, died on December 30th at the age of 79 in the town of Hyde Park, Mass.

General Alfred P. Rockwell, former professor of engineering in the Sheffield Scientific School of Yale University, and later in the Institute of Technology in Boston, subsequently becoming president of the Eastern Railroad Company and identified with textile manufactures, died suddenly in New Haven, Conn., December 24th, of heart disease. He was brevetted brigadier general for his services in the Civil War.

George A. Ellis of Springfield, Mass., a well-known engineer, who installed the electric-light plant in Memphis, Tenn., and directed other engineering work in southern cities, died of heart disease on December 27th, aged 61 years.

Amos S. Stetson of Whitman, Mass., died on December 26th in that town. In 1893 he purchased the interest of the Whitman Electric Lighting Company from the Thomson-Houston Company of Lynn, and assumed the management of the plant. He was at one time in business in Mobile, Ala., and had many other financial interests.

Royal C. Vilas, president of the Pyle National Electric Headlight Company of Chicago, died of pneumonia at his home in Chicago on December 29th. He was 61 years of age and had been prominently engaged in railroad affairs since 1862. He was at one time general freight traffic manager of the Erie railroad and later organized the New York Air Brake Company, of which he was made president. He withdrew from this company in 1895 and came to Chicago, where he was engaged up to the time of his death with the company of which he was president. Mr. Vilas leaves a widow, four sons and two daughters.

President J. M. Allen of the Hartford Steam Boiler Inspection and Insurance Company died suddenly last week at his home in Hartford, Conn., from the effect of heart trouble. Mr. Allen was a prominent business man and was one of the leaders in the boiler-inspection business. The institution of which he was president was organized some 30 years ago and was built up by Mr. Allen until it is now the leading company of its kind in the world. The deceased was well known in Chicago, where Mr. H. M. Lemon is manager of the company. Mr. Allen was a member of various scientific and historical societies. For years he was a lecturer on insurance topics at Cornell University. He was born in Connecticut 70 years ago.

Electricity Comparatively Harmless.

When fatalities or damages seemingly attributable to electricity occur, the popular belief is that electricity itself, as a force, is directly responsible for them. In fact, however, there are few forces of nature that are less harmful in themselves than electricity. The damage done by flood or tornado, for instance, is done directly by the water or the air. But electricity, when it works, usually does so indirectly or by setting another of nature's forces into operation. An exception to this may be where the victim may have been so weak, physiologically, that a simple fall from a chair might have had a similar result. But in the majority of cases death from electric shock is shown to be due to well-defined chemical changes in the blood or tissues, due to the electric current. The damage done also to gas and water pipes by electrolysis, while primarily occasioned, it is true, by the escape of electricity from electric-railway circuits, is not directly due to that force, but rather to a secondary action, and that a purely chemical one, namely, the setting free by electrical action of certain elements, such as chlorine and sodium, constituents of a saline solution in the soil, which attack and corrode the iron pipes. Without some such solution in the soil there would be no such thing as electrolysis. Also, when lightning strikes a tree and shatters it, the result is not due directly to electricity, and not even to the electric current, but rather to the intense heat which the electric current generates in passing through the tree, which heat suddenly converts the sap into steam, and the latter in expanding, if the force be sufficient, tears the tree to pieces. If the force is not sufficiently powerful, the effect may be only to loosen the bark of the tree in places, the evidence of which may last for years, but may not be otherwise hurtful to the tree's growth. So far, indeed, from electricity being necessarily fatal to animal or vegetable life, it is well known that in proper quantities it is decidedly beneficial, and, when properly applied, acts as a stimulus to vegetation. An excess of current, however, will also kill vegetation. In both of these cases its action is due to the chemical changes which it effects in the growing plant or tree.—Cassier's Magazine.

Institute Meeting in Chicago.

The next meeting of the Chicago branch of the American Institute of Electrical Engineers will be held at the rooms of the Western Society of Engineers on January 12th instead of January 5th, as announced by mistake. The papers of Lukes, Bechtel, Eglin and Bibbins, presented at the New York meeting of December 18th, will be discussed, as well as Lamar Lyndon's storage-battery paper of a previous date. Several storage-battery experts will be present, as well as others more particularly interested in gas engines and distribution systems. A profitable evening is anticipated.

The Lachine Rapids Power House.

[*Continued from page 33.*]

trolling switches and the red and green pilot lamps for the same.

On the top of the table will be seen the terminal board, by which means it is possible to put ammeters, wattmeters, etc., in on any feeder and on any phase, by connecting the ammeter to the terminal and taking out the connecting bar. The instrument is then connected on the secondary side of the current transformers and in series with the overload relay.

The Direct-current Distributing Switchboard for

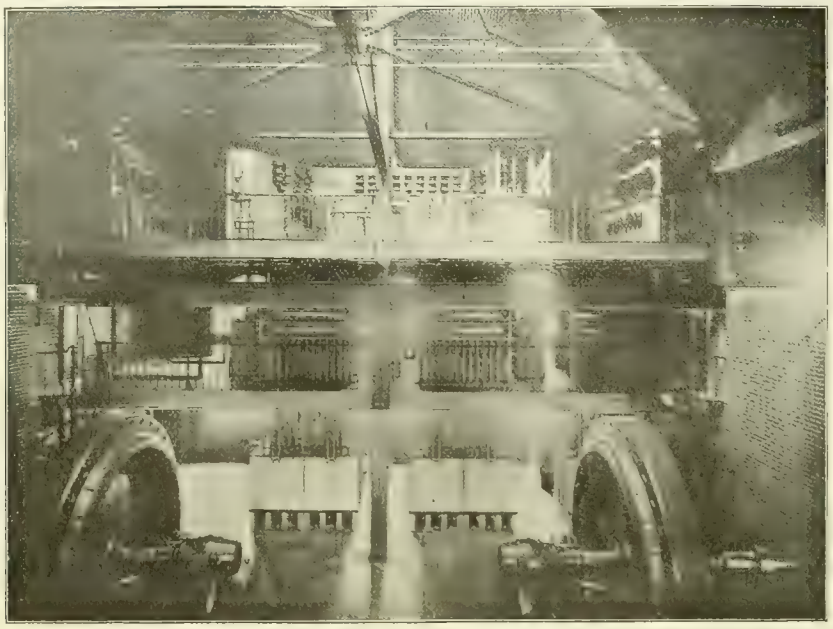


FIG. 9. LACHINE RAPIDS POWER HOUSE.—INTERIOR OF STATION.

the Auxiliaries.—These switchboards, of which there are two, are mounted alongside of the feeder-bench boards. They are seven feet six inches high and seven feet long, and constructed of blue Vermont marble. On them are mounted the fuses for all the supply leads of the direct-current controlling or auxiliary devices, the source of energy being from either set of the exciter bus bars. The enclosed type of fuses, with indicating device, is used throughout on the board.

The Motor-operated Main Rheostats for the Exciters.—These rheostats are mounted on the floor in the rear of the main-instrument switchboard. There are two sets of these, one for each set of exciter bus bars. Each set contains four rheostats, operated simultaneously by means of a worm shaft driven by a half-horsepower direct-current motor.

By means of special clips, the triple-pole, double-throw switch on the exciter panel, depending on its position, throws a rheostat of one of the two sets in series with the hand-operated shunt-field rheostat of the corresponding exciter. The latter rheostat is mounted underneath the ceiling floor of the second gallery, and is controlled by means of sprocket-chain gearing from the operating table. On the operating table are mounted the controllers for these rheostats. The object is to raise or lower the voltage simultaneously on all exciters which are in multiple, and thus to simplify the operation.

Alternating-current Bus Bars.—The high-tension bus bars, situated on the first gallery, are mounted on soapstone panels, two inches thick, with 1¼-inch and 1½-inch soapstone barriers. Each bus bar is composed of two-inch by three-eighths-inch hard-drawn copper bar, supported on studs which pass through hard-rubber bushings. It will be seen that the current is carried from the oil switches through the current transformers to the knife-blade switches, and thence to the bus-bar studs by means of copper bars. The knife-blade switches serve the purpose of making the oil switches entirely dead for cleaning and for repair purposes. On the back of the panels the connecting strips and terminals are so well insulated as to make it impossible to touch any bare or current-carrying part of the bus bars, etc. The insulation being three thicknesses of oil linen, asbestos pressed board, over which is wound, completely covering the same, a hard braided cord, after which it receives one coat of so-called fireproof paint.

Oil Switches.—There are two types of electrically controlled oil switches in use. On the main floor, for the generator and feeder switches, there are 28 c mpartment type oil switches, furnished by the General Incandescent Arc Light Company of New York. These switches are mounted in a buff-brick chamber, divided by soapstone barriers, into three compartments, one for each phase. In each compartment there are two oil wells, containing switch clips, which are connected by an inverted copper U connector. The latter is fastened to a wooden rod, and the three rods are connected together outside of the switch compartment by an iron cross-bar. The solenoids, one for opening and the other for closing the switch, operate a crank and connecting-rod movement, to which is attached the above cross-bar. There are six 14-inch breaks in each phase.

On the first gallery for the three tying switches are three compartment-type switches, furnished by the General Electric Company, they being the well-known General Electric Company's compartment switch, and operated by a direct-current motor, and are quite similar to the G. I. switches in general construction.

Governing Controllers.—Inasmuch as the wheelman in any case is required to start the wheels and to open the valves on the governor, and to bring the waterwheels and generator up to approximately normal speed, it was decided that the best plan would be to let the wheelman start up each unit, and after bringing the generator to approximately the right speed, to give the switchboard attendant only such control as may be necessary to get the generator in synchronism.

Two solenoids operate the ratchet wheels, which are fixed to the spindle or rod which connects the fly-ball with the governor-regulating valve. One of these solenoids operates a ratchet in one direction so as to raise the speed, and the other solenoid operates another ratchet in the opposite direction, which lowers the speed.

The Signal System.—On the generator and exciter panels, annunciators are mounted. Each annunciator has six compartments with ground-glass covers, back of which are two five-candlepower, 75-volt lamps, connected in multiple, and on each piece of ground glass is printed certain signals. These lamps are operated from single-pole, double-throw cam switches mounted on the operating table. Similar annunciators and switches are mounted at each turbine governor, and the lamps here are in series with those on the main switchboard. Thus it is possible for the wheelman and the switchboard attendant to interchange with each other, six different kinds of signals, which are lettered on the ground glass.

The Synchronizing Device.—Another interesting feature is the synchronizing device, in which the system of connection is novel, making it almost impossible for a mistake on the part of the operator. There is only one Lincoln synchronizer used, and there are four different sets of bus bars for each generator, and for each bus-bar tying switch there is one four-hole receptacle on the operating table.

If the operator wishes to synchronize two sets of bus bars, he inserts the four-point plug on the corresponding tying panel. If he wishes to synchronize a generator with the bus bars, the plug is inserted in the corresponding four-hole receptacle. Half the power house, as seen from the main floor, is shown in Fig. 9, giving the relative position of the new switchboard.

High-power Westinghouse-Parsons Steam Turbine.

The Westinghouse-Parsons steam turbine was commercially introduced during the closing months of the last century. The sizes then built were of 600-horsepower nominal capacity, direct-connected to 400-kilowatt polyphase generators. Subsequent development has been so rapid that within a period of four years turbines of 5,500-kilowatt, or 7,500-horsepower nominal capacity, have been designed and are under construction. These machines will have a continuous overload capacity of 11,000 horsepower in one self-contained unit, and thus rank among the world's largest prime movers.

Recently, marine work has been contemplated by the builders, and the near future may be productive of turbines of still greater power, although of slightly different arrangement, necessary to adapt the present type to marine usage.

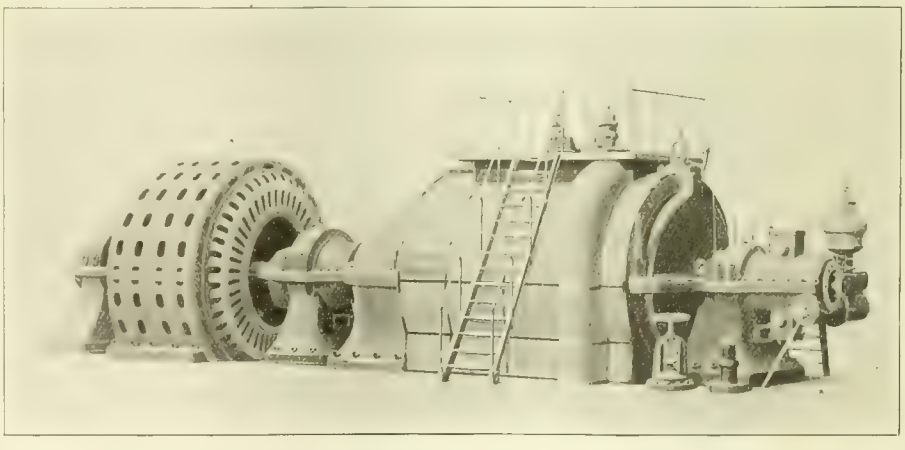
The 5,000-kilowatt turbo-generating unit illustrated herewith is representative of the general type which will be constructed for large powers. This type embodies the experience acquired in the construction and operation of a large number of machines. The principle of operation and the general relation and arrangement of rotating and stationary elements characteristic of former types have been employed.

The most distinguishing features of the new type are the extreme compactness and low speed secured. These features have been practically prescribed by the necessity of minimizing the cost of power-building construction for larger station capacities. The space occupied by the 7,500-horsepower turbine is approximately 27 feet eight inches by 13 feet three inches, and the height to the top of the hand railing is 12 feet. This is equivalent to 20.2 horsepower per square foot of floor area required. For the complete unit a rectangular area of 47 feet four inches in length and 13 feet in width is required, which is equivalent to 12 electric horsepower per square foot of floor space.

In point of speed, the new type fulfills the demand for a unit operating at moderate speed. The 5,000-kilowatt units operate at 750 revolutions per minute, the 2,000-kilowatt unit, 1,200-1,560, revolutions per minute, and the 1,000-kilowatt unit 1,500-1,800 revolutions per minute, depending upon the frequency desired. These speeds, although not comparable to engine speeds, do not impose much greater stresses upon the rotating parts, and, in addition, secure the great advantage of reduction in the bulk, weight and cost of the unit.

The accompanying plan and elevations of the 5,000-kilowatt unit show the general arrangement of the main cylinder body, bearings and auxiliary parts.

The unit rests upon a single bedplate, cast in two sections, which are secured by shrunk links. To the bedplate, which is heavily ribbed to secure rigidity, are bolted the pedestals, generator casing and turbine body, but the bed-plate itself is not secured to the foundation by other means than the weight of the unit. Steam and exhaust connections are made beneath the floor level.



WESTINGHOUSE-PARSONS STEAM TURBINE.—5,000-KILOWATT TURBO-GENERATOR.

In the smaller machines of this type the cylinder barrel and both journals are cast in a single casting, thus largely minimizing machine work. In the large machine, however, the barrel is cast in two sections united by links, the outboard section carrying the journal and worm casing and the inboard section the journal and exhaust opening, which extends through the bedplate. As in former types, linear expansion and contraction of the turbine are provided for by a sliding foot. The inboard journal pedestal is bolted securely to the bedplate, but the outboard pedestal is free to slide between parallel machined ways. The main body of the casing is heavily lagged with non-conducting material, secured in place by sheet-steel casings.

Leakage of air from the atmosphere into the exhaust spaces of the casing at the entrances of the shaft is prevented by frictionless packing glands. No oil is employed, and in consequence the condensation from the turbines is pure distilled water.

In shaft construction great rigidity has been se-

cured with minimum use of metal. A central steel quill carries the entire rotating parts, both blades and balance pistons. Hollow forged-steel ends are forced into the two ends of this quill, under hydraulic pressure, and are, in addition, secured by arrowhead links. High-pressure steam is conveyed to all parts of this quill structure in such a manner as to eliminate stresses and consequent distortion, due to highly superheated steam.

Power is transmitted to the generator shaft through a flexible coupling, which is housed partly by the turbine and partly by the generator inboard journal. The coupling is split at the junction of the two shafts, so that by removing one bearing cap and the coupling bolts either section of the unit may be lifted out without disturbing the adjustment of the remaining section. In the smaller sizes the engagement surfaces of the coupling consist of the squared or hexagonal ends of the shafts, but in the larger machines a crowfoot sleeve is keyed to each shaft and the power is transmitted by an outside quill engaging the crowfeet. This great flexibility is secured, together with the greatest facility in dismantling.

The journals in the larger machines are of the solid, self-aligning type, similar to that employed in generators and cross-compound engines. The departure from the familiar oil-cushioned journal employed in the small machines is occasioned by the speed reduction secured. The journal shells are babbitt-lined and are split horizontally, the two halves being united by bolts with shim adjustment. Oil from a central system is introduced at the center under slight pressure, thoroughly flushing all parts. Axial adjustment is provided by metal shims arranged in quarter-box fashion. The diameter of the shaft at the journal of a 5,000-kilowatt machine is 15 inches, strikingly small in comparison to the 34-inch shafts required for a cross-compound reciprocating engine of corresponding capacity.

Longitudinal adjustment to preserve proper side clearance is secured by a thrust bearing located next to the outboard bearing. The bearing is not subjected to longitudinal thrusts from the action of the steam, and is consequently of small size.

The two half shells are advanced in opposite directions by graduated set screws, so that the actual running clearances are measured in thousandths of an inch. Once set, these adjustments are permanent and do not require frequent "taking up."

Steam enters the turbine successively through an automatic quick-closing throttle, hand throttle, strainer and the main admission valve. A circular steam port surrounding the entrance to the initial stage conveys this steam to all points so as to avoid stresses incident to more localized admission of highly superheated steam.

An important feature of the steam-distribution system is the provision of a by-pass valve. This valve admits high-pressure steam to the second stage of the turbine on overloads in order to increase its capacity, up to 50 per cent. in excess of full rated load. By properly proportionating the by-pass steam to the overload on the turbine maximum economy may at all times be secured, together with reserve-overload capacity. This results in a slight rise in the economy curve on heavy overloads, resembling in some respects the engine-economy curve on loads exceeding that of maximum economy. The turbine, however, only suffers in economy at heavy overloads, while the engine economy decreases progressively from 75 to 80 per cent. of full-load capacity.

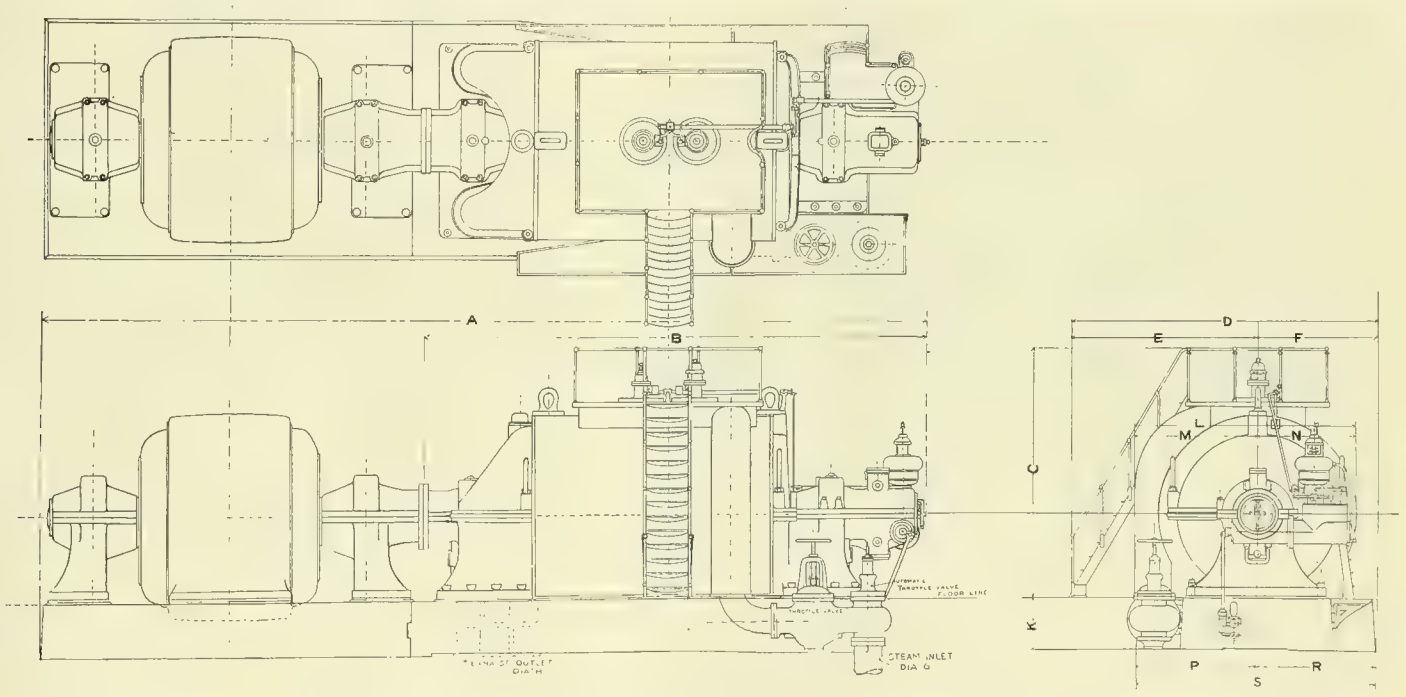
The main admission valve consists of a double-beat poppet valve operated by a small piston, this in turn being controlled by a small pilot valve directly actuated by the governor mechanism. The valve admits steam to the turbine in puffs, the duration of which are proportioned by the governor to the load upon the turbine. This intermittent method obviates the throttling of steam to accommodate loading and secures the highest economy by using at all loads steam at boiler pressure.

At the extreme outer end of the turbine shaft is mounted a worm driving a short horizontal cross-shaft. This shaft drives at one end the oil pump and at the other end the governor through bevel gearing. An eccentric provides the reciprocating motion necessary for the valve mechanism.

The governor is of the fly-ball type, with 90-degree bell-crank ball levers mounted on knife edges and fitted with roller contacts. The governor sleeve and spring is mounted on ball bearings, and adjustment of the spring tension may be made while the turbine is running, thus affording a most simple and convenient means for paralleling alternating-current generators and dividing the load proportionately between them.

At the extreme end of the outboard pedestal is mounted an auxiliary speed-limit governor. It is likewise of the centrifugal type and may be set to release, at any predetermined speed, a small plunger valve which controls with high-pressure steam the operation of the quick-closing throttle before mentioned. This is normally held open by means of an overbalanced differential piston. At the moment the speed limit operates, the excess pressure is removed and the throttle closes. This device is employed purely for insuring absolute immunity from accident from excess speed, due to the possible disablement of the governor mechanism.

Copious lubrication is supplied to all journals by means of a plunger pump driven from the worm shaft. The warm oil returning from the bearings passes through a copper-coil cooler in the bedplate and thence to a reservoir, from which the pump draws its supply. The cooled lubricant is circulated at slight pressure, sufficient to insure positive flow. At no point is oil under high pressure employed for preventing erosion of rubbing parts, bearing areas being sufficient for supporting the weight of the rotating parts.



WESTINGHOUSE-PARSONS STEAM TURBINE. PLAN AND ELEVATION OF 500-KILOWATT TURBO-GENERATOR.

Generators.

In general construction the 5,000-kilowatt turbo-generators conform to those now building for smaller machines. The field or revolving element is built from a solid cylinder of steel slotted for the reception of the bar windings, and provided with ventilating openings corresponding with openings in the laminations of the stationary element. The generators may be wound for high voltage if desired, in order to avoid the use of step-up transformers in a system of power transmission at voltages ranging up to 15,000.

The 5,000-kilowatt turbo-unit here illustrated will be employed in heavy electric-railway service, which is the most exacting encountered in central-station operation. These machines will form the initial equipment of the Pennsylvania Railroad terminal property in New York city, operating with electric locomotives the heaviest Pullman trains through the tunnel approaches to Manhattan. Three similar units will be used for the power service on the Philadelphia Rapid Transit Subway system, now under construction. Eight 5,000-kilowatt units will furnish power to the London subway system, and three 3,500-kilowatt units will be used for the surface system of the same city. These units will operate under 175 pounds steam pressure, high vacuum and 100 to 175 degrees of superheat.

Northwestern Cedarmen's Convention.

The annual meeting of the Northwestern Cedarmen's Association was held at the Auditorium Hotel, Chicago, January 5th, and was one of the most successful and enjoyable gatherings this association ever held. Owing to the illness of President R. H. Downing and the inability of Vice-president William Mueller to be present, M. K. Bissell of Escanaba, Mich., was elected temporary chairman. The president's address was read by the secretary, and was received with applause. The reports of Secretary Gilman and Treasurer Reade were next in order, followed by reports of the standing committees.

The following-named officers were elected: President, H. W. Reade of Escanaba; vice-president, D. MacGillis of Milwaukee; secretary, J. T. Hayden of Minneapolis; treasurer, W. B. Thomas, Manistique, Mich. The directors elected are E. H. Valentine of Chicago, O. Erickson of Escanaba, Marshall H. Coolidge of Minneapolis and F. W. Robinson of Gould City, Mich.

In the evening the members enjoyed a banquet at the Union League Club as guests of the Chicago contingent.

A full report of the proceedings of the convention will appear in the next issue of the Western Electrician.

Electric-railway Improvements in Galveston.

The Galveston City Railway Company will expend about $60,000 during the coming year for improvements. The original budget for the coming year embraced the proposed expenditure of $227,000 for extensions and improvements, but this sum has been cut down on account of the large amount that will be incurred in street paving, due to raising the grade of the city. Major R. B. Baer, president and general manager of the company, says that the company has expended the sum of $1,068,000 in rehabilitating the system and in improvements since the great storm which swept over the city three years ago.

Copper Market.

During December of last year the price of copper fell off, as is usual at that period, the price of bar copper settling to the basis of 12 cents a pound. The new year, however, sees Electrolytic quoted at 12½ cents and Lake at 12¼ to 12⅜ cents a pound. Consumption in this country has fallen off and producers are obliged to turn to Europe for customers. The demand in Europe seems good and cable orders are brisk, sales having been made as high as 12⅝ cents.

Municipal Plant Not Desirable in Binghamton.

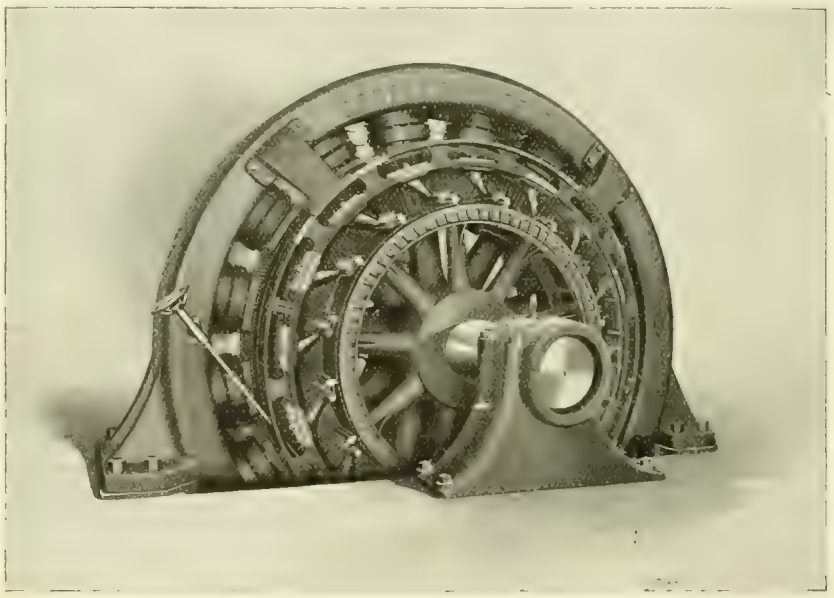
After a careful investigation for eight months a special committee of the Common Council of Binghamton, N. Y., has presented a report recommending against the erection of a municipal electric-lighting plant. The committee states that from the cities that have municipal lighting plants from which reports were received, few are successful, and only two secure street lights as cheaply as does Binghamton.

Railway Generator for St. Louis Exposition.

One of the interesting exhibits among many large and impressive power units in Machinery Hall at the Louisiana Purchase Exposition will be the electric generating equipment furnished for the supply of power to the intramural railway. The plans for this plant provide for a generating capacity of 4,400 kilowatts and the construction of the machines to furnish this power is well under way. They will be divided into eight units, each consisting of a standard Crocker-Wheeler railway-type generator similar to the one shown in the picture, direct-connected to the prime mover. There are two units of 900-kilowatt capacity each, running at 100 revolutions per minute, one driven by a 1,500-horsepower gas engine, and the other by a Buckeye cross-compound steam engine. A 600-kilowatt generator running at 85 revolutions per minute is driven by a horizontal cross-compound 20 by 40 by 54-inch engine. Three units of 500-kilowatt capacity each are to be furnished. One with a speed of 100 revolutions per minute, the other two being driven at a speed of 135 revolutions per minute. The seventh unit is one of 400-kilowatt capacity, running at 150 revolutions per minute.

The last generating unit in the series is driven by a Doble waterwheel. The unit is of 100-kilowatt capacity and runs at 700 revolutions per minute.

With the exception of the differences in size and details as to the proportions, the several generators



RAILWAY GENERATOR FOR ST. LOUIS EXPOSITION.

are similar. The cast-iron magnet frame is of the internally flanged type, parted on its horizontal diameter and bolted together by flanges on the inside. The poles are of mild steel, cast-welded into the frame, giving a minimum magnetic reluctance and a maximum strength. The field coils are made up in two or three sections, which are individually wrapped, taped and insulated, and separated from one another by small wooden blocks to improve the heat-radiating qualities. To allow the removing or replacing of the coils the pole shoes are detachable. The armature is of the ironclad type, consisting of a toothed core of laminated mild steel, in the slots of which the windings are protected by wooden wedges fitting in notches near the tips of the teeth. Very careful attention is given to the insulation, the formed conductors being bound and varnished and the slots lined with heavy insulation.

The commutators are constructed of high-grade drawn copper, with ample surfaces to carry current without undue heating and to give a large radiating capacity. Each brush rigging consists of a rocker-ring held by brackets bolted to the field frame, which in turn supports brush-holder arms with independent brushes on each. The brush holders are of the parallel-movement type, characteristic of the Crocker-Wheeler apparatus. On each one four sets of laminated copper strips carry the current and control the movement of the brush from or toward the commutator, always maintaining the same angle with its surface. This causes the brushes to wear away evenly, and as they become shorter allows them to be extended and clamped in a new position without altering the surface of contact. The brush pressure is regulated by a helical spring, which does not carry current, and hence is less inclined to heat and vary its tension. When desired, the brushes may be lifted from the commutator and held away from it by a half turn of the adjusting screw. This is a feature that is especially useful when it is expedient to test individual brush resistances, or certain windings for grounds.

The plant will be of interest not only to technical men but to the public in general, as in it are combined the three prime movers now used for the generation of electric power—steam, gas and water.

Blades Starting-box Patent Upheld on Appeal.

The United States Court of Appeals for the Seventh Circuit (Judges Jenkins, Baker and Bunn) at Chicago by Judge Baker rendered a decision on January 5th sustaining Judge Kohlsaat of the Circuit Court, who, in March last, rendered a decision sustaining the Blades patent, No. 418,678, dated January 7, 1890, covering the automatic underload release starting-box commonly used with direct-current shunt motors, wherein the retaining magnet is connected in the shunt field circuit. This suit was started in 1898 against Harding & Hammer, selling agents for the Chicago Rheostat Company. The Chicago Rheostat Company was afterward acquired by the General Incandescent Arc Light Company. This patent was held invalid in 1897 by Judge Baker of the Circuit Court of Indiana, and the fight since that time has been an uphill struggle in behalf of complainant to sustain a patent which had once been declared invalid. This is the first instance in a number of years where a patent which has once been declared invalid has been thus revived.

The complainant, the Cutler-Hammer Manufacturing Company of Milwaukee, was represented by W. Clyde Jones and Keene H. Addington, of the firm of Jones & Addington, Chicago. The defendants were represented by Parker & Carter and Edward Rector of Chicago.

The full text of the opinion of the Court of Appeals is as follows:

This is an appeal from a decree adjudging appellants [Edward W. Hammer and Edwin R. Harding] to be infringers of claims 1 and 4 of letters patent No. 418,678, January 7, 1890, to Blades, assignor, for an electric switch for motors.

Claim 1 is as follows: "1. In a shunt-wound electric motor, the combination, with the field circuit, of a magnet in said circuit, a hand switch adapted to open and close the armature circuit, said switch arranged to be held in its closed position by the magnetism of the said magnet, and means for automatically retracting the said switch to its initial position when the magnet is deenergized by the cessation of the current through the field current, substantially as described."

Claim 4 is the same except that the means for retracting the switch to its initial position is limited to a spring.

The opinion of the Circuit Court, reported in 124 Fed., 222, cites the prior patents.

Baker, circuit judge, delivered the opinion of the court.

The record shows that between 1880 and 1890 there was a rapid development of the electric motor for commercial uses. The series motor, in which the whole current passes in direct connection through the field and the armature, and in which therefore a varying load on the motor in a constant-potential circuit would produce changes in revolution from a possibly excessive speed under no load to an undesirable slowness under full load was found serviceable in cases where the load was constant, or where, the load being variable, an attendant was continuously at hand to adjust the current to the load. For factory use, where machines and tools, to perform their functions properly, are required to run at a fixed speed irrespective of changes of work from moment to moment, something steadier was sought, and it was found in the shunt-wound motor in a constant-potential circuit, in which the current is divided before entering the motor, the major portion passing through the armature and the minor through the field. At first the shunt-wound motors were made with high-resistance armatures to prevent their being burned out when the current was turned on and before the motor had developed its counter electric pressure to protect itself. These motors came nearer the mark of self-regulation than the series kind because the field, being in shunt, was independent of the varying stress on the armature; but the high resistance in the armature, the rotational energy of the field magnet remaining constant, left the speed somewhat subject to variations of the load. At this state of development several inventors gave their attention to devising governors or regulators. It was next discovered that a shunt-wound motor with an armature of the least practicable resistance was virtually self-regulating under varying loads. But this type was especially susceptible to being burned out at starting and before the motor had acquired a protective speed. So the starting box, or hand switch, was inserted in the armature circuit, and its sufficient resistance to the current could be cut out gradually by moving the switch arm from one contact point to another, until, when the current was fully on, the motor would be in a state of self-defense.

The self-regulating shunt-wound motor with starting box had been in commercial use some considerable time before Blades entered the field. It was attended with these dangers: the accidental opening of the field circuit, which would likely be destructive of the armature; the leaving of the switch-arm on an intermediate contact point, which would destroy the starting box, as its resistance coils were not intended nor adapted to be left in circuit, and the failure to return the switch-arm to its initial position, whereby, if the motor should stop on account of the current being cut off by the opening of a switch at the factory or at the central station, or by the blowing out of a fuse, or diminished by a sufficient drop of potential, and if the current were then turned on or the potential restored, the low-resistance armature would be burned out. Manufacturers, with whom were associated some of the greatest inventors and students in the electrical world, well understood and warned their customers against these perils.

The structure portrayed by the patent in suit not only protects the motor and the starting box from all the aforestated dangers, but affords additional benefits by effecting an instantaneous release when the field circuit is broken and a delayed release when the current supply is cut off. This device won immediate recognition and went into general commercial use.

The bringing together, within the mental vision, of these manifold difficulties and the means for overcoming them all and conferring new advantages we think evinced a high degree of invention, unless the prior art showed the way and left no room for initiative. To give the results of our examination of the prior art we think it unnecessary to detail the structures of the reference patents. The shunt-wound motor with low-resistance armature and hand switch or starting box was old. The electro-magnet dated back to the beginning of the electric art. Springs of one sort or another had been employed in various arts, including the electrical.

In regulators for electric generators and in governors for motors with high-resistance armatures, magnets and springs had been balanced against each other on the contact arms of resistance coils that were left permanently in circuit, so that a loss of current, by diminishing the energy of the magnet, would permit the spring to pull the contact arm to a point of less resistance, and vice versa, thus producing a floating switch. The inventors of these devices had not in mind the problem Blades solved, for it had not yet arisen; and the means they applied to their problems will not obviate the perils that were found to attend the shunt-wound motor with low-resistance armature and manual starting box.

In cases where it was desired to start a motor at a distant point without an attendant a pulling magnet, eneregized when the current was turned on at the central station, was used to pull, as would the hand of a present operator, the contact arm of the starting box from its off to its on position. In these automatic starters no spring is opposed to the magnet. In automatic starters, as such, an opposed spring would be worse than useless: for, the end to be attained being the pulling of the switch-arm from its off to its on position, any force that resists is counter to the object in view. These inventors, therefore, designedly left out the spring from their combinations as being an element hostile to the accomplishment of their purpose. And if a skilled mechanic, desirous of adding the protective functions of the patent in suit to the function of the automatic starter, had opposed a spring to the pulling magnet, in the field circuit, he would have found the magnet, to be strong enough to pull the switch-arm through its arc against the resistance of the spring, would draw off so much energy from the field that the armature would speed up to a degree that would make the motor commercially inoperative. Not only are starting and stopping opposite operations, but just as there is a material difference between the field magnet and the pulling magnet of the automatic starter (though magnets are magnets), so we think there is a vital distinction between the pulling magnet of the automatic starter and the retaining magnet of the patent in suit.

Dangers to a motor in operation may rise from an excessive current. The fuse is the ordinary protective device. Certain inventors employed pulling magnets, put into action by the excess of current, to shut down the motor. These overpressure protective devices are inert in the presence of the dangers that threaten from underpressure or no pressure. Their

devisers were considering a different problem and the structures themselves are incapable of filling the office of the instrument described in appellees' patent.

One inventor, preceding Blades, addressed his attention to the dangers to a self-regulating shunt-wound motor in a constant-potential circuit that come from a cessation or material loss of current, but missed the mark by directing his efforts to the wrong point, the main switch. As we read the Shepardson patent, it contains no hint of the Blades structure.

The prior art contains no equivalent combination. We think that there was patentable novelty in the application of an underload-retaining magnet to a manual starting box in the location of such a magnet in the field circuit of a self-regulating shunt-wound motor, and in adjusting it to act in that location with the starting box located in the armature circuit we find nothing in the prior art to militate against the allowance of the claims in suit.

Appellants insist that these claims, which limit the location of the magnet to the field circuit of a shunt-wound motor, must fall by reason of amendments made while the application was pending. The original specifications located the magnet "preferably in the field circuit." The field circuit, as distinguished from the armature circuit, implies the shunt-wound motor. No matter, therefore, how broad the applicant made the original description of his invention, the narrowing of the specification and the limitation of the claims in suit left the invention as now claimed within the preferred range of the original specification.

We think the record contains sufficient evidence of infringement. The decree is affirmed.

Evansville Telephone Situation.

A ruling has been made by Judge Anderson of the United States court at Indianapolis, by which he dismissed the injunction suit of the Cumberland Telephone Company against the city of Evansville. His ruling is to the effect that the city has a right to order the removal of all poles and wires and other property of the company from the streets and alleys of Evansville. Judge Anderson held that a corporation has no power to sell its property and its business unless the franchise and ordinance under which it is operating specifically provides for its sale and transfer.

It was shown that the Evansville telephone exchange was granted a franchise by the city in December, 1882. In July of the following year its business and property were purchased by the Cumberland company, and the latter company has carried on the business since that time. The City Council passed a resolution declaring the company to be operating without a franchise and ordered the company to remove its poles from the streets within 90 days under penalty of having them removed at the company's expense.

In its complaint for injunction, the telephone company affirmed its right to use the streets and alleys of the city and that the city's action was contrary to public policy. Judge Anderson held that the Cumberland company has no rights by assignment of the Evansville telephone exchange, and no rights under the ordinance of 1882, which it can ask the court to protect. Hence, the restraining order is dissolved.

The decision is regarded with great favor by the Independent telephone men. The new Municipal Telephone Company, recently organized and granted a franchise, will at once occupy the field. It is possible that the Municipal company may offer to buy the Cumberland's plant, as the city cannot well do without service during the time required to install a new plant. The Cumberland company greatly improved its plant last summer. It constructed a new exchange building and installed a new switchboard and made other improvements.

Telephone Fight Predicted.

The report is prevalent in Boston financial circles, and has gone out through the daily papers to the effect that the Central Union Telephone Company, whose headquarters have just been moved from Chicago to Indianapolis, is to be used to fight the Independent telephone companies in the Middle West, and, if possible, prevent them from getting into Chicago. This promises to be an expensive campaign, according to Boston advices, and may result in bond issues. An official of the American Telephone and Telegraph Company is quoted as saying: "All the subsidiary companies with their reports sent to General Thomas Sherwin, auditor, will estimate the cost of extensions in 1904, showing amount of money required. Based on the winter orders for poles and cables already placed, the extensions will exceed those of 1903 on all lines, and at least $30,000,000 will be asked for, although the home office may cut this amount, on account of the money stringency, to $25,000,000."

The North American Telephone Company has just completed the Denison-Wagoner division of its line, connecting Denison, Texas, with Wagoner, I. T. This company has 157 exchanges in North Texas and Indian Territory. The company is building a toll line north to Joplin, from whence it expects to build to Kansas City and St. Louis.

Telephone News from the Northwest.

The Citizens' Telephone Company of Mankato, Minn., is constructing a line to St. Clair, which will be completed this month.

The Wisconsin Telephone Company is installing a central-energy switchboard at Chippewa Falls, Wis.

The Dakota Central Telephone Company has completed a new line into Groton, S. D., for the use of farmers.

The St. Cloud (Minn.) office of the Northwestern Telephone Exchange Company averages 4,558 calls a day, exclusive of long-distance business.

Patrons of the telephone exchange of Grand Forks, N. D., sent a Christmas purse of $80 to the telephone operators, there being 16 to share it.

The local telephone company at Kimball, S. D., constructed its system last April, and has just declared a dividend of two per cent. The company has no indebtedness.

The Iowa Telephone Company will begin extensive improvements at Dubuque in the spring. A new exchange building will be erected and an underground system installed, requiring an expenditure of $125,000.

The Iowa Telephone Company will move its general offices from Davenport to Des Moines at once.

The Exline (Iowa) Telephone Company has purchased a large amount of wire which it will use in the construction of a new line.

A meeting of the managers of most of the leading telephone companies of Iowa was held recently for the purpose of discussing the establishment of a mutual telephone clearing house and toll-line checking bureau in Des Moines.

The Iowa Telephone Company will build a new exchange building at Waterloo, Iowa, and make other improvements costing about $100,000. The United States Telephone Company will also build a new exchange building at Waterloo.

A rural telephone line is projected into Edmore, N. D.

The Dakota Central Telephone Company will make extensive improvements to its long-distance lines in South Dakota.

The annual report of the Winona (Minn.) Telephone Company shows a total of 942 instruments in use. Numerous extensions and improvements are planned for the coming season.

The new quarterly directory of the Twin City Telephone Company for Minneapolis and St. Paul shows a gratifying growth, especially in the residence connections, which the company attributes to its having no party lines and is therefore free from the annoyances which accompany such service. The company will make many extensions in its toll lines.

The Home Telephone Company of Ashland, Wis., has declared its third dividend of three per cent. during the last year, making a total of nine per cent. paid for the year. R.

Indiana Telephone Items.

The telephone companies operating in Indiana had a prosperous year. Twenty-seven new companies were incorporated, many new exchanges and branch exchanges established and hundreds of miles of extensions and toll lines erected. The general conditions are very satisfactory and future requirements will be taken care of promptly. It is said that there is a telephone in service for every 50 inhabitants. Beginning with the new year, a number of the railway lines substituted telephone for telegraphic orders in the operating of trains. The interurban lines are all operated by telephonic orders. The Northwestern Traction Company completed its new long-distance system last week. It is said to be the most elaborate and perfect system now in use by any interurban in the state.

The Consolidated Telephone Company of Danville and its farmer patrons are at outs because of a proposed raise of 25 cents a month in telephone rents. The company operates the exchanges at Danville, Plainfield, North Salem and Pittsburg, and is owned by a corporation of which Dr. Amos Carter of Plainfield is president and George D. Foot, general manager. A full metallic service has just been completed, and excellent service is the result. The managers have announced that, with the beginning of the new year, the rates for residence and country telephones would be $1 a month. This was accepted by the town people, but the farmers rebelled and pledged themselves that in case the company refused them service at the old rate they would organize a new company and establish a plant of their own. Since the Consolidated company took charge of the plant it has spent over $18,000 in putting in full-metallic circuits, and it is asserted that actual loss is experienced at a 75-cent rate. Since some of the more conservative farmers have investigated the cost of putting in a new system, it is believed the advance will be accepted.

A telephone pole in Newcastle is the object of contention between the telephone company and the Indianapolis and Eastern Traction Company. On account of its nearness to the line of the traction company cars cannot run past it. Passengers are, therefore, compelled to walk to and from the center of the city to the car. The citizens generally side with the traction company in its contention that the pole must be moved, but the council sides with the telephone company in its position that the pole must remain where it is.

General Manager Bromley of the Delaware and Madison Counties Telephone Company, with headquarters at Muncie, states that his company has had a very successful year and is now operating over 3,100 telephones. The company has expended over $80,000 during 1903 in extensions of toll lines and in the exchanges, and the future of the company looks bright. F.

Southeastern Telephone Developments.

A recent fire damaged the Southern Bell telephone exchange at Atlanta, Ga., to the extent of $20,000. The work of repairing the wrecked portion of the switchboard is now well under way.

The stockholders of the Capital City Telephone Company of Raleigh, N. C., a concern formed to take charge of the consolidated Bell and Interstate interests, have met and elected W. T. Gentry, formerly with the Bell company in Atlanta, president and L. A. Carr vice-president. The new company now controls all but two of the former Independent systems in North Carolina. It is understood that the system in Raleigh will be placed underground. The new concern also made a futile attempt to take in the Raleigh Telephone Company.

After a long fight over the question of a charter for an Independent telephone company in Chattanooga, Tenn., the matter has just been settled by the signing of a contract by the East Tennessee and Hamilton Telephone Companies, fixing the charges in the city and suburbs by specifying the rates to be charged within various limits.

The East Tennessee Telephone Company of Bristol, Va., has been chartered with a capital of $10,000. J. C. Symms is president.

The Bell company has just completed a long-distance line from Winston, N. C., to Mt. Airy, N. C., and the wires are being strung in the latter town. L.

Michigan Telephone Matters.

The question of whether subscribers to the stock of the Co-operative Telephone Company of Detroit may be held for further installments, will go to the Supreme Court. That final decision may be had as soon as possible a test will be heard on January 31st by the four justices of the peace, sitting en banc. An appeal from their decision will be heard by Judge Hosmer at an early date thereafter, and the case then carried on to the Supreme Court.

The telephone exchange of Mt. Clemens was removed to the Slush Building the first of the year, where fine quarters have been secured, Mr. Grantham, the local manager, having gotten a lease of the second floor of the block for a term of years. The present instruments will be replaced with more modern equipment. W.

Third-rail Extensions in Pennsylvania.

It is reported that the controlling interest in the Lackawanna and Wyoming Valley electric railway has passed into the hands of the Westinghouse Electric and Manufacturing Company. An illustrated description of this interesting road, 12 miles of which, between Scranton and Pittston, Pa., is already in operation, was given in the Western Electrician of August 29, 1903. The purchase price is given at about $6,000,000 and the object of the Westinghouse company in getting control is for the purpose of making practical demonstrations of several operating devices and of illustrating the utility of electric railroads in the transportation of freight.

It is also stated that the Lehigh Valley company is planning the purchase of the Binghamton and Southern railroad for the purpose of running it as a third-rail electric road between Dushore, Pa., and Binghamton, N. Y., and that the company will equip its branch from Harvey's Lake to Wilkesbarre with the third-rail system, and run frequent cars on it during the summer.

GENERAL TELEPHONE NEWS.

The Kansas Telephone and Electric Company is rebuilding its exchange at Parsons.

The Carbondale Telephone Company of Carbondale, Kan., has been chartered with a capital of $2,000.

The Belleville Telephone Company of Belleville, Kan., has received a state charter fixing its capital stock at $25,000.

Joseph Renefroe of Opelika, Ala., has been selected as manager of the new exchange to be put in at Columbus, Ga., at an early date.

J. A. Cullen has been transferred from Richmond, Va., to Bessemer, Ala., where he takes charge of the Bell telephone plant, which has been greatly increased of late.

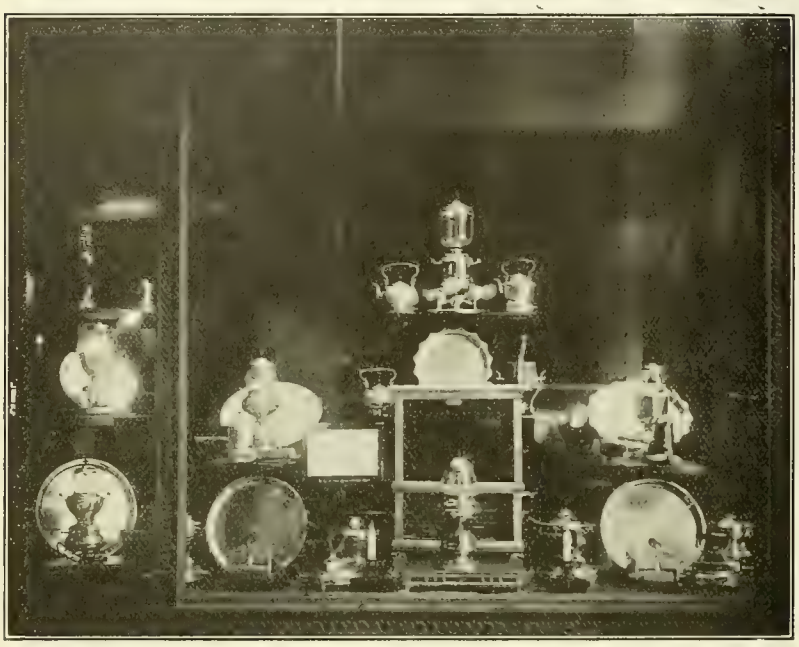
A. W. Fisher has resigned as manager of the Waupaca (Wis.) office of the Wisconsin Telephone Company. He is succeeded by E. T. Powell of Stevens Point, Wis.

The Missouri and Kansas Telephone Company is stringing an additional copper circuit from Wellington to Harper, to be used as a through circuit for the business of Western Kansas and Oklahoma. A new toll line is under construction from South Haven, Kan., to Gueda Springs, via Portland.

Electric Heating and Cooking Utensils.

A novel and efficient method of electric heating and cooking consists in equipping apparatus of this character with an electric-heating unit, which can be easily removed in case it should become necessary. One decided departure consists in the direct application of these units to the cooking and heating apparatus, so that cooking pots and dishes may be constructed in such a way as to obviate the necessity of using a stove. The method employed to accomplish this result was described in detail in the Western Electrician for May 23, 1903, page 412. The Prometheus Electric Company of New York city, which has put this system on the market in this country, has recently established a number of agencies throughout the country, all of which are meeting with success, it is said.

One of these agents is R. H. Macy & Co. of New York, and the accompanying illustration shows an interesting display of electric-heating and cooking apparatus in one of the large Macy show windows. Recently a number of new electric-heating appliances have been perfected, such as cigar branders, paste heaters, can solderers, vulcanizers, etc. All of these have been successful on account of the ease with which the heating units can be applied and the high efficiency of this method of application.



ELECTRIC HEATING AND COOKING UTENSILS.

Electricity and Life.

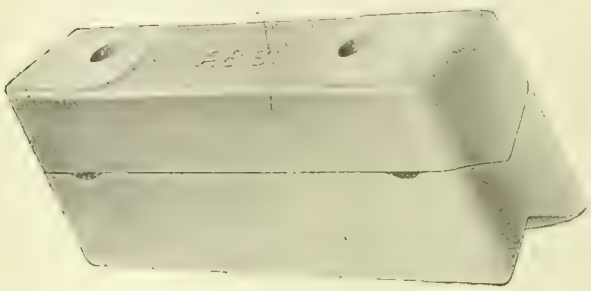
In a recent article by Albert P. Mathews, associate professor of physiology at the University of Chicago, in The World Today, entitled "Will Living Matter Be Formed Artificially?" are the following interesting paragraphs:

"There is good reason for believing that the chemical as well as the physical changes of protoplasm are produced by alterations in electrical conditions, and that the remarkable chemical powers of protoplasm shown in its syntheses and decompositions are in reality electrical, and resemble those produced in electrolysis by the action of a current. When, for example, an electric charge is removed from an organic compound, it decomposes and new compounds arise. We can, therefore, say that those substances will poison protoplasm which give up or part with their charges easily. Substances which give up their charges with especial ease are mercury and silver, which are accordingly very poisonous. We are even able, from electrical data recently obtained, to calculate approximately for any salt how much will be necessary to kill a given protoplasm in a given time.

"It may fairly be said, then, that the forces of protoplasm are electrical, in large part at least, and that they give rise under these special conditions to the phenomena which constitute life. This is, of course, quite different from saying that electricity is life. Life is a name we give to a group of phenomena; while electricity plays a part in producing these, it is not itself the phenomena."

New Corner Cleat.

Something new in the line of cleats has been placed on the market by Pass & Seymour of Solvay, N. Y. It is known as a corner cleat, and a glance at the accompanying cut will show its usefulness in carrying wires around beams and corners. In the past it has been customary to use two pairs of the regular cleats for this work, but by the use of the corner cleat only one pair is necessary, resulting in a neater job as well as a saving in time, labor and material.



NEW CORNER CLEAT.

Union Engineering Building.[1]

At the annual meeting of the society, held in New York city, December 1st-4th, a report was called for from the representative of the society on the joint committee intrusted with the details of Mr. Andrew Carnegie's proposed gift of a building for the needs of the engineering societies.

Mr. Charles Wallace Hunt, as such representative, presented a verbal report, from which the following information is derived:

It will be recalled that in advance of the Saratoga meeting an announcement was made to the society, which will be found at page 870, Volume XXIV., of the Transactions. It mentioned the purpose of Mr. Carnegie's donation of one million dollars, which should bring the libraries, assembly-halls, offices and meeting rooms of the societies of engineers into one great building, which, while ample in size for their individual needs, should arrange for their convenience as respects business and professional uses. It was proposed, in addition, that the building should give adequate accommodation for such other technical, scientific and engineering bodies as might require the use of a properly equipped auditorium.

During the intervals between that report and the present meeting, the joint committee of fifteen has been in conference on the details referred to it, and has appointed an executive committee of five to facilitate the work of the general committee.

The sub-committee of the executive committee has been engaged in the preparation of the material which might be necessary to submit the needs of these societies to a competition of architects, as to the structural details of the building. A committee on organization has been appointed, consisting of Messrs. A. R. Ledoux, Charles Wallace Hunt and S. S. Wheeler, and their recommendations to the joint committee have been adopted and the organization committee instructed to take the necessary preliminary steps to secure the legislative action for which their report called.

The full report of the committee on organization is as follows:

"The undersigned [names given above are appended] were appointed a special committee at a meeting of the executive committee of the Union Engineers' Building Association, on July 9, 1903, and were instructed 'to propose a plan of organization for the bodies exclusive of the Engineers' Club, which are to participate in the gift.' In transmitting instructions to this committee, the chairman of the executive committee summarized our duties, as he understood them, as follows:

"1. To suggest an organization to hold title to the land and building.

"2. A method of superintending and administering the building after completion.

"3. Provision for granting the use of parts of the building to other organizations whose objects and work may be of suitable character and which may contribute to the maintenance of the building.

"4. Provision for contingencies, such as the withdrawal of one of the societies, or the failure on the part of anyone properly to carry out its obligations.

"The committee was authorized to consult legal counsel. It has held several meetings and has informally consulted members of the American Society of Civil Engineers, and others interested.

"After having informally and tentatively approved suggestions formulated by one of its members, Mr. Hunt, the same were submitted to the law firm of Butler, Notman, Joline & Mynderse, from whom a written opinion was obtained.

"Having considered this legal advice and taken note of all suggestions received, the committee unanimously advises as follows:

"1. The total amount offered by Mr. Carnegie shall be administered as two gifts—one to the engineering societies and the other to the Engineers' Club—each to be held and administered independent of the other. The allocation of the fund to be made at once, but the buildings to be designed and erected as one operation; thereafter the respective titles and administrations to be entirely independent.

"2. The property represented by land, buildings and equipment of the engineering societies shall be held and administered by an executive corporate body, preferably under a special charter, to be obtained from the state of New York, each of the constituent societies being entitled to name from its membership three persons to act as incorporators and thereafter as directors.

"3. Each society annually to elect or appoint, as their by-laws may prescribe, one of their voting members to serve on the board of directors of the executive corporation for a term of three years; a vacancy in said board to be filled by an appointment made by the society, the retirement of whose representative causes the vacancy.

"4. The land and property being held for the societies by an executive corporation, the said corporation may, to pay for the land acquired, issue certificates of indebtedness or bonds bearing interest at four per cent., and redeemable on six months' notice, the buildings being a gift from Mr. Carnegie.

"5. Each of the constituent societies may purchase and hold an equal amount in value of the said bonds or certificates, but the board of directors of the executive corporation may authorize any of the constituent societies to hold an additional amount; that is, in excess of its portion, but such excess shall be subject to recall at its par value at any time that the directors of the executive corporation may so order, to the end that each society shall have an equal interest in the property of the corporation if it so desires.

"The certificates held by each society shall be inalienable unless they are offered to the executive corporation at their par value, and such tender shall not be accepted by the board of directors within one year thereafter.

"6. The property of the executive corporation shall be used perpetually as a meeting place and headquarters for the constituent societies, and for such other scientific associations as may be temporarily admitted by the consent of the board of directors of the executive corporation. Such associations may pay a pro rata share in the expenses of the headquarters, but no profit shall be made from such use.

"7. Each of the participating societies shall be entitled to rooms and space in the property adequate to its need, paying its share of the running expenses in accordance with the amount of space occupied, said space to be assigned and a proper assessment therefor determined by the board of directors of the executive corporation.

"8. The excess of receipts over expenditures, if any, shall be used for reducing the subsequent contribution of the several societies for maintaining the building, and for the advancing of engineering arts and science, by and through the participating constituent associations. No dividends shall be declared or profits divided, but a reasonable repair and rebuilding fund may be established.

"9. If the income of the executive corporation shall be less than the expenditure, the deficiency shall be made good by an assessment on each of the constituent societies, so allocated as to be in proportion to the number of voting members of each society.

"An excess of receipts over expenditures may be allocated to the societies in like manner to reduce their annual assessment.

"10. Should any of the constituent societies fail or refuse to appoint directors, the remaining members of the board of the executive corporation shall administer the property with all the force and effect as though the board contained its full quota of members.

"11. Finally, your committee, in offering the above suggestions, has had in mind the setting aside of the money used for a building for the Engineers' Club, so that on the completion of the said building, the relations of the club and of the engineering societies will terminate. Thenceforward, the constituent societies are to carry through the executive corporation the administration of the building and its accessories, leaving the scientific, professional, in-

1. This is the "second circular" to the American Society of Mechanical Engineers from a committee consisting of James M. Dodge, C. W. Hunt and F. R. Hutton.

tellectual and financial activity in each organization entirely independent of the others, and free to develop to any extent and along any line that may be determined each for itself.

"The details of the superintendence and administration of the buildings can best be considered after the organization of the proposed executive corporation through the procuring of a special charter."

It may be mentioned that when the sub-committee on building plans took up the consideration of the necessary areas it developed at once that the cost of the building which would be required for the accommodation of the engineering societies, on 125 feet front on Thirty-ninth Street, and the Engineers' Club on a 50-foot front on Fortieth Street, would exceed the preliminary or tentative figure mentioned by Mr. Carnegie in his official letter of gift.

When this conclusion was reached, a special committee was appointed to visit Mr. Carnegie and talk the matter over with him. He made it evident that it was his desire and intention to erect a building which should be a monument to the engineering profession, and that it was his purpose to make this building adequate, and the question of cost was in his mind secondary to the attaining of the object dear to his heart, which was the bringing together of all classes of engineers into a building in which they could co-operate for the common purpose of the profession.

It may be desirable to repeat some of the statements of the previous announcement, that the location of the proposed building, as given in the sketch plan herewith, is one of the most desirable ones in the city of New York.

The New York Public Library Building occupies the entire eastern frontage of the block between Fortieth and Forty-second Streets on Fifth Avenue, while to the westward is the open square known as Byrant Park.

It will be conveniently accessible from the terminals of the New York, New Haven and Hartford Railroad, and the New York Central and Hudson River Railroad at Forty-second Street, at Park and Madison Avenues, and from the Pennsylvania terminals coming in from the west, at Thirty-third Street and Seventh Avenue. The elevated railway at Sixth Avenue has a station at Forty-second Street, and the Third Avenue Elevated, Forty-second Street and Park Avenue. The junction of the Rapid Transit underground lines at Forty-third Street and Broadway will make this station an important express point for trains both from downtown and from the north.

Convenient surface lines, both up and down town, intersect at Forty-second Street. The hotel and theater district of the city are centering more and more around this particular region.

The committee will be very glad to receive from members of the society suggestions which may be helpful in the matter of interior arrangement or detailed requirement of the proposed building, to the end that it may be in every respect thoroughly adapted for the needs of the societies which are to occupy it.

The committee would report that for the three societies which have so far signified their purpose to make use of the proposed building, the requirement of floor space in square feet, outside of the general rooms for auditoriums and library needs, is as follows:

Purpose.	Electrical.	Mechanical.	Mining.
Reception room	600	800	620
Editorial room	400	700	360
Secretary or Assistant	400	300	360
Counting room	600	600	720
Accountant -Stenographers	400	900	700
Board and Committee	1,000	600	760
Stationary and Transactions	1,200	1,200	1,000
Closets	400	400	400
Sundries	200	400	600
	5,200	5,500	5,120

The Society of Civil Engineers has issued a circular to its members reporting the condition of affairs at the present time and their probable need for 9,000 square feet of floor space, but definite action cannot be taken by that society until a letter-ballot is had and until after the annual meeting of the society in January.

In the letter-ballot taken on the question of the necessary changes in their by-laws by the American Institute of Mining Engineers, the vote showed over 1,600 in favor of the change, and only 11 in opposition to it, which is regarded as showing an overwhelming sentiment in favor of the engineering building.

It may be further of advantage to report that the action in the joint committee on all questions which have been submitted to it has been unanimous, and that throughout, in all decisions, the joint committee has had the benefit of the counsel, advice and co-operation of the representatives appointed by the American Society of Civil Engineers, who have sat with the committee in all its deliberations.

Among the Christmas gifts received by George J. Gould, Jr., was a perfectly appointed miniature railway train. It was imported from Germany expressly for young Mr. Gould at a cost of $500. The train and its equipment is an exact reproduction of a first-class Pullman train. It consists of a locomotive and tender and a vestibule train. It runs on steel rails and is equipped with an automatic-brake system and an electric-lighting plant. The locomotive is large enough so that the owner may seat himself in the cab. The fuel used is alcohol.

CORRESPONDENCE.

New York.

New York, January 2.—The gas and electric-lighting interests of the city have served notice upon Commissioner Robert Grier Monroe, head of the Department of Water Supply, Gas and Electricity, that they would fight to a finish any attempt to reduce the lighting rates they offered when their bids were submitted a year ago. In making their bids the lighting companies stuck to their old rate of $17.50 a year for each gas light in Manhattan and $146 for each electric arc light. Commissioner Monroe reported to the Board of Estimates that the bids were too high and recommended the establishment of municipal lighting plants. Not until December 4th, last, did the board reject the bids, and in the meantime the companies had been furnishing light and had refused part payment, offered by Controller Grout, who proffered them 60 per cent. on electric bills and 80 per cent. on gas bills, with the effect that $1,250,000 has accumulated in the city treasury for such payments. To protect their interests the companies have filed a motion in mandamus proceedings to compel Commissioner Monroe to execute the contracts, which he has held on his desk for nearly a year, at the figures contained in the bids. The following-named gas and electric companies are involved: The Standard, the Northern Union, the Central Union, the New Amsterdam, the Brooklyn Union, the Consolidated Gas Companies, the New York Edison Electric Light Company, the United Electric Light and Power Company and the Brush Illuminating Company.

The popularity of the telephone as a means of communication is shown by the fact that during the last three years the number of instruments in use in Manhattan and the Bronx has increased by 76,000. The total number now in use in the two boroughs is 132,000.

A new automatic fire-alarm system has been put into use on Staten Island. Fire-alarm boxes have been established all over the island at a cost of $35,000.

Property owners of Queens and Nassau Counties at a public hearing before Mayor Low approved the franchise granted by the Board of Aldermen to permit the New York and Long Island Traction Company to extend its tracks through Queens County and to the terminal of the Brooklyn elevated lines. The grant covers about 15 additional miles of track within the city limits, practically all in Queens County. The only opposition came from the counsel for the New York and North Shore Railway Company, which operates over one mile of streets included in the grant to the other company.

Contractor McDonald and the Rapid Transit Commission took Mayor McClellan and party through the new rapid-transit subway yesterday on hand cars. At the end of the line luncheon was served and on the return trip the members of the party were dropped at convenient stations. Chief Engineer Parsons accompanied the party and explained the details of the progress in the work.

The Hudson River Electric Power Company of Queensbury, which was incorporated last week with a capital of $1,000,000, proposes to construct an artificial lake as large as Lake George, in which enough water can be stored to maintain the Hudson River at a normal height during the low-water period. The company has for its purpose the development of the power and resources of the fall of the Upper Hudson and for the distribution of electric power as far west as Utica and Syracuse and as far south as Hudson. It is expected that the company just incorporated will build the large storage reservoir in the Sacondaga Valley, for which the engineers of the Hudson River Water Power Company have been planning for the last two years. The dam and power station will be built at Conklingville, and something like 600 pieces of property will be flooded as well as several small hamlets. The legal department of the company has been searching titles and getting options on property for several years, and it is anticipated that by the time permission is asked of the Legislature to construct the dam the company will own every piece of property to be flooded. The directors are E. J. West, Bryce E. Morrow, J. D. Hilliard, Jr., C. M. Doolittle and L. W. Guernsey, all of Glens Falls.

The Interurban Street Railway Company announces that the upper West Side of Brooklyn is soon to have direct connection with the Brooklyn Bridge by trolley. To connect the West Side electric lines with the bridge terminal it was only necessary to put in electrical equipment between West Broadway and Center Street on Canal Street. The switch at Center Street has been completed, and only a small part of the track remains to be equipped.

The Western Electric Company announces the opening of a new show room at its downtown branch, 22 Thames Street. O.

New England.

Boston, January 2.—The selectmen of the town of Dedham and the officials of the Norfolk Western Street Railway Company are at loggerheads over certain amounts claimed to be due the town from the railway company on street-watering and other accounts provided for in the franchise. On December 26th the selectmen held conferences with the people supplying electrical power to the railway company and secured the discontinuance thereof. The road was tied up for several hours, and finally secured power from another source. An injunction was applied for, and is in force until January 11th, restraining the Dedham authorities from interfering again in such manner with the operating of the road. An important point in law, relative to the discommoding of the traveling public, has been raised, and the matter is the subject of much discussion in the section of Massachusetts where the affair occurred.

An important consolidation has been authorized by the Massachusetts railroad commissioners, who have granted the petition of the Newton Street Railway Company for the right to acquire, by purchase, the Commonwealth Street Railway Company and issue new stock to the amount of $292,000 on account thereof; also to purchase the Wellesley Street Railway Company and issue $115,000 additional stock to pay for the acquisition. These sales of the railways named have a direct bearing upon the plans of the Boston and Suburban Electric Company, which is working toward a through line from Boston to Worcester and other points at the heart of the commonwealth, in competition with the Boston and Worcester company.

A jury in the Superior Court at Boston gave the Boston Safe Deposit and Trust Company a verdict of about one-half what was sued for, in the company's damage case against the Boston Elevated company. This case was the first affecting the matter of depreciation of values on Washington Street, by reason of the noise and other annoyances complained of in connection with the operation of the road, and there was more interest in the result than in previous cases because Washington Street is the principal thoroughfare of the city. The award was $9,938.66.

Settlement has been begun with the victims of the Hudson, Pelham and Salem Electric Railway Company's disaster of last summer. Claims in Nashua, N. H., amounting to about $20,000, will have to be met and adjusted. Fred B. Collette, whose son Gabriel was instantly killed, has received $4,000, and the administrator of the estate of Charles H. Gilbert, who was also killed, has accepted a like sum.

Another chapter in the Worcester and Southbridge Street Railway Company's financial history was added to the record late in the month of December, when Frank D. Perry of Worcester, a member of the Bay State Construction Company, which built the road, filed a voluntary petition in bankruptcy in the United States District Court. Perry was one of the indorsers of the notes floated in the name of the company, prior to its passage into the hands of receivers. Inasmuch as he is nominally liable for their amount, his schedule of liabilities foots up $962,652.28, one of the largest amounts ever recorded against an individual debtor in that court. There are other indorsers who will have to go into insolvency also, if the claims against them are pressed to a settlement, as seems likely, although extraordinary efforts have been put forth looking to a reorganization of the property.

Stockholders of the Edison Electric Illuminating Company have voted an increase in the capital stock to the extent of 9,500 additional shares at $200 per share, as authorized by the State Board of Railroad Commissioners, rights to expire January 15, 1904.

The Fair Haven and Westville Street Railway Company of Connecticut contemplates the erection of a car barn, with capacity for 100 cars, and improvements and additions planned for will cost about $100,000.

The Ware Electric Company of Ware, Mass., has voted to increase its capital stock to $40,000, and is proceeding rapidly with the construction of its power house.

The Amherst and Sunderland Street Railway Company has asked the Massachusetts railroad commissioners to authorize an issue of $117,000 bonds.

At North Adams, in the recent municipal election, railway and telephone-franchise matters were incidental issues, and it is understood that a majority of the incoming members of the city government are in favor of encouraging the establishment of an Independent telephone exchange. B.

Ohio.

Cleveland, January 2.—Two ordinances were introduced in the City Council at Cleveland a few days ago, tending to carry the three-cent-fare idea into execution. One was to the effect that the franchise for the line on Woodland Avenue, which expires on September 10, 1904, be given to the new company, which proposes to operate on a three-cent-fare basis, and that the same action be taken in regard to the Central Avenue line, the franchise expiring on March 25, 1905. The other provides that fares on street-car lines in the city be three cents, except where otherwise provided. Mayor Johnson is still pushing this matter, and it is uncertain as to what the result will be. Public sentiment has been ameliorated since the fares were reduced to six tickets for 25 cents, just a year ago.

It is believed that the Ohio River and Columbus line, between Sardinia and Ripley, will be completed within a short time, if weather conditions permit work. Wagenhals & Cavenaugh of Cincinnati are doing the construction work.

The Cincinnati, Newport and Covington Traction Company has declared a dividend of 1½ per cent. for the last quarter of 1903.

Judge Ferris has decided the contention between the Cincinnati, Milford and Loveland Traction Company and the Cincinnati and Columbus Traction Company, over the bridge at Milford, in such a way

that both roads have a right to use it. Manager Philip C. Swing of the latter road has asked the commissioners of Hamilton County for additional time to complete the reconstruction of the bridge, which requires strengthening, in order to support the weight of cars passing over it.

The Circuit Court at Cincinnati has held the law valid which requires corporations to pay the jury fees in condemnation suits. It was claimed by the Cincinnati, Milford and Loveland Traction Company that the law discriminated against corporations in this respect, but the court said that, owing to the power given them to condemn property for their own use, it is just that they should pay the costs they thus create.

A new schedule has been prepared for the Cincinnati, Lawrenceburg and Aurora line, beginning January 4th. From six to nine o'clock a. m. cars will be run every half hour and from 9 a. m. to 3 p. m. an hourly train will be operated, after which half-hour cars will be again run until six o'clock in the evening. This schedule will be maintained for the remainder of the winter and early spring, when it will be changed to comply with the needs of the season. C.

Indiana.

Indianapolis, January 2.—The year 1903 will long be remembered as interurban year for Indiana. The Indianapolis list of interurban roads was increased from seven to 10 and the mileage increased from 273 to 524. This does not include connections. The Crawfordsville extension of the Indianapolis and Northwestern, the Indianapolis and Cincinnati and the Consolidated Traction Company's lines, all now under construction and well nigh completed, will increase Indianapolis' direct mileage at least 200 miles in a short time. Three new roads into the city, projected for 1904, may add materially to this mileage.

A notable feature for 1903 was the connection of the Indiana and Ohio lines through Richmond and Dayton. This will soon be extended to Columbus, Ohio, and thence to Zanesville, a distance of 250 miles from Indianapolis. The introduction of the buffet car and of the Holland palace sleeping car was not only an advance feature in the history of Indiana interurbans, but it marked an epoch in the history of transportation facilities, as it enters the interurban as a competitor of steam roads for long-distance as well as local travel.

During the closing months the first interurban was opened in Southeastern Indiana, connecting Evansville and Princeton. The extensions of this line will ultimately reach Vincennes and Terre Haute, and thence to Indianapolis. Short lines have been completed in Northern and in Eastern Indiana and the interurban spirit has been awakened all over the state. East and west lines are promoted, trunk lines to Louisville and Chicago are on the map, and, all together, remarkable progress was made during the year.

The interurban lines bring 153 cars into Indianapolis every day and take an equal number out, exclusive of the freight cars. It is estimated that the number of people brought into and taken out of Indianapolis during the year was 2,250,000.

The gross earnings of all the interurbans running into Indianapolis in 1903, approximately, was $1,850,000 for the year. This is a total business over 524 miles of road. Managers place the operating expenses at 45 to 50 per cent. The total outstanding capitalization of these roads and the three roads now building is $54,005,000. The freight business done by these interurban lines for the year is estimated at $154,000. The effect of the interurban traffic was noticeable in all lines of business conducted in the cities connected. The roads now in operation, together with their connections, have added to Indianapolis a shopping population of 1,000,000 people.

Wallace B. Campbell of Anderson, promoter of the Anderson-Lebanon cross-state traction line, has been granted a 50-year franchise to enter Lebanon. This completes the franchises in all the towns and cities, and he will now secure the rights-of-way and then organize his company. By the terms of his franchises the road is to be built during the year 1904. Mr. Campbell says the capital is ready as soon as the way is secured.

The pay of the motormen and conductors on the Indianapolis, Shelbyville and Southeastern Traction line has been increased from 18 to 20 cents an hour and the time reduced from 11 to 9½ hours a day.

The Broad Ripple line has passed to the ownership and charge of the Indiana Union Traction Company, and is being operated in connection with the Indianapolis Northern.

The Indiana Northern Traction Company, which is building a line between Wabash and Marion, the grading for which is nearly completed, has filed a mortgage covering the property to secure an issue of $50,000 of five per cent. 30-year bonds. The proceeds [illegible] to go into the line.

Tipton, Kokomo and Noblesville are preparing to celebrate the completion of the Indianapolis Northern traction line through that part of the state. The residents of these three cities will participate in the celebration at Tipton, at which addresses will be made by the three mayors and George F. McCulloch, president of the road.

[illegible] McKain of Indianapolis has [illegible] the waterpower dams in the Tippecanoe River at Norway and Tiogo, near Monticello. These powers were once used in the manufacture of paper and lumber. It is now proposed to improve these dams and operate electrical generating plants and transmit the current to the surrounding towns and cities. F.

Michigan.

Detroit, January 2.—The Bartlett Illuminating Company of Saginaw has filed a mortgage to the Trust Company of North America of Philadelphia for $750,000 to secure bonds for that amount. The proceeds of the bonds, it is understood, will be used in making improvements and extensions to the company's property.

At a recent test of the new electric-lighting system at Belding the 37 arc lights illuminated the town very well and the citizens are entirely satisfied. The system was put in active operation January 1st.

The Three Rivers Electric Lighting Company will begin to string wires, and if the weather is favorable it is hoped the lights will be in working order by the last of the week.

There may be trouble in the Owosso City Council when the question of the Owosso and Ionia electric-railway franchise comes up. One faction of the council wants the road to enter the city on the same street as the Owosso and Corunna line, while another faction opposes this.

A formal order for the payment of $100,000, proceeds of sales of Detroit and Flint railway bonds to the Detroit United Railway, has been made by Judge Donovan. The bonds were put up when the Detroit United bought the interurban road.

At the meeting of the electors of West Bloomfield Township, recently held at the town hall, the grievances the township claims to have suffered at the hands of the Detroit United Railway were discussed. The chief bone of contention is the rate of fare to Detroit, which is 35 cents. When the franchise was granted the old Pontiac and Sylvan Lake Railway Company, the fare to Detroit was 25 cents, and the Township Board supposed it would so continue, or become less. Instead of that it was boosted to 35 cents.

Anticipating a decision by the Common Council committee in favor of air brakes, the Detroit United Railway has forestalled the council's action by closing a contract to equip 225 cars with air brakes. This improvement, which means the expenditure of a large sum, will result in the installation of the new system on the principal lines by an early date next spring. The contract binds the National Electric Company, successor to the Christensen Air Brake Company, to install compressor stations at the various Detroit United Railway stations by March 10th and proceed with the installation of air brakes on the cars as rapidly as possible, work to begin at once. The company now has 150 double-truck cars, including interurbans, equipped with air brakes, and it was simply an engineering problem how to so equip the single-truck cars. So far as the 225 contracted for are concerned, that problem has been solved. It will be necessary to remodel the running gear of the cars, and this will be done at the company's barns. Two tanks, one 16 inches in diameter and the other 18 inches in diameter, are to be placed on each truck. The company has 1,000 cars altogether, but about 100 of the city cars are summer and winter cars, while others are interchangeable, so that the open cars can be placed on the running gear of the closed cars, utilizing the trucks that are equipped with air brakes. Double-truck cars are favored by the Detroit United Railway, and they are gradually replacing the old pattern. The action of the street-railway company bids fair to end a dispute that has waged between the city and company for three years.

The River Rouge electric-light plant is almost ready for use, according to McCleary & Colquett, the Detroit contractors, and Village Engineer P. W. Keating. River Rouge citizens may expect light by January 15th. C. G. W.

Kentucky.

Louisville, January 2.—Business men of Louisville are expecting extensive development of electric-railway interests about the city the coming year. The proximity of the network of roads in Ohio and Indiana is having its influence, from the fact that all the towns and cities of those two states are rapidly increasing their business and growing in size. Retail houses in Louisville are making an earnest endeavor to increase their business, and they see in the extension of the present lines and the building of new ones a means of accomplishing their purpose.

The Louisville and Eastern is already carrying a large number of people into the city weekly. It is to be extended to Shelbyville in the spring. It is almost certain now that this line will be completed as soon as possible when favorable weather for building comes. Within 30 days or a little more the Louisville Railway Company will have a line to Jeffersontown completed. This will make it possible for people of a number of small villages to reach the city easily. Lines are also being built to Meadowlawn, on Preston Street road, and the Louisville and Mt. Washington line on the Bardstown road will likely be built the coming summer.

Plans of the Louisville and Southern Indiana Traction Company have already been spoken of. The management hopes to connect with Cincinnati, Indianapolis and Evansville and give people along the lines an outlet to the larger cities. Work is now being done on the Evansville and Indianapolis lines. Connections will be made with other roads for the purpose of giving a through route. The Cincinnati, Lawrenceburg and Aurora, from Cincinnati, will probably extend lines down the river, to be met by the Louisville and Southern Indiana, building in the other direction. It is hoped to make the same arrangements with a line building south from Indianapolis. Connections will then be made with a number of the larger towns of Indiana. The Ohio Valley Traction Company has also planned a line between Louisville and Cincinnati, the route being shorter than the Louisville and Nashville by 15 or 20 miles.

As already mentioned in the Western Electrician, the Kentucky Traction Company has planned an extensive system. It is thought that a portion of the work will be begun early in the spring. It will connect a number of towns between Louisville and Nashville and form direct connection between the two cities.

It is also believed by many that the traction roads will build a central station in Louisville within a short time. As now planned, they will drop passengers at the street corners, but this is not the most satisfactory way of handling the business, and a movement may be made for the station, all interurbans using it. Whether this will be done the coming year is hard to tell. C

Northwestern States.

Minneapolis, January 2.—A 20-year electric-light franchise has been granted to Stephen Pauly at Miller, S. D.

The new electric-light plant at Chaska, Minn., has been tested and accepted by the council.

The Chisholm (Minn.) council has refused to purchase the electric-light plant from the Crowley Electric Company for the price asked, $13,000.

H. A. Holredge has been elected as manager of the Omaha (Neb.) Electric Light and Heat Company. The position has been vacant for nearly a year.

The city of Eau Claire, Wis., is agitating the buying of the electric-light plant.

An engineer representing an eastern company is at Sioux Falls, S. D., investigating the feasibility of establishing a street-car system there.

A franchise has been granted at Beaman, Iowa, to the Marshalltown Electric and Interurban Railway Company.

M. E. Springer of Des Moines may establish a gas and electric-light plant at Creston, Iowa.

The court has ordered the Chippewa Valley Electric Railroad Company to pay its share of the street-paving expense at Chippewa Falls, Wis., within 30 days, or the injunction preventing the city tearing up the track will be dissolved. The decision is a victory for the city. The council will refuse to grant a new franchise until the company agrees to pay liberally for it.

J. B. Nygron has resigned as city electrician at Mora, Minn. C. S. Rygh of Madison, Minn., was elected to succeed him.

The gross earnings of the Janesville (Wis.) Street Railway Company for the last year amounted to $13,554.

The Southern Wisconsin Interurban Railway Company, M. Hayes, president, has applied for a franchise at Janesville, Wis.

The Nebraska Central Electric Railroad Company is negotiating for a right-of-way for its new line from Omaha to Hastings.

The Cherokee (Iowa) Electric Lighting Company will build an electric line from Cherokee to the insane asylum. Bonds amounting to $75,000 will be floated to cover the cost.

Dr. George Brickbauer has bought the electric-light plant at Elkhart Lake, Wis., and will reopen the plant.

A power, water and electric-light plant will be erected at Shell Lake, Wis. The cost will be about $10,000.

The Interurban Electric Railway Company at Omaha, Neb., is negotiating with the traction company for the right to use the latter's tracks within the city limits of Omaha.

An election will be held at Dike, Iowa, on January 18th for the purpose of voting a franchise to the Marshalltown Electric Street Railway Company.

The Lincoln (Neb.) Traction Company has filed with the clerk of the District Court objections to the sale of its plant to Charles A. Freauff.

The Twin City Rapid Transit Company has taken out permits for installing the machinery in its new power houses in Minneapolis. The permits call for 12 transformers, seven generators and five motors, costing a total of $731,600. This amount includes $27,000, which will be spent in adding to the equipment of the old power house. R.

PERSONAL.

Edward R. Taylor of Penn Yan, N. Y., well known for his work in developing the electric furnace, was a visitor in Chicago this week.

T. J. Roderick, superintendent of the Indianapolis and Shelbyville Traction Company, has resigned and will be succeeded by Arthur A. Anderson, who will also be superintendent of the Indianapolis and Cincinnati Traction Company.

James F. Cummings, well known as an electrical engineer and contractor and at present engaged on extensive underground construction in St. Peters-

burg, Russia, is in this country on a flying visit. He was in Detroit last week.

ELECTRIC LIGHTING.

The City Council of Warrensburg, Mo., is considering the proposition of building an electric-light plant to be owned by the city.

Foraker Bros. have been granted a 20-year franchise for electric lighting in Stafford, Tenn. They expect to install the plant this winter.

Arc lights of 2,000 candlepower are being put on the Columbia Gardens cars and the Walkerville (Wash.) electric cars for use as headlights.

The electric-light and waterworks plant of Palmyra, Mo., has been sold to W. E. McCully of Macon. The price received is stated to be $25,500. F. B. Hobart of St. Louis was former owner of the system.

At a recent meeting of the Milan (Italy) City Council the proposition to establish a municipal electric-light and power plant was defeated. This action of the council insures that the Edison Electric Company will renew its contract with the city.

W. M. Deming of Cincinnati has succeeded in reorganizing the General Electric Company at Memphis, Tenn. C. K. G. Billings, S. T. Carnes and others transferred their holdings to the new company. C. M. Harney of Knoxville has been chosen president and Mr. Deming will be manager.

ELECTRIC RAILWAYS.

Chicago elevated railways report good gains in earnings for December last, as compared with the corresponding period in 1902. The South Side Elevated gained more than six per cent., the Northwestern nearly seven per cent., and the Metropolitan 4.33 per cent. The last-named road carried 120,694 passengers during the month, the largest in its history.

A new railway system in which the cars are supported by skates instead of wheels is described in Revue Technique. The cars are raised on a thin film of water, which is forced under the skates through a jet. A third rail is laid between the two gliding rails, and a friction wheel, driven by electric motors, runs on this and furnishes the propelling force. The advantages claimed for this system of traction are a great reduction in the track resistance and in the power required by a car, a much smoother running of the cars, and hence a smaller depreciation both of track and car. There is no danger of derailment, and high speeds can be attained.

The Chicago Union Traction Company has added the name of Charles H. Aldrich, former solicitor-general of the United States, to its legal forces. Mr. Aldrich will probably appear for the company next week, when the question will be argued as to Judge Grosscup's jurisdiction in entering an order on October 9th by which D. A. Kohn and others were prevented from taking action in the state court to interfere with the approval of the new leases of the traction company. Several of the Union Traction officials have been conferring with members of the City Council recently on the subject of more street cars for cross-town lines on the West Side.

AUTOMOBILES.

An improved trackless train was successfully operated in Paris recently. The train used in the test consisted of a motor carriage, similar to an ordinary automobile, and five cars. The improvement consists in the transmission of sufficient motive power from the motor to move each car.

Manufacturers of automobiles are preparing to come to Chicago for the automobile show to be given by the National Association of Automobile Manufacturers, which will open at the Coliseum on February 6th and continue a week. There will be 400 machines on exhibition, representing France, Belgium and Germany, as well as the American product.

SOCIETIES AND SCHOOLS.

The twelfth annual convention of the Northwestern Electrical Association will be held at the Hotel Pfister, Milwaukee, on January 20th and 21st. Secretary Mercein has arranged an attractive programme. Further details will be given in the Western Electrician of next week.

PUBLICATIONS.

Electricity as applied to agriculture or "electroculture" is gone into quite thoroughly by E. Guarini in his brochure entitled "L'Etat actuel de l'Electroculture," published by Ramlot Bros, Brussels, Belgium. The brochure gives the descriptions and results of many tests of the effect of the electric current on the germination and growth of plants.

Another card calendar is being sent out this year by the Bullock Electric Manufacturing Company of Cincinnati, which is a continuation of the series of 1903. The calendar is made up of 12 cards 3½ by six inches, of handsome design and coloring, and each bearing on the front, besides the calendar of the month, a picture of some noted scientist or engineer connected with electrical work. On the back of each card is a short biography of the man. These calendars are artistic and out of the ordinary and attract attention.

TELEGRAPH.

General Superintendent E. J. Nally of the Postal Telegraph Company has created three new districts in the Western Division. W. I. Capin, superintendent of the fifth division, with headquarters at Chicago, has charge of all the lines and offices west of the Missouri River, including Kansas City, Omaha, St. Joseph, Leavenworth and Atchison.

SPACE TELEGRAPHY.

It is reported that the project of installing a space-telegraph service between Vashon Island and Port Townsend, Wash., has been abandoned for the present, owing to electrical disturbances which, it is thought, would interfere with the practical working of the system.

Rapid work in the sending of space-telegraph messages was accomplished between Cambridge and Lynn, Mass., recently by the use of Stone apparatus with a new type of receiving coherer. The messages were sent and received by two expert telegraphers at the rate of 20 or 30 words a minute.

MISCELLANEOUS.

After a most stormy passage the White Star steamship Teutonic arrived in port in the middle of the month of December and reported that during the voyage the foremast was struck by a bolt of lightning. The occurrence of lightning at that time of the year in the North Atlantic is extremely rare. Snow was falling heavily at the time, which makes the incident seem doubly queer.

Street-railway employes of Bloomington, Ill., inaugurated the new year with a strike, which ties up the transportation lines of that city and cuts off traffic connection with Normal, Ill., three miles distant. The strike was ordered upon the refusal of the company to grant an increase of one and two cents an hour, respectively, for men less than one year and those over one year in service. It is reported that scenes of disorder and violence unprecedented in Bloomington marked the effort of the street-railway company to move its cars on the third day of the strike.

In the neighborhood of the town of Tjilatjap, on the coast of the Island of Java, extensive deposits of magnetic-iron sand have been found. The deposits are opposite the Island of Noesa Kembangan and extend about 29 miles to the east along the coast line. The sand lies on the surface and is said to contain in some places as much as 80 per cent. of iron. Samples taken in different parts give a very good result when smelted. Some time ago an English company, with a Hollander at its head, acquired the right of exploiting these deposits, which have been known since 1854.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) December 29, 1903.

747,922. Counting and Indicating Machine. William Ackerman, New York, N. Y., assignor to the United States Graphotype Company, New York, N. Y. Application filed October 6, 1902.

An electromagnetic arrangement releases the arm, which operates a dial indicator.

747,949. Signaling System. William H. Dammond, Detroit, Mich., assignor of one-fourth to Edward M. Bryant, Detroit, Mich. Application filed November 5, 1902.

The system comprises a track having an electrically continuous rail and a rail insulated into sections or blocks, contacts near the entrance to the blocks, contacts in the blocks, a tripping post for each contact, and a source of electricity for each block having one pole connected to the continuous rail and the other pole connected to the section of the insulated track and to contacts of predetermined sections. Signals carried by a locomotive and suitable means for utilizing the current of the electricity of each block to control the operation of the signals of the locomotive are further specified.

747,967. Train-controlling and Signaling System. Fred P. Green, East Aurora, N. Y., assignor of two-thirds to Shelly S. Aldrich and David Underhill, Jr., East Aurora, N. Y. Application filed February 11, 1903.

A line wire, a series of yielding contact fingers, each having a flexible spiral body portion and an exposed contact plug, a branch wire connecting the line wire with the contact plug and inclosed by the body portion of the finger, and an electrically controlled signal mechanism having a contact shoe arranged to be moved into contact with the plugs of the fingers are the salient features. (See cut.)

747,968. Electric Meter. Ludwig Gutmann, Peoria, Ill., assignor to the Sangamo Electric Company, Springfield, Ill. Application filed January 6, 1902.

Combined with a metallic armature in contact with mercury is a field magnet and a transmission gear one element of which is secured to the armature and the other attached to a non-magnetic support passing through the magnetic circuit of the field magnet.

748,053. Bar for Collecting Electricity for Sectional Circuits. Henri Dolter, Paris, France. Application filed February 19, 1902.

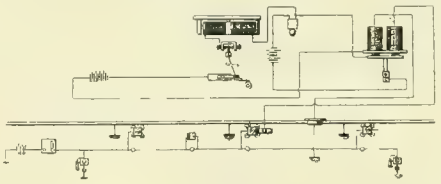
Several contact parts electrically connected together form a bar or brush, the parts insulated magnetically from each other. Means for magnetizing the parts with opposite polarities, and means for reversing the magnetization of the parts when the movement of the car is reversed are further provided.

748,086. Electric Firing Gear for Breech-loading Guns. John F. Meigs, Sigard A. S. Hammar and Leighton N. D. Mixsell, Bethlehem, Pa., assignors to the Bethlehem Steel Company, South Bethlehem, Pa. Application filed August 27, 1902.

In a breech mechanism are combined an operating lever carrying a contact, and a movable terminal adapted to engage the lever and lock the same and engage the contact thereof to complete the circuit.

748,098. System for Controlling Fluid Pressure. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 21, 1903.

The main parts are a motor, a controlling switch for the motor, a fluid compressor, means independent of the motor for driving the fluid compressor, and means for rendering the compressor driving means inoperative when the circuit of the motor is opened.



NO. 747,967 TRAIN-CONTROLLING AND SIGNALING SYSTEM.

748,107. Apparatus for Detecting the Temperature of Metals. Albert Sauveur, Cambridge, and Jasper Whiting, Lexington, Mass. Application filed June 10, 1903.

Magnets, past which heated articles are conveyed, are adapted to be connected by the articles. An armature is operated by the magnets and means opposed to the magnets hold the armature in normal position. A marker operates on the articles, a motor operates the marker, and means operated by the armature control the action of the motor.

748,121. Electric Arc Lamp. Knut Tornberg, Medford, Mass. Application filed November 1, 1902.

The carbon supporting and feeding mechanism comprises two successively arranged freely rotatable guiding rolls situated on the same side of the carbon, and each having a V-shaped peripheral carbon-receiving groove. A non-grooved, straight-faced feeding roll is situated on the opposite side of the carbon, between the two guiding rolls, which are rotated positively, and thus feed the carbons.

748,123. Electric Switch. Isaac G. Waterman, Santa Barbara, Cal. Original application filed February 27, 1902. Divided and this application filed July 1, 1902.

A switch blade is secured to an axle which in turn is rotated by a crank, the blade making contact with different contact points.

748,143. Wireless Telegraphy and Transmission of Power. James T. Armstrong and Axel Orling, London, England. Application filed March 11, 1901.

For the transmission of power there is combined with a receiving apparatus having a shaft adapted to be rotated step by step on the arrival of signals, a suitable crank rotated by the shaft and a connecting rod to transmit motion from the crank to the steering gear of torpedoes or to other mechanism.

748,144. Regulating Device for Electric Circuits. Malcolm H. Baker, East Liberty, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed June 26, 1902.

A regulating reactance is made to pull against the force of a balancing weight, which regulates the distance which the core moves in the coil of the regulator.

748,145. Method of Regulating Electric Circuits. Malcolm H. Baker, East Liberty, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed June 26, 1902.

A weight on the end of an arm moves a plunger up in a solenoid connected in another solenoid, which regulates the reactance in the circuit.

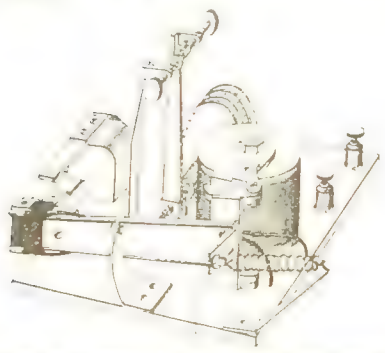
748,146. Constant Power-factor Regulator for Electric Circuits. Malcolm H. Baker, East Liberty, Pa., assignor to the Westinghouse Electric and Manufactuing Company, Pittsburg, Pa. Application filed June 28, 1902.

In a system of electrical distribution, a constant power-factor regulator for electric circuits, comprises relatively movable primary and secondary coils, a core having a fixed relation to one of the coils, the other coil having a variable inductive relation to the core, and a weight controlling the movement of the movable coil, the relations being such that the weight brings the movable coil to equilibrium at a point of proper regulation in the circuit.

748,147. Method of Regulating Electric Circuits. Malcolm H. Baker, East Liberty, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed June 28, 1902.

The method of maintaining a practically constant power factor in a system in which a transformer is employed to operate translating devices in series in its secondary circuit consists in automatically and simultaneously varying the secondary voltage and the primary current in the same sense or direction and in approximately the same proportion.

to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed De-



mon, St. Paul, Minn., and Luther H. Stiles, Red-

the armature.

Porter and Burleigh Currier, Philadelphia, Pa.

ways. Alfredo Diatto, Turin, Italy. Applica-

748,323. Thermostat. George A. Wall, Providence,

748,337. Socket for Incandescent Electric Lamps. Charles Bakeley, Covington, Ky., assignor of one-half to Charles Akers, Covington, Ky. Ap-

the socket by a shaft passing in at the side and carrying

748,338. Socket for Incandescent Electric Lamps. Charles Bakeley, Covington, Ky., assignor of one-half to Charles Akers, Covington, Ky. Ap-

748,3[illegible]. Igniting Device. William Gardner, Brook-

Telephone Manufacturing Company, Rochester,

Lean, New York, N. Y. Application filed No-

to floors of the building, directional signaling devices

between the signaling devices and corresponding indicators. A switch controlled by the movement of the car limits the signal indications to those corresponding to the direction of movement of the car.

748,409. Elevator Signaling Apparatus. John McLean, New York, N. Y. Application filed De-

Contacts located at each floor of the building engage the circuit terminals carried by the car and light signals

748,422. Trolley. Walter J. Rowley, Allegheny, Pa. Application filed May 7, 1903.

vertical arms and engaging the guards, and cords con

748,441. Trolley. Thomas F. Varley, Lowellville, Ohio. Application filed August 14, 1903.

748,442. Vibrator for Induction Coils. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company, Providence, R. I.

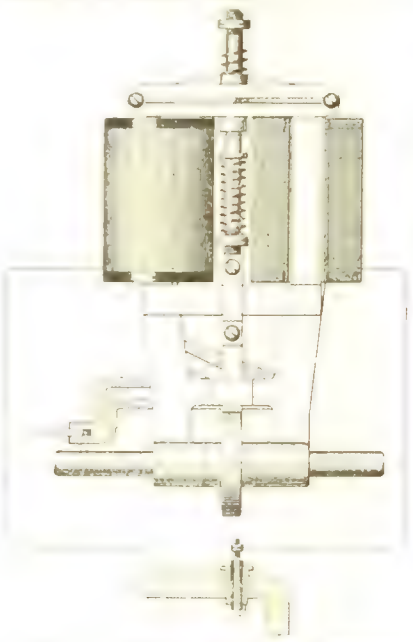
a circuit controlling plate, an armature lever and two

the armature lever, the former being stronger than the latter.

748,445. Incandescent-lamp Socket. Charles Wagner,

bore. Devices are arranged in axial alinement in the

James B. Williams, Springfield, Ohio, assignors to James B. Williams, Springfield, Ohio. Ap-



ELECTRIC GENERATOR FOR

748,451. Railway-crossing Signal. Elmer E. Wolf and James B. Williams, Springfield, Ohio, assignors to said Williams, George H. Kyle, Carthage, Ohio, and James B. von Schriltz, Spring-

connected with the contact arm to move the same, electro-

arm, and a lever cooperating with each magnet and having one arm provided with an armature and another arm adapted to engage the actuating arm.

748,488. Controlling System for Conveyors. Arthur C. Eastwood, Cleveland, Ohio. Application filed

A current generator and means for causing the gen

the inventor's idea.

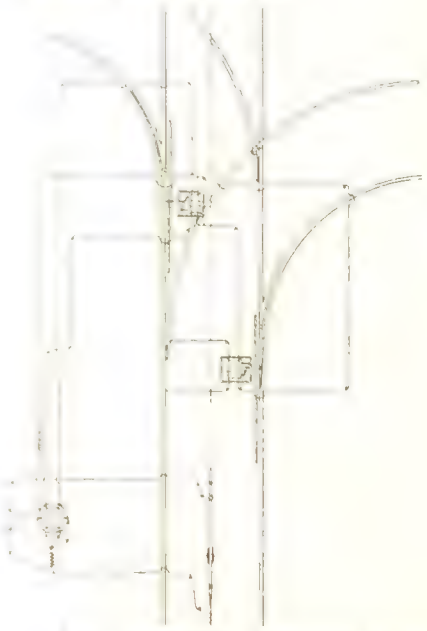
748,502. Electric Signaling Apparatus. Felix B. Herzog and Schuyler S. Wheeler, New York, N. Y.; said Wheeler assignor to said Herzog.

A circuit controlling device comprises an operative member, manually movable in two intersecting directions in one plane and manually movable also in a reciprocal

748,508. [illegible] Tramway or Other Cars. Albert King, Nottingham, Eng-

ported by the arm, a lever connected with the shaft, and the lever, the shaft being in operative connection with

748,524. Telephone Support. Charles H. Pelton and William Ramsey, Springfield, Ohio. Application



748,534. Electric Generator for Intermittent Currents. Malcolm P. Ryder, Whiteplains, N. Y.

An electric generator for intermittent currents, com-

actuating the armature relatively to the magnetic member. (See cut.)

748,557. Electrically Controlled [illegible]

the main line are provided each with a switch tongue. A

is located, and means for successively closing the several circuits whereby the two switch tongues may be simul-

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on January 4, 1904:

and

N. Y.

355,420. Prevention of Induction in Electric Circuits.

kins, Philadelphia, Pa., assignor to the United States

355,425. Central Office Telephone Switchboard. Frank C. Watkins, Philadelphia, Pa., assignor to the United States

Company, New York, N. Y.

355,431. Telegraph Receiving Instrument. William Arthur,

355,443. Method of Suspending Electric Lights. Henry F. Edwards, Providence, R. I., assignor of one half to the American Electrical Works, Providence, R. I.

355,446. Safety Circuits for Electric Lights. Edwin T. Greenfield, New York, N. Y., assignor to himself, and

N. Y., assignor to the Railway Telegraph Company.

N. Y., assignor to the Railway Telegraph Company.

N. Y., assignor to the Standard Underground Cable

Company, Pittsburg, Pa.

355,611. Coupling for Electric Wires. Henry Howson,

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXIV. CHICAGO, JANUARY 16, 1904 No. 3

Automatic Telephone Service in Grand Rapids, Mich.

On Saturday, January 9th, at 12:30 p. m., the Citizens' Telephone Company of Grand Rapids, Mich., one of the largest and oldest Independent telephone companies in the United States and one which throughout its entire career has been successful, both in local and long-distance business, changed the character of the service given its local subscribers from manual to automatic operation. For more than a year this company has been busy in building a new home for its exchange, improving the character of its outside construction and getting everything in readiness for the installation of an automatic system. This work was finished during the first week in January, and it was decided to make the change on Saturday at noon. At 12:30 the girls operating the manual switchboard, two blocks away from the new exchange, left their positions, and in seven minutes connections leading through the distributing board to the automatic exchange had been made and the automatic service in Grand Rapids had been established.

The company had for some time been instructing its patrons in the use of the automatic telephone and notice had been given each of the 5,000 subscribers that the change of service would be made at the hour above mentioned. Naturally, there was much curiosity on the part of the public to test the new service, and the result was that a perfect avalanche of calls began pouring into the automatic switchboard as soon as the connections were made. At one time during the afternoon a careful inspection of the second-selector switches in each one-hundred group on the switchboard showed that 1,500 telephones, out of a total of 5,000, were in use. This remarkable load was carried by the switches for several hours after the conversion was made, and, in fact, an extraordinary volume of business continued to flow into the exchange until 10 or 11 o'clock at night.

Prior to making the change the cables to the old exchange had been tapped on to the new cables in the rear of the distributing board leading to the subscribers' instruments. Toothpicks had been inserted between the heat coil and the line terminal springs on both sides of each subscriber's line. As fast as one force of men cut the old cables on the rear of the board another force withdrew the toothpicks from the heat coils on the front, and connections were instantaneously made between the switches and the lines of the subscribers. Mr. Tarte, the general manager, estimates that the largest number of calls passing through his exchange at one time prior to this occasion was 400. More than four times that number passed through the automatic exchange at one time, and, apparently, without any inconvenience to the apparatus whatever.

At the close of the day's work the subscribers, the exchange management and the representatives of the Automatic Electric Company, which furnished the automatic apparatus, expressed themselves as entirely satisfied with the results. It is said that the change from one switchboard to another of such a capacity in so short a time was never attempted before. In 10 minutes after the order to cut in had been given the Citizens' Telephone Company was operating more automatic telephones than any other company in the world.

The method of making a call through the automatic exchange has been described at length in several issues of the Western Electrician. Briefly stated, it is as follows: The subscriber removes the receiver from the hook and successively turns the dial with the finger in the hole representing each figure composing the number of the subscriber desired. He then presses the button just below the dial, which rings the subscriber's bell, unless the desired line is busy, in which event a busy signal is heard in the receiver. Suppose No. 2,222 is called. The first movement of the dial with the finger in No. 2 hole sends two impulses over the line to the first selector switch, which selects a trunk line leading into the second group of thousands. The second movement again sends two impulses over the line which operates the second selector switch, giving the trunk line leading into the second-hundreds' group of the thousands group already selected. The two last movements of the dial operate the connector switch which gives the units and tens of the call, and completes the connection with the lines of the subscriber desired. The hanging up of the receiver instantaneously restores the three switches to their normal position. A special dial has been made for the telephones in use by the Citizens' Telephone Company, which has an extra hole above the 0 which is marked "Long Distance." The revolution of the dial one time with the finger in the "long-distance" hole immediately gives the subscribers the ear of the long-distance operator, who then makes long-distance connection in the same way as though she were connected with a manual switchboard.

The Citizens' Telephone Company of Grand Rapids was organized September 13, 1895, with a capital stock of $100,000. Service was first given on July 1, 1896, with 832 telephones in service. The growth of the Grand Rapids exchange since then has been as follows: January 1, 1897, 1,776 telephones; 1898, 2,100; 1899, 2,525; 1900, 3,110; 1901, 3,435; 1902, 3,794; 1903, 4,927; January 1, 1904, 5,132 telephones.

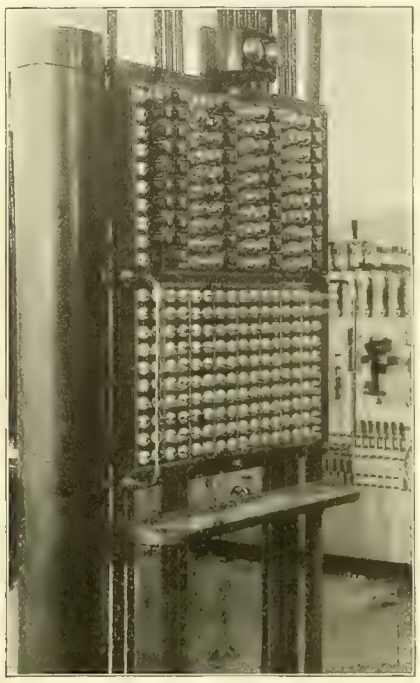
Outside of Grand Rapids the growth of the company has been quite as rapid as it has been in the city. A great many exchanges have been built; others have been purchased, and the necessary toll lines to connect the different parts of the system together have been constructed. The largest exchanges, outside of Grand Rapids, are at Lansing, with 1,784 telephones, and Traverse City, Mich., with 1,116 telephones, and there are many others with from 200 to 600 telephones, making the total of 10,358 telephones outside of the Grand Rapids exchange. The company now owns and is operating 2,200 miles of metallic toll-line circuits. The majority of these lines are built of copper wire, and nothing but copper has been used in the construction of toll lines for the last two years.

In addition, the company is closely allied with the Citizens' Telephone Company of Muskegon, hav-

AUTOMATIC TELEPHONE SERVICE IN GRAND RAPIDS.—NEW SWITCHBOARD (FIVE SECTIONS OF 1,000 SWITCHES EACH).

ing considerable stock in that company, and being represented on its board of directors. The Calhoun County Telephone Company of Battle Creek is managed and operated by the Citizens' Telephone Company of Grand Rapids, and the Jackson Citizens' Company, which owns one of the most modern Independent exchanges in the state, is closely allied with the Grand Rapids Citizens' Company, the secretary, general manager and some of the directors of both companies being identical.

The company is now capitalized for $2,000,000,



"TELLTALE" BOARD IN GRAND RAPIDS AUTOMATIC EXCHANGE.

and $1,400,000 has been paid in. The company has paid eight per cent. dividends yearly since its first organization, and its twenty-sixth two per cent. quarterly dividend will be paid on January 20, 1904. The officers of the company are as follows: Directors—Charles F. Rood, president; Edward FitzGerald, vice-president; E. B. Fisher, secretary; William J. Stuart, treasurer; Philip Graham, R. D. Graham, C. E. Perkins, L. J. Rindge, E. G. Studley, J. B. Ware and Gaius W. Perkins. Active management—E. B. Fisher, secretary; C. E. Tarte, general manager; Albert Stacey, superintendent of construction; Edmund Land, superintendent of equipment.

The old switchboard, which was of the magneto transfer type, has been filled up for some time, and in the spring of 1902 the company bought a site for a new building between Louis and Campau Streets, on the east bank of the Grand River. After due consideration a contract was placed with the Automatic Electric Company of Chicago in December, 1902, for 5,000 switches and telephones complete. The work of re-wiring the old plant and getting ready for the "cut-over" has been in charge of General Manager Tarte, assisted by Messrs. Land and Stacey.

It was found necessary to re-wire every subscriber's station, change the circuits and re-wire all of the branch-exchange switchboards, install a great amount more of underground and aerial cable, do away with the knob installations in the city, and, in fact, do considerable more work than would have been necessary to install a new exchange, and yet do it without interfering in any way with the old service. The work, which was started in March, 1903, is now complete.

The new building, 77 by 143 feet in ground dimensions, is built of red brick, and consists of two stories and a lofty basement, which is almost entirely above ground. It was completed in the early part of December, 1903. The basement contains a furnace, coal rooms, etc., and the main part of it is used as supply department. A driveway runs under the entire west side of the building, so that teams delivering freight can come in from one street, drive to the proper door in the supply department to deliver the freight, and then drive out the other street.

Of the first floor, the front half is entirely devoted to office purposes. Entering the building at the main entrance the lobby, or public waiting room, is reached. The sides of this room are finished in marble 45 inches high, with tile floor to match. Directly in front is the general office, 45 by 38 feet, used by the auditor and his numerous clerks. To the right are the offices of the secretary and general manager. On the left, extending down a corridor on the east side of the building, are the offices of the superintendent of construction, local manager, superintendent of equipment, etc. All these offices are handsomely finished in dark oak. The ceilings are all steel, not only in these offices, but in every part of the building.

Back of the offices, the first floor is used for shop purposes. This shop room is a fine one, 64 by 75 feet, well lighted, well ventilated, and, in fact, is as fine a room for shop purposes as there is in the city of Grand Rapids. This company does all of its own repair work, makes its own cable boxes, etc., and is well equipped, as it necessarily should be, to take care of the work made necessary by its numerous exchanges.

On the second floor is found all of the apparatus in connection with the automatic exchange, such as distributing frame, storage-battery plant, power apparatus, "telltale" board, air compressor, and automatic switches. In addition to this, the trouble department, toll room, locker room for trouble men and toll operators, reception or rest room for toll operators, dining room, kitchen, etc., are also located on the second floor.

All cables entering the building are brought in through a tunnel 210 feet long. This tunnel is built of concrete and is six feet six inches high and three feet 10 inches wide. It extends from the new building up Louis Street to a manhole at the corner of Louis and Campau Streets. At this corner the old underground system is reached, and this is the place where the splices and changes were made to cut the lines out of the old exchange into the new one.

It was necessary to change each cable, and, in fact, each pair of wires, one at a time, as the entire cutting over of lines was made while the telephones were in service and without interruption to the service. The method of handling the cut-over has been as follows: Permanent cables were run through the tunnel from the manhole at the corner of Louis and Campau Streets to the distributing frame in new building. Temporary cables were then run from the distributing rack to the old building, and as soon as a pair of wires was cut into the new cables, they were jumped back to the old office through the temporary cables and connected up before the old taps were taken off. In this way the changes were made without inconvenience to subscribers. Cables are brought into the east side of the building from the tunnel and carried from the basement to the second floor by means of pockets built in the side of the wall.

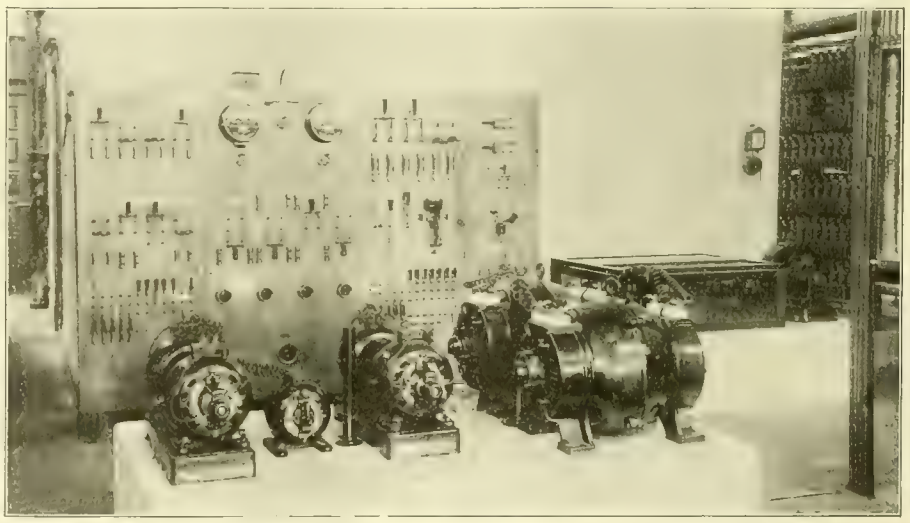
A Cook distributing board, equipped with 8,875 terminals on the line-cable side and 5,250 combined sneak-current and lightning arresters on the central-office side, has been installed. The terminals on the line side are in groups of 25-pair mounted 225-pair high, and on the central-office side in groups of 25-pair mounted 175-pair high. After going through the distributing board, the lines are carried into a multiple cut-off section in the toll room, and from there are carried into the automatic switches.

The first selector switches are mounted on shelves of 25 each, and these, with the necessary second selectors and connectors, are mounted in groups of 100 each. Ten of these groups make a complete section of 1,000 lines each. There are five of these 1,000-sections installed, as is shown in the picture on page 47, and the main switch room has a capacity of eight sections.

Directly in front of the middle 1,000-section is found the "telltale" board. (See picture on this page.) In case a heat coil blows on any of the switches, a lamp is immediately lighted on the telltale board and a magneto bell starts to ring, thereby calling the attention of the switchboard man to the fact that something is wrong. There is one lamp for each group of 100 first selectors, and the attendant knows at once where to go for the trouble. At the 100-groups there is an individual lamp for each shelf of 25 first selectors, which also lights, and as soon as the attendant reaches the particular 100 that the trouble is in he can then, by means of the shelf lamp, locate and remedy the trouble with very little delay.

In connection with the telltale there is also a generator lamp board. Ringing current for each group of 100 is carried through two lamps at this board, and if a line is grounded or short-circuited in any group, the lamp of that group will light when the ringing current is sent out on the line, thereby calling the attendant's attention, so that the trouble may be remedied.

Power apparatus includes two Sprague 4.1-horsepower dynamotors for charging storage batteries. These machines are run from 220-volt direct current and deliver 75 volts to storage batteries. There are two Holtzer-Cabot, type-E, one-half-horsepower motor-generators. They are run from 220-volt direct current and deliver 75 volts on the ringing side. A small supplementary Holtzer-Cabot dynamotor, made to run from 50-volt direct current (storage battery), is provided to do the ringing Sundays and nights. The power switchboard, of pink Tennessee marble, is provided with voltmeter, ammeter, underload and overload switches, automatic starting boxes, etc. Two battery interrupters, for the purpose of furnishing current to rotate the automatic switches, are provided. These interrupters are directly coupled to two Sprague one-fourth-horsepower motors.



POWER BOARD, CHARGING AND RINGING MACHINES IN CITIZENS' EXCHANGE, GRAND RAPIDS.

AUTOMATIC WALL TELEPHONE

An air compressor, to be used for the purpose of blowing dust out of the switchboard, has been installed. Pipes from the air compressor are run to each group of switches and a nozzle provided, so that a flexible-rubber hose can be attached. The

compressor tank is tested to 150 pounds pressure and is run by an electric motor provided with an automatic regulator, so that it is regulated between a pressure of 60 and 80 pounds.

The storage-battery plant consists of two sets of 26 cells each of American Storage Battery Company's 400-ampere-hour cells. In addition to this, there are two sets of 12 cells each of Chloride accumulator, used to furnish current for the toll boards.

General Manager Tarte's pet hobby is the development of the toll-line business, and with the idea of taking care of future, a swell as present, business, a complete, well-equipped, up-to-date toll-line board has been installed. The growth of this part of the business for the last five years has been remarkable, and it is expected that with better facilities for handling the work, and with more lines where needed, a large increase will be shown in the volume of business during the next 12 months. On Saturday, January 9th, the day on which the change from manual to automatic was made, more than 500 messages were handled through the new toll board between the hours of 12:30 and 8 p. m. Business for the last year has been so congested that it has been almost impossible to handle it, but it has nevertheless shown a steady gain. Operators have been overloaded with work, lines have had more business than they could carry, and there has been no chance for relief, because if new lines had been built there was no room on the switchboard to bring them in and no possibility of adding any more positions. In the toll-line department there were 112,502 messages in and out of Grand Rapids in 1899; 165,265 in 1900; 195,561 in 1901; 259,650 in 1902, and 306,619 in 1903.

The toll board proper, which is manually operated, has 20 positions installed. The first and second positions are the local switching section. All of the local exchange lines are brought from the distributing board to this section, which is practically a multiple section, before they are carried to the automatic switches. This section is equipped with 5,400 multiple jacks and has a capacity of 10,500 lines. The third position is a test panel. The individual wires of all toll lines are brought into separate jacks at this board, and the tip and sleeve wires from the switchboard side are also brought to individual jacks. Galvanometer, twin plugs, test-

C. E. TARTE,
GENERAL MANAGER CITIZENS' TELEPHONE COMPANY.

ing keys, etc., are provided for the purpose of facilitating the testing of lines. The fourth position is vacant. The fifth, sixth and seventh positions are recording positions. Eighth position is "through" board, i. e., board at which all "through" business between outside lines is handled. Ninth to twentieth positions, inclusive, are regular toll positions, i. e., positions where business between local subscribers and toll lines are handled. Twenty-first and twenty-second positions are for rural lines, of which there are 150 entering the exchange.

In the center of the toll room are located three two-position desks. The first desk is the toll chief operator's desk, and the other two are information desks. All of the apparatus in the toll room was furnished by the Kellogg Switchboard and Supply Company, Chicago. The desks and switchboard are finished in quarter-sawed oak and the entire installation is first class in every respect.

The method of handling a toll-line call is as follows: When an automatic subscriber desires conversation with a toll subscriber, he pulls down the "long-distance" finger-hole on his dial and then presses the ringing button on his telephone. This lights a lamp on a trunk line at the recording-toll position, and the recording operator plugs in on the jack associated with this lamp. After the recording operator has found what is wanted she tells the local subscriber that she will call him when she gets his "party." When the automatic subscriber hangs up his telephone he automatically releases the trunk line and restores his own line to normal condition.

The recording operator makes out a slip containing the desired information and passes it, by means of a messenger, to the proper toll operator. When the toll operator is ready to complete the connection, she will talk over the proper order-wire key to one of the switching operators at the multiple section, and tell her what number she wants. The switching operator will designate the trunk line, will test the number wanted and will put the trunk plug into the proper jack. The switching operator then throws over a key associated with the trunk cord, and this puts out a lamp at the toll operator's position, indicating to her that she can ring the subscriber and complete the connection. The toll operator has complete control of the switch, and when the local subscriber hangs up his telephone a supervisory lamp associated with the cords at the toll operator's position will light. When the toll operator is through with the switch and takes her plug out of the trunk jack, a signal is given to the switching operator to take down the switch. If the line wanted is busy, the switching operator puts the trunk plug into a jack that has the "busy buzz" on it, and leaves it there until she gets the signal from the toll operator to take down the connection. Incoming toll business is handled the same as described, with the exception of that part handled by the recording operator.

Adjoining the toll room is the operators' locker room, equipped with expanded-metal lockers. The reception room and the dining room, which the company has provided for the use of operators, are next to the locker room, in the southwest corner of the building, and are finished in weathered oak "Old Mission" style, and there are fine settees, rockers and reclining chairs, with heavy red-leather seats. The walls are tastefully decorated with numerous pictures. In connection with the dining room is a kitchen, well equipped with gas stove, sink, etc., and a matron will be constantly on duty to look after the wants of the toll-line operators.

NEW MANUALLY OPERATED TOLL BOARD OF THE CITIZENS' TELEPHONE COMPANY OF GRAND RAPIDS

The recent hurried dispatching of American marines to the Corean capital is understood to have been not only for the purpose of protecting the American legation at the capital but also the property of the Chemulpo electric railway and the electric-light plant, in both of which Americans are interested. There are other large American interests in Corea; in fact, it is said at the State Department that they are perhaps more important than those of any other nation.

Chicago Electrical Association May Affiliate with Western Society of Engineers.

Important business was transacted at the meeting of the Chicago Electrical Association on January 8th. The meeting was called to order by President P. B. Woodworth, and after the routine opening business a resolution relating to an affiliation with the Western Society of Engineers was adopted. This resolution reads as follows:

"Whereas, Our president reports that it may be feasible for our members to be transferred to membership in the Western Society of Engineers without paying any entrance fees, thereby making our organization the electrical section of the Western Society of Engineers, be it

"Resolved, That our secretary send each of our members a statement of the advantages to be gained by such a transfer and application for said member's transfer; this question of transfer to be voted upon at our next regular meeting."

This resolution was presented to the members, so that they might consider the question of affiliation before the next meeting, when it will be voted upon. If the step be taken it will be of advantage to both societies. The Western Society of Engineers is a strong organization and possesses a fine library and reading room, with many advantages, which would benefit the Chicago Electrical Association. On the other hand, it would be to the advantage of a society of the nature of the Western Society of Engineers to have an electrical section composed of young and active men who are more directly allied with this branch of engineering.

A nominating committee presented a list of officers for the coming year, for which the secretary was authorized to cast the unanimous vote of the society. The names of the officers elected follow:

President—W. B. Hale, electrical engineer in charge of telephone electrical laboratory, Western Electric Company.

Vice-president—F. M. Holbrook, engineer, Chicago office Crocker-Wheeler Company.

Secretary—D. W. C. Tanner, of Barton & Tanner, patent attorneys.

Treasurer—H. G. Dimick, assistant factory engineer, Western Electric Company.

Auditor—H. Cochrane, electrical engineer, Eaton & Prince Company.

Directors—A. Scheible, secretary and treasurer, George Cutter Company; H. Almert, superintendent Cicero Light, Heat and Power Company; W. G. Carlton, operating department, Chicago Edison Company.

After the regular business of the meeting was over an instructive and entertaining lecture was delivered by Mr. Charles G. Y. King, mechanical engineer of the Commonwealth Electric Company, upon the erection of a 5,000-kilowatt turbine, illustrated with lantern slides. A brief report of this lecture appears on another page of this issue.

The New President.

William B. Hale, the new president, has been a member of the association since its inception. He has read several papers before it, and was secretary at the time of his promotion. Mr. Hale was born in Clinton, Ont., July 18, 1868. He studied at the University of Toronto and also took the electrical-engineering course at the School of Practical Science in that city. After graduation he entered the Meteorological Observatory of Toronto, and, after becoming familiar with the special methods of magnetic measurement used there, removed to Chicago, where he secured employment with the old Sperry Electric Mining Machine Company and later with the Western Electric Company, with which he is still connected. For the last seven or eight years he has filled the position of chief of laboratories for the Western Electric Company and has been largely responsible for electrical testing and measurement in general throughout the plant, with special reference to cable testing and experiments in cable manufacture. Mr. Hale is a diligent student and has become a recognized expert in electrical-laboratory work. He has made a number of trips to other cities in the interest of his company, and a year ago was sent on a general eastern tour of observation, during which time he visited many educational and industrial institutions, including the Bureau of Standards at Washington. At present Mr. Hale is in charge of the electrical laboratory of his company, in which

W. B. HALE,
PRESIDENT CHICAGO ELECTRICAL ASSOCIATION.

many problems in telephone engineering are worked out. Mr. Hale is also no mean linguist, speaking Spanish fluently and French passably, with a good reading knowledge of Italian and Portuguese. During the Chicago World's Fair of 1893 he was delegated to represent the Western Electric Company among the Spanish-speaking visitors.

Modest and unassuming, Mr. Hale is a man of excellent capacity and sterling character. His friends esteem him highly and are disposed to congratulate the Chicago Electrical Association on a wise and happy selection.

Recent Advances in Space Telegraphy.

Two new devices in space-telegraph apparatus, which are deserving of attention, have recently been patented by Lee De Forest of New York, N. Y. The patents relate to concentration and reflecting devices calculated to enhance the effectiveness of the receiving apparatus. The accompanying diagram shows the transmitting apparatus of one of these systems:

It is the accepted theory of the nature of electromagnetic waves in space and conducting bodies that when the aerial conductor at the sending station is charged, lines of force radiate from the whole surface of such conductor in all directions and normal to the surface, and if the other side of the spark-gap is earthed or grounded the lines of force radiating from the surface of the aerial conductor traverse circular paths and at their other ends rest upon or reach the surface of the earth, thus forming, so to speak, semispheres with the aerial conductor as an axis. When the spark passes across the spark-gap, the electrical charge in the aerial or generating conductor oscillates or surges to and fro, the waves being reflected at the upper end of the conductor, at which point a static loop is formed. The other or lower ends of these lines of force, which rest in the earth, move outwardly from the center over the surface of the earth in ever-widening circles. Consequently an electrical displacement opposite in sign to the electrical displacement at that instant traversing the upright conductor thus travels outwardly with the velocity of light in all directions also in the form of a circle of ever-increasing diameter with the conductor as an axis, which wave follows the surface of the earth or water, finally reaching distant points or receiving stations even when located far below the horizon.

In the practical operation of space-telegraph apparatus and in order to secure the greatest amount of efficiency it is desirable to provide means whereby the direction of propagation of the energy waves radiated from the generating aerial conductor at the transmitting station may be controlled and determined.

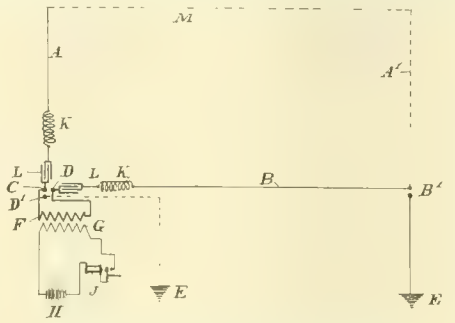
Referring to the diagram, (A) designates an aerial or radiating conductor. Instead, however, of directly connecting this conductor to ground through the spark-gap of its charging and discharging apparatus, an insulated horizontal wire or conductor (B) is led off from the base of the conductor. It is preferable to employ a length of vertical or aerial conductor (A) corresponding to one-quarter a wave length and a length of horizontal conductor (B) corresponding to one-half a wave length.

By this arrangement a horizontal insulated wire or conductor is employed and led off in a particular direction from the aerial conductor, the horizontal wire or conductor being arranged any convenient distance above the surface of the earth and which at the end farthest removed from the aerial conductor is grounded either directly or through a spark-gap, as indicated at (B'). It has been found that the lines of force generated in the aerial conductor by the surgings occurring therein instead of radiating in all directions from the conductor are concentrated in the plane which contains the two wires or conductors (A) and (B), and thus the plane of these conductors determines the plane or direction of propagation of the energy waves which are radiated.

In the arrangement shown it will be observed that before the spark occurs between the terminals or balls (C) (D) the vertical and horizontal wires or conductors will be charged oppositely, and consequently the lines of force joining these two charges will lie mainly in the plane determined by these wires or conductors, thus giving a direction of propagation to these waves as well as concentrating the waves in the direction of propagation. When the spark occurs the electrical surgings set up in the two wires or conductors find earth through the secondary spark-gap (B'). Consequently the resulting energy wave is in the form of a plane-polarized wave with its direction of propagation lying in the direction of the length of the wire (B), and having once acquired a direction of propagation such direction is maintained, except as diffusion affects the same as it progresses outwardly over the surface of the earth or water.

In order to operate the apparatus to the best advantage, the coherer or other wave-responsive device at the receiving station should be so placed and located that a maximum of positive potential and a maximum of negative potential shall occur at the two terminals simultaneously. This result is not accomplished in the arrangement of the apparatus where a single aerial receiving conductor is used connected to earth through a coherer or other form of wave-responsive device, for in this case one terminal of the coherer, being connected to the earth, is at zero potential.

In carrying out the invention, therefore, it is proposed to employ two or a co-operating pair of aerial-collecting conductors, in each of which stationary waves are produced by the cutting of the lines of force or waves of energy radiated from the



DE FOREST'S SPACE-TELEGRAPH TRANSMITTER.

transmitting station, as above explained, and to so separate and place the collecting conductors and the coherer that the latter will be located at a point where occurs a loop of positive potential in the stationary waves of one receiving wire or conductor and a loop of negative potential in the stationary waves of the other receiving wire or conductor, thus securing conditions of maximum efficiency.

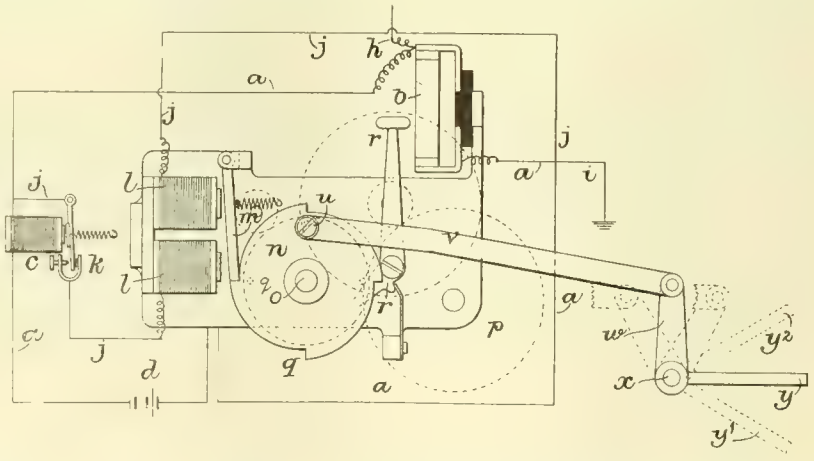
The other invention of De Forest also relates to reflecting or concentrating devices. In accordance with the invention the radiating antenna is surrounded with a series of vertical conductors, which may be called "secondary" antennæ, the conductors being disposed about the antenna in a curve, which theoretically should be a parabola having its focus in the antenna.

The conductors forming the reflector are, however, each grounded, either by a direct ground connection or by a conductor, which extends horizontally in the direction it is desired to transmit the signals and there connected with a ground through a secondary spark-gap. Another spark-gap is placed at the base of the antenna, which may be charged by any suitable apparatus, the reflector conductors each having their base connected with the antenna by a conductor and each is also connected with a conductor extending horizontally in the direction it is desired to transmit the signal. These horizontal conductors are grounded at their outer ends through a secondary spark-gap. This ground connection should be removed from the antenna a distance corresponding to a multiple of a quarter-wave length, preferably a half-wave length. The secondary radiating antennæ, forming the reflector, should preferably be located at such a distance from the main or primary antenna that the waves radiated therefrom and traveling in the direction of the conductors will be in step or phase with that part of the wave radiating from the primary antenna, which is traveling in the same direction. To secure this the length of the conductors connecting each of the reflecting or secondary antennæ with the main antenna added to the length of the conductors, connected to the latter, should be equal to a half-wave length more than the length of the conductor, which is connected with the main antenna. As it would in most instances be undesirable to separate the primary and secondary antennæ to such a distance, the same result is obtained by introducing lag-producing or retarding devices in the conductors, connecting the base of the antenna with the reflectors.

One of the great objects of inventors in space telegraphy is the transmission of power, and though little advance has yet been made, a few devices have been suggested.

James T. Armstrong and Axel Orling, both of London, England, have patented a device, which, though it does not transmit any considerable amount of power, enables an operator to control other apparatus at a distance without the intervention of wires, as, for example, the controlling of torpedoes. Any form of sending and receiving apparatus may be used, the coherer of the receiver operating a local circuit in which is contained an electromagnetic device operating a ratchet-wheel mechanism through a certain cycle according to the wave impulses sent out from the transmitting station.

According to the construction shown in the diagram given below, the receiving apparatus consists of a normally closed electric circuit containing a coherer and electromagnet, a local battery, a break-wheel, and two brushes, the coherer being connected with an aerial collector and conductor and to the earth in the usual way. A shunt is provided having a switch, which is operated by a magnet and is adapted to energize an electromagnet. Upon the arrival of suitable electromagnetic waves the resistance of the coherer is reduced in the well-known manner and sufficient current permitted to flow through the circuit to energize the magnet, whereupon the switch is closed and current permitted to flow through the shunt, which energizes another electromagnet, and short-circuits the coherer. Owing to the resistance of the circuit being thus lowered, a stronger current now flows through the circuit, which imparts considerable energy to the magnet (which keeps the switch closed) and to the electromagnet. The latter is provided with a spring-controlled armature, which also forms a detent and is adapted to normally engage one or the other of the teeth of a ratchet wheel. This ratchet wheel is mounted upon the shaft of a spring motor of any suitable construction, which shaft also carries the break wheel. The ratchet wheel is provided with a suitable number of laterally extending pins by means of which a spring-controlled triphammer is operated every time the ratchet wheel is permitted to rotate by the attraction of the detent by the magnet. In this way the hammer is caused to tap the coherer to restore it to its normal condition of resistance after the circuit has been opened by the rotation of the break wheel, but before the circuit is again closed by the contact of the brush with the next conducting portion of the break wheel.



ARMSTRONG-ORLING WIRELESS CONTROL OF POWER AT A DISTANCE.

By this arrangement the following sequence of operations is obtained: Upon the arrival of the electromagnetic waves the resistance of the coherer (b) and the circuit (a), of which it forms a part, is reduced and the switch (k) operated, and as a result the electromagnet (l) is energized and attracts its armature (the detent) (m) from engagement with the ratchet wheel (n). The shaft (o) is now released and begins to move under the influence of its motor (p), carrying with it the break wheel (e), which immediately afterward opens the

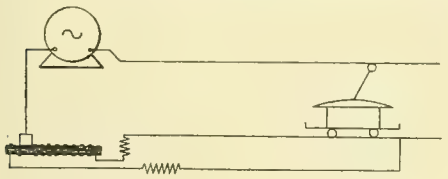
circuit (a), permitting the detent (m) to return to its normal position to engage the next tooth of the ratchet wheel. The hammer (r) is now tripped and decohesion effected while the circuit is still open, which is thereafter closed when the shaft (o) stops by the contact of the brush (f) with the next conducting portion (s) of the break wheel. In this position the apparatus is in a condition to receive the next impulse when the electromagnetic waves again arrive, the result of which will be to permit the shaft (o) to rotate another step, during which the cycle of operations is again performed. These impulses may be readily transmitted by mechanical contrivances to the steering shaft of a torpedo or for other purposes of a similar nature.

Arrangement of Return-current Conductor in Alternating-current Traction Systems.

As is sometimes the practice, a return feeder is put in paralleling the return rail in alternating-current traction systems to avoid fall of pressure in the rail, due to its resistance. One difficulty arises in attempting to divert all the current to the return feeder, the rail will persist in taking its share.

In order to divert the current from the rail to the return feeder, William M. Mordey and Arnold G. Hansard of London have devised an ingenious method for which a patent was recently granted them in this country.

In conjunction with the return feeder connected in parallel with the return rail, a transformer is provided with two windings, one of which is arranged in series with the return rail and the other with the return feeder, the arrangement being such that the return currents in the two windings will be in



ARRANGEMENT OF RETURN-CURRENT CONDUCTOR.

opposite directions to each other. By giving the winding connected to the return rail a suitably greater number of turns than that of the other winding the return current can be diverted from the return rail into the return feeder in any desired ratio by reason of the electromotive force set up by the first winding in the second winding.

In the case of long lines, the return rail may be divided into a number of separate sections, each of which is connected to its corresponding return feeder through one winding of a transformer, the other winding of which is in the circuit of the return feeder, or each section of return rail may be connected through a winding of one of a number of transformers to a common-return feeder in which is the other winding of each transformer, or the sections of the return rail may be connected together in series with each other through one of the windings of a series of transformers, the other windings of which are arranged in a common-return feeder or in separate-return feeders.

The arrangement is simple and is made clear by the accompanying illustration. It can be applied either to single or multiphase systems.

Death of Hon. W. W. Skiles.

Congressman W. W. Skiles died at his home in Shelby, Ohio, on January 9th of pneumonia, after an illness of short duration. Mr. Skiles was born at Stoughstown, Pa., December 11, 1849, and went with his parents to Richland County in 1854. He obtained the rudiments of an education in the public schools and graduated with his brother, George M. Skiles, at Baldwin University, Berea, Ohio, in 1876. The Skiles brothers studied law in Mansfield, Ohio, and were admitted to the bar on July 24, 1878. Immediately afterward they began the practice of law at Shelby. Mr. Skiles was married on October 3, 1877, to Miss Dora Matson, and a son and daughter were born to them. Mr. Skiles always kept up the practice of law, but was interested in many industrial enterprises. He had been president of the Shelby Electric Company since its organization in 1896. Funeral services were held on Wednesday last.

The Urban Construction Company of Kansas City, Mo., has been awarded the contract of building the power house for the Kansas City and Olathe Electric Railway Company. The power house is to be built at Lackman, Kan., which is as near the center of the line as can be found satisfactory. The estimated cost is $17,000.

Ozone in Laundering.

A curious commercial application of ozone has recently been put in operation in a Paris laundry, according to La Nature, for the purpose of disinfecting the articles submitted for renovation.

The establishment has been installed under the surveillance of the city, from whence a permit was obtained, and a locality in the Saint Honoré Market given for the purpose, the property to revert to the corporation at the expiration of 25 years, during which period the entire works are to be open to inspection by delegates and students of hygienic methods of laundering.

The method is such that articles pass rapidly

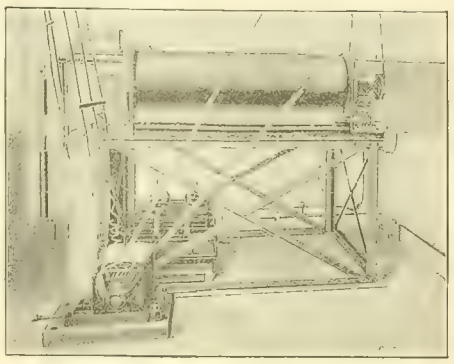


FIG 1. OZONE IN LAUNDERING. OZONE GENERATORS.

through the various processes from the first reception to the final delivery. The electric current destined for lighting the establishment, and for the "ozoners," which are actuated by eight motors, is developed by two vertical engines of 55 horsepower each, coupled directly to two dynamos of 37 kilowatts each, a total of 74 kilowatts. The "ozoners," of the Otto system, are located in a special room, expressly guarded against possible intrusion, because of the danger from the high potentials utilized for the work (see Fig. 1).

A package of soiled apparel on arriving is at once marked with a designating tag, which remains attached through the various processes, up to the delivery. The first move after tagging is shown in Fig. 2, where the employe is filling a tank. This being completed, the cover is hermetically sealed, and the ozone-saturated steam is turned on. At the expiration of about 25 minutes the tank or cylinder is discharged from the bottom, and the contents are now freed from all possible chance of infection from the microbes of smallpox, scarletina, tuberculosis,

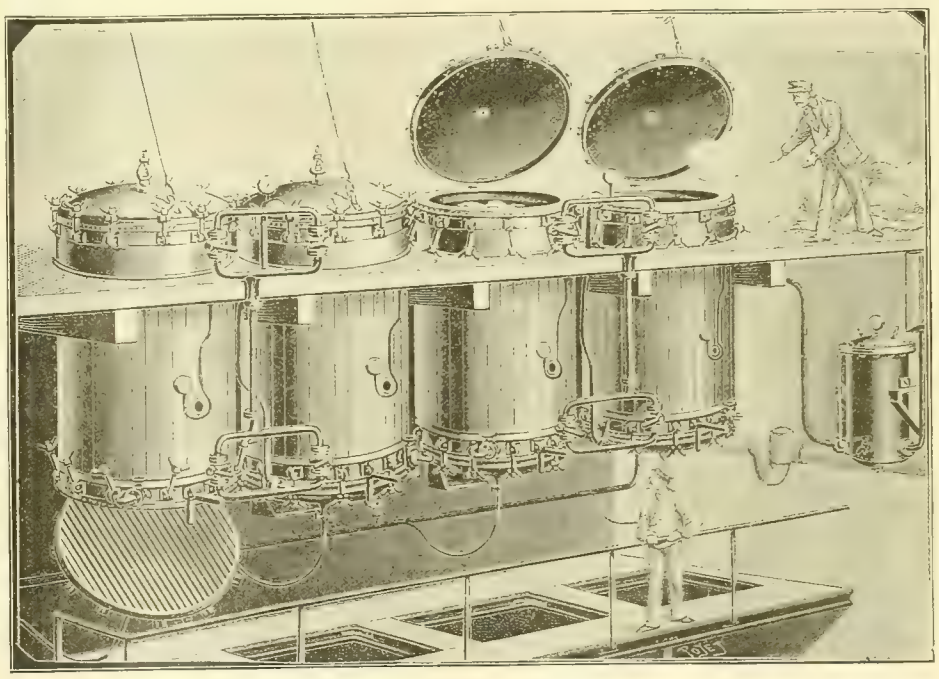


FIG 2. OZONE IN LAUNDERING.—DISINFECTING CYLINDERS.

etc., so that the employes of the laundry can manipulate the articles free from all fear of contagion.

Schönbein's experiments in 1840 showed that when water is decomposed by voltaic current, the electrodes being of gold or platinum, the oxygen, which appears at the positive pole, possesses in a high degree the properties which Van Marum called the "smell of electricity." When the positive electrode is formed of an oxidizable metal, these results are not shown, but the electrode is rapidly consumed. The oxygen so collected retains these properties for an indefinite period if kept in a closed vessel, but heat, or the contact with an oxidizable metal, or charcoal or oxide of manganese destroys them.

In 1845 the same investigator showed that the action of phosphorus on moist air developed the same gas. De la Rive and Marignac showed that sparks produced ozone in pure and dry oxygen and came to the conclusion that ozone is oxygen in an allotropic state, just as the diamond is a form of carbon.

Nature, in 1880, announced that ozone had been liquefied, as other gases had been before. Other experiments seem to indicate that ozone is explosive.

COMMUNICATION.

Do We Know the Law of Gravitation?

To the Editor of the Western Electrician:

It is almost like attacking a man's religion to question the accuracy of that sacred equation

$$f = K \frac{m_1 m_2}{d^2}$$

so long used to express the law of gravitation, but recent investigations of the writer have led him to believe that the law should be expressed

$$f = K \frac{m_1 m_2}{d^{2 + \frac{1}{d^n}}}$$

To fix the exact value of the exponent n, however, hardly seems possible with our present imperfect knowledge of the masses and distances apart of the centers of masses of molecules and atoms.

The question naturally arises, Why is the new equation preferable to the old?

First, let us consider the reliability of the old equation, which was "designed" to fit only the observed phenomena of the motion of the planets and the earth's attraction for the bodies near it. It is certainly reliable, so far as it stands the test of observation and experiment, but this has been for large values of d only. More accurate observations and experiments, especially with small values of d may show it to be, like Boyle's law, but an approximation. In fact, as far as past observation and experiment is concerned, any equation would express the law of gravitation just as well, provided only that it closely approximates the first equation for large values of d.

The new equation for large values of d gives values of f so close to those of the old equation that the difference is inappreciable, but as d grows smaller the f of the new equation increases faster than the f of the old, so that for molecular and atomic distances f becomes great enough to account for cohesion, adhesion and the so-called chemical affinity. In fact, the new equation was "designed" with this object in view.

Heretofore mathematical investigations based on the old equation have apparently proved that molecular attraction and chemical affinity could not be due to gravitation. With the new equation, this difficulty is removed, and it must be admitted by all that it is a possibility, if not a probability, that the same force that retains the planets in their orbits and draws bodies to the earth, also binds together the molecules and atoms. If this is indeed true, it opens the way to the solution of many problems as yet unsolved.

Gentlemen, the question is before you. Is it scientific to assume at least three arbitrary and independent attractive forces to account for what one attractive force alone, gravitation, will explain?

ARTHUR A. SKEELS.

Cleveland, Ohio, January 2, 1904.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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AUTOMATIC telephony has undoubtedly strengthened itself by its capture of Grand Rapids—capture, that is, so far as the local Independent service is concerned. Grand Rapids is a city of importance, and in telephone history is noted as a stronghold of the Independents. That the Citizens' Telephone Company of that city, with its experience and record of success, should choose the automatic apparatus when the time arrived to rebuild its exchange certainly furnishes food for thought. Other automatic exchanges in large cities have been installed almost uniformly by newly established companies. With them the adoption of automatic apparatus is not so significant, perhaps, as in the case of the Grand Rapids Company, which has learned the telephone business by the hard knocks of experience. We give an illustrated account of the new plant in the Michigan city in this issue, and our readers, particularly those connected with the telephone industry, will find it instructive and interesting. It appears that satisfactory service was given by the automatic switches from the first, but of course a final verdict cannot be passed on the result of a few days' experience. A year from now, perhaps, the Grand Rapids exchange will have demonstrated whether the automatic apparatus may be considered a success in a city of that size. In the mean time the automatic exchange in Chicago is giving service to an increasing list of subscribers, and so far with success, although the conditions here are somewhat complicated and not so clear-cut as in Grand Rapids. It is evident, from all indications, that the battle between the automatic and manual systems is on in earnest and must be fought to a finish. Both the Bell people and the Independents are intensely interested in the outcome. Happily, the contest is one of technical methods rather than pure business rivalry, and the result ought to show an improvement in telephone operation. The subject is to be discussed at the next Chicago meeting of the Institute on February 2d, and the local committee has shown commendable enterprise in choosing such a live and interesting topic.

RUBBER is so extensively used for electrical insulation, and it seems so difficult to find a suitable substitute, that it is disappointing to learn that the world's supply brought to market is diminishing rather than increasing. Statistics of the production for 1903 are not yet available, but some figures have been published recently purporting to show the total supply of rubber from different parts of the world, and, according to these, the production in the two years 1900 and 1902 decreased by some 3,500 tons—that is, whereas the total output in 1900 was 57,500 tons, that in 1902 was only 54,000 tons. It is interesting to examine the figures given for the different countries. The two main sources of supply are Brazil, Peru and Bolivia, on the one hand, and East and West Africa and the Congo country on the other. From the first group the total supply in 1900 was 25,000 tons, and from the second 24,000 tons, but while in the former case the production has increased, it has appreciably decreased in the case of the latter. Thus, Brazil, Peru and Bolivia contributed 30,000 tons to the world's supply in 1902 as against 20,000 tons for East and West Africa and the Congo country. A small supply is now being had from the Straits Settlements, but in 1902 the output was only 1,000 tons. In every other case the production shows a decrease. Various states of South America gave 3,500 tons in 1900 and 1,000 tons in 1902; Central America and Mexico gave 2,500 tons and 2,000 tons, respectively; Java, Borneo, etc., 1,000 tons in 1900 and nothing in 1902, and similarly the supplies from Madagascar and Mauritius and India, Burmah and Ceylon have ceased altogether. Thus, of the total supply of 54,000 tons in 1902 as much as 50,000 tons came from Brazil, Peru and Bolivia, and East and West Africa and the Congo country, which remain the world's chief sources of supply.

It will be noted with some surprise that if these figures are correct the supply of rubber from Central America and Mexico was 500 tons less in 1902 than in 1900. It has been hoped that parts of Mexico and the Central American states would add materially to the world's stock of rubber, and many American investors are familiar with glowing prospectuses of Mexican rubber plantations. The Philippines, too, have been looked upon as a possible contributor of importance. In the case of these islands it is too early to predict failure for these hopes, but so far as Mexico is concerned it looks as though the promoters have been over-sanguine. It takes several years to bring a rubber plantation to a productive stage, we believe, but surely, after all the clamor that has been made about Mexican rubber for the last decade, the figures of the two years mentioned should show some increase rather than an absolute decrease.

IN RELATION to the electrical equipment of the suburban service of the Illinois Central Railroad Company in Chicago, readers of the Western Electrician will be pleased to have the assurance, on the authority of a prominent officer of the company, that the subject is under careful consideration by the directors and officers of the company. As we understand it, the point to which study is now directed is one of policy. It is recognized that electrical operation has manifest advantages over the steam locomotives, particularly from the passengers' point of view, but the first thing to be decided is whether the change is feasible when considered as an economic proposition. If, with its present experience and knowledge, the company were to start, ab initio, to provide equipment for its suburban service, it would undoubtedly make use of electrically transmitted power. But it has a large outfit of steam locomotives and passenger cars built for the suburban service and not well adapted for use elsewhere in the system. To "scrap" this material, or even the locomotives alone, would involve a considerable sacrifice, even if the company were convinced—as it should be, of course—that electrical operation will compare favorably with steam, in point of cost, with interest on the investment included.

We have information that leads us to believe that the company has reached a point where it is willing to make the change as soon as it is convinced that it can do so without loss, or without much loss. Therefore, the present policy seems to be to get as much service as possible out of the existing equipment, with the idea that it is destined to be succeeded by apparatus adapted for electrical operation. Thus, we understand that no new steam locomotives for the suburban service have been purchased within the last two years. Likewise, the new side-door passenger cars have trucks adapted for electrical equipment. So that there is every indication that the Illinois Central is keenly alive to the trend of events and is making its plans to adopt electric power soon. In this attitude patrons of the suburban trains will discover the reason for the rather "run-down" condition of the cars—unusual on the Illinois Central—and will draw the conclusion that existing discomforts are to be succeeded by extensive betterments that will at once do away with the smoke-and-cinder nuisance and provide more modern and comfortable cars.

But while it seems to be pretty certain that the electrical conversion is bound to come, and come before long, it appears to be equally true that the dollars-and-cents aspect of the problem is the only one to which the company has given serious consideration so far. Engineering details will come later. Will there be overhead or third-rail contact? Will alternating or direct-current motors be used on the cars? Will there be electric locomotives or motor cars, or both? What system of transmission will be adopted? How far will the "electrification" extend? These and other interesting questions of like purport must remain unanswered for the present. But it is gratifying to learn that the company is seriously considering the application of electricity, with all indications favoring its adoption sooner or later. The suburban service of the Illinois Central is extensive, involving many miles of track, and the contracts for electrical equipment will be large. We congratulate the company on its attitude of intelligent study of the problem and sincerely hope that nothing may occur to prevent the seemingly imminent adoption of electricity, not only because such an improvement would be in the line of electrical progress but also because it would make for the betterment of the Lake Front of Chicago as well as one of the most important transportation systems of the city.

Erection of a 5,000-horsepower Vertical Turbo-generator.

At the meeting of the Chicago Electrical Association on January 8th Charles G. Y. King, mechanical engineer of the Commonwealth Electric Company, entertained and instructed the members with an illustrated lecture upon the steam-turbine power house now in process of construction by that company, known as the Fisk Street station. Lantern-slide pictures interspersed throughout the lecture showed the gradual growth of the plant from the beginning of the building up to the present, the part which was especially interesting being the construction and the installation of the two 5,000-horsepower units now nearing completion.

The growth of the electrical industry was aptly shown by three views showing, respectively, an old Edison plant of 20 years ago, the Harrison Street station of Chicago 10 years ago and one of the present mammoth units of the Fisk Street station. The plant of 20 years ago would not suffice to-day to excite one of the turbo units at Fisk Street; while the total capacity of the Harrison Street station 10 years back would only furnish the current of one of the generating sets toward which the eyes of the engineering world are now turned.

The ultimate capacity of the plant will be 14 turbo-generators. Each of the turbines will require eight boilers of 5,000 square feet heating surface to supply it with steam, so that the amount of space required for the generators is small compared with that of the boiler room. A view of the north front of the station, looking down in line with the row of generators, shows the boiler room to take up about half the width of the station, the generator room about one-fourth, and the train shed, where the coal is unloaded, about one-fourth. The smokestacks are 205 feet high.

In connection with the coal-handling apparatus, a new feature is to be noted. In the ordinary apparatus of this sort much fine coal is wasted by sifting through the conveyors and falling into the ash pit. This is now saved by a chute in connection with the conveyor which collects such fine coal and carries it to a special hopper, whence it is fed to the boilers.

One of the turbines is now practically completed and preliminary tests have been made for the purpose of readjustment. The other is well along in erection.

To begin with, the installation of the machinery requires a very heavy foundation construction. This is entirely of concrete laid upon piles driven 50 feet to solid rock. Each pile is capable of sustaining a dead weight of 20 tons. To date in the construction of the building 4,996 such piles have been driven.

In the process of construction of the foundation a template of wood is first built up, of the shape of the desired formation, the concrete being then laid on in layers inside the template. The necessary bolts for the base plates are held in place and securely embedded in the concrete.

First after the concrete comes the bed plate, and upon this is bolted the distance piece between the bed plate and the first stage of the turbine.

The footstep for the vertical shaft is then fastened to the bed and the shaft lowered into place, which is a piece of work requiring the utmost care. Following this comes the bucket wheel, which is a large disk, cast solidly, the buckets being bolted onto its edge in sections. There are 1,000 buckets on the wheel. After the bucket wheel is in place the first stage of the turbine is put on. All this work requires great accuracy in handling the crane, as the parts are extremely heavy and fit to a nicety.

Now comes the stationary armature field, which rests upon the top of the turbine casing. The armature, together with the wiring and casing, weighs 50 tons and is six feet 10 inches in diameter. Inside it, on the vertical shaft, is next mounted the revolving field, 45 tons in weight, with its pole pieces heavily strapped with steel bands to resist the enormous centrifugal force due to the high velocities.

The unit is now complete, except for the accessories, such as the governing apparatus, etc., which are added afterward.

Between the footstep in the base and the lower end piece of the shaft a film of oil three to four thousandths of an inch in thickness, is kept circulating at a pressure of 1,200 pounds to the square inch, preventing wear on the bearing surface. A device operated by a worm and gear enables the attendant to raise and lower the whole moving part of the turbine and adjust it to the thousandth part of an inch.

The inlet steam pipe for each turbine comes from the boiler room and divides into two branches, one going to the valves on each side of the turbine. There are a large number of these valves on each side, each opening betwen a pair of blades in the first stage of the turbine. Each valve is operated by a solenoid, whose circuit is closed by contacts arranged spirally on a drum which is rotated by a steel ribbon coming from the centrifugal governor.

As the speed increases, the governor operates to revolve the drum in a direction which successively energizes the solenoid circuits to close valves until the number of buckets receiving steam is cut down sufficiently for the speed to fall off again.

The main steam pipe is fitted with a butterfly valve which can operate automatically and shut off steam in case the turbine for any cause should attempt to race.

An important part of the installation is the condenser, of which several views were shown. The condensing water is pumped in by a centrifugal pump 10 feet in diameter. One condenser is used for each unit and each contains 4,775 tubes 16 feet 2½ inches in length.

During the lecture Mr. King showed one view of the comparative size of a turbo unit from the ground to the top of the governor and a vertical cross-compound reciprocating engine of an equal capacity. The extreme top of the turbo unit came on a level with the center of the shaft of the reciprocating engine, and from this it can be conceived that, when it comes to cubical contents, the steam turbine is much smaller than its rival, which stands close to 50 feet from foundation to the top of the low-pressure cylinder.

Northwestern Electrical Convention.

The twelfth annual convention of the Northwestern Electrical Association will be held in Hotel Pfister, Milwaukee, Wis., on January 20th, 21st and 22d. An interesting and instructive programme has been prepared. It is as follows:

WEDNESDAY MORNING, JANUARY 20TH

Convene at 11:30 a. m. Roll call. Reading of the minutes of the previous meeting. Annual address by President F. W. Bowen of Kenosha, Wis. Reports of secretary and treasurer.

WEDNESDAY AFTERNOON.

Appointment of nominating and membership committees. Applications for membership. Reports of all committees except nominating. Miscellaneous business.

Paper—"Storage Batteries for Central-station Work," by J. M. S. Waring of Chicago.

Paper—"Peculiarities of Magnets," by Richard Varley of Providence, R. I.

Paper—"Rectifiers," by W. Sheidel of Chicago.

WEDNESDAY EVENING.

Theater party.

THURSDAY MORNING.

Paper—"Double-current Generators and Their Connection with Double-current Supply," by W. L. Waters.

Paper—"Central-station Heating," by W. H. Schott of Chicago.

Paper—"Standard Practice in the Use of Alternating-current Electrical Apparatus," by J. J. Gibson.

THURSDAY AFTERNOON.

Report of nominating committee and election of officers.

Paper—"Steam Turbines" (illustrated), by James Lyman, Chicago.

Paper—"Rectifiers," by Professor C. F. Burgess, University of Wisconsin.

Lecture—"Radium". (illustrated), by Professor R. A. Millikan, University of Chicago.

THURSDAY EVENING.

Annual banquet.

FRIDAY MORNING.

Unfinished business. Adjournment.

The sessions will be held in the convention hall on the second floor of the Hotel Pfister. Manufacturers will make exhibits in the rooms and corridors of the hotel.

It is expected that a large party will go from Chicago. James Wolff, master of transportation, as in former years, has arranged for special cars on the Chicago and Northwestern train for Milwaukee leaving the Northwestern station in Chicago at 9 a. m. on January 20th.

Following is a list of the names of the present officers of the Northwestern Electrical Association: President, F. W. Bowen of Kenosha, Wis.; first vice-president, A. M. Barron of South Bend, Ind.; secretary and treasurer, Thomas R. Mercein, Milwaukee; directors, S. B. Livermore of Winona, Minn., T. F. Grover of Fond du Lac, Wis., and J. H. Harding of Laporte, Ind.

Freight Handling by Electric Railway.

There is a plan on foot to establish in Detroit, Mich., at least four freight-receiving stations in the extreme corners of the city, to be connected with the various steam-railway and boat freight depots by electric street-car lines. This is being considered by the Detroit United Railway and the Board of Commerce, acting in conjunction with a committee appointed by the City Council. A definite plan of action has not been determined yet, but the plan is to establish a freight-receiving station in each of the big manufacturing districts in the north, east, south and west corners of the city. The freight accumulated will be conveyed to the railroad and boat warehouses at regular intervals by electric cars. This, it is figured, will save much time in handling shipments of all kinds. Now the freight must wait for cars to be brought to the sidings or must be hauled across the city to the railroads. It has also been proposed to have the Detroit United Railway build an electric freight belt line around the city.

Iroquois Fire Investigation.

By the coroner's count 572 deaths have occurred as a result of the Iroquois Theater fire. Mrs. and Miss Owens, who were among those who lost their lives, were the mother and sister of Roy Owens of the Automatic Electric Company. The slight disparity in number between the newspaper reports and the official record of the coroner is due, no doubt, to the fact that some of the bodies were moved from one morgue to another, and a few were counted twice by the newspaper representatives.

The results of the coroner's inquest so far have gone to show only too well the lack of necessary fire precautions, which caused the disaster. The building, though without doubt fireproof in itself, with its contents and just the right train of circumstances, became the worst fire trap known in the history of the country.

The direct cause of the fire, as was reported at first, was an open spotlight situated above the switchboard and not owned by the proprietors of the theater but by the Bluebeard Company. The flames originated, according to what appears to be a preponderance of evidence, by the edge of a drapery over the proscenium arch blowing into the open arc or very near it, as was testified by several witnesses among those who were on the stage at the time.

Stationary Engineer Robert E. Murray was an important witness at the inquest, as he had rushed upon the stage immediately after the fire broke out. He testified as did many other witnesses that the asbestos curtain caught on the proscenium-light reflector, which was swung out from its normal position. He also stated that there were no precautions for fire on the stage except kilfyre tubes. There were four standpipes in the house, but only one hose, which was in the front of the building. It also was testified by this witness that there were no fire-alarm boxes in the building, and that a telephone in the front office of the building on the second floor was the only means in the building for turning in an alarm. As to skylights over the stage, conclusive proof was shown that these were not electrically operated but could be raised by releasing a counterweight, which was not done at the time of the fire.

Another important witness was William Wiertz, who was operating one of the lights on the stage. He stated that the spotlight in question was not directly under the curtain and that at the time of the "moonlight" scene a blue shade was over all the lights. As to the inclosed spotlight on the bridge over the switchboard (the lens-box light) the witness said that the inside of the casing was lined with asbestos paint and that in front of the carbons there was an asbestos blind, so that the glare of the carbons would not fall directly on the scene. He also said that all the connections were carefully insulated with rubber tape.

The investigation has shown without doubt that there was no sprinkling apparatus above the stage and that no proper signs were placed over the exits, most of which were closed and locked. Iron gates barred the way on the stairs leading from the balcony to the dress-circle entrance, and it was stated at the hearing by Manager George N. Dusenbury of the auditorium part of the theater that these gates were locked when the fire broke out and the rush came.

After the Iroquois fire the mayor immediately caused all theaters and places of amusement closed. A City Council committee then set about preparing a new fire ordinance, intended to prevent a recurring disaster. Among the clauses of the new ordinance, which are likely to be adopted, are the following: No more calcium lights shall be used on stages in Chicago; the switchboard shall be inclosed with a fireproof screen; all arc lights used on the stage must be approved by the city electrician; a telegraph alarm-box must be placed in the theaters; all fuses must be of the fireproof-inclosed type; a system of lighting for the auditorium and entrances independent of the stage system shall be installed, the circuits of which shall be entirely independent of every other circuit in the house.

It is also proposed to compel either an open space on four sides of the building or else a fireproof-inclosed passageway for the fire escapes. Automatic-sprinkling apparatus must be installed over the stage. An open-elevator shaft with sprinkler may be substituted for an inclosed shaft. Steel fly galleries and rigging lofts shall be built.

Northwestern Cedarmen's Association.

The annual meeting of the Northwestern Cedarmen's Association was held at the Auditorium Hotel, Chicago, Tuesday, January 5th. It is interesting to electrical men from the fact that the cedarmen are large pole producers. The meeting was well attended and was pronounced a most successful one. Although the majority of the members of this association operate in the Northwest, Chicago has become the recognized center of the cedar-pole men and as a consequence the Chicago members felt that it was time that the convention was held in this city.

The business session occupied the attention of the members during the entire afternoon, the greater part of which was taken up with discussions, of which the meeting was prolific. Reports from members indicated that the cedar trade was in a fair condition.

The meeting was called to order by Treasurer Reade. M. K. Bissell of Escanaba, Mich., was chosen chairman, and the routine business of the meeting was begun.

The secretary read the annual address of President R. H. Downing (who was prevented from attending by illness), which was, in part, as follows:

"The first paragraph of your constitution and by-laws reads as follows: 'The title of this organization shall be the Northwestern Cedarmen's Association, and its object shall be to secure a full understanding of the conditions surrounding the white-cedar market in the territory covered by this association, the establishment of uniform weights and rules for the inspection of cedar as legitimate basis for more nearly uniform prices, and to propose and carry out such other measures as may be deemed for the welfare and in the interest of wholesale dealers in and manufacturers of white cedar, members of this association.' This covers the whole ground—'secure a full understanding of the conditions surrounding the market as a legitimate basis for more nearly uniform prices' and give the information to the members so they can profit by it. This is all it can be expected to do. It simply proposes to collect or secure information for you and place it before you in such shape that it will enable you to know what you should obtain for your product.

"When the association was first organized and manufacturers and dealers began to take some interest in it the white-cedar industry was in a rather chaotic condition. There was no uniformity in prices or weights, no specifications as to quality or kind; each man was a law unto himself and wanted to be to his competitor. All this has been changed. The delivered lists based on shipment from one central point equalize all prices; the rate classification books issued by the association, from a financial standpoint, are alone worth all it costs any of you for membership and dues. The price lists are compiled by committees who are or should be experts in their line and in closest touch with the market, and, although I have heard expressions of opinion to the contrary, I believe no list has ever been issued that was not an honest opinion of the committee as to the values that could be obtained at the time. This is all the association promises to do for you, and none of you can truthfully say it has not fulfilled its promises. It has done more. The last three years have been years of quickly shifting values; prices of all commodities have advanced without concerted action by the association. None of us would have obtained what we did for our material, and no doubt some of us would be selling at 1893 prices. So much for what it has done.

"What are its possibilities? What benefits can you expect from it in the future? I have stated that values have advanced for the past three years. Unfortunately, this is not exactly correct. Like almost all other commodities, that in which you deal has taken a decline in the last six months. As you have always obtained better results by united action in securing any advance the market justifies, it is common sense to assume that united action would more quickly stop an unwarranted decline. With the country in excellent financial condition, with the water squeezed out of a large number of over-capitalized industrial concerns, and inflated values of stocks and commodities and prospects getting better every day for a year of good business, why should we not by united action now make a strong effort to hold prices steady for a product that has never had an inflated value? For, good as the prices may seem that you have been getting the last two or three years, there is no other forest product that does not bring a higher average price per carload than white cedar.

"My remarks are chiefly for those who handle posts and shingles, but they apply with equal force to members engaged in the pole business. To them I would say, do not believe you can fool your competitor by talking high price and good demand to him when you meet him, and then cut the life out of the first contract you get a chance to bid on; he is doing the same thing. Get together; agree on a reasonable price and stand by it; there is going to be business enough for you all.

"I would request of my successor to be careful in the selection of committees. The best men we have should be appointed on them and they should meet often, and it seems to me it would be a good plan for the association to have a general meeting in April or May, after the winter's operations are completed, to discuss prevailing conditions and make any changes in the list that might be desirable."

Secretary Gilman, in the course of his report, said:

"The last year has been a fairly good one for our members, but not as prosperous a year as some of its predecessors. There has nothing occurred, however, during the year that has warranted calling a special meeting of the association, and there have not been any changes made in the recommended price list since May 10th last. How well the prices have been maintained you who are engaged in selling the trade know.

"During the last year our association has held its own as far as membership is concerned. We have lost some members by firms going out of business and have gained some others, so that we have a membership of 73 in seven states, mostly, however, in Illinois, Wisconsin, Michigan and Minnesota. Since our annual meeting a year ago we have lost six members, as follows: Humbird Lumber Company, Sand Point, Idaho; Holcomb-Lobb Company, Chicago, Ill.; A. D. Day & Co., Engadine, Mich.; C. Harter & Son, Pembina, Mich.; Ross Bros. & Co., Spaulding, Mich.; Parkinson Cedar Company, Madison, Wis. We have gained six new members., viz.: Maltby Lumber Company, Bay City, Mich.; R. Connor Company, Marshfield, Wis.; John R. Davis Lumber Company, Phillips, Wis.; Page & Hill Company, Minneapolis, Minn.; Bay De Noquet Company, Nahama, Mich., and L. H. Roberts, Paton, Iowa.

"We have had several applications for membership from jobbers who put in stock in the woods and sell it in bulk to our members. Owing to the change made in our eligibility clause two years ago it has not been possible to admit to membership such concerns, as our organization, as generally interpreted, is a selling organization.

"We have had a great deal of correspondence during the last year with handlers and large users of cedar products all over the United States, and many applications for our rules for inspection and tables of weights, showing that our association is being universally recognized as authority on white-cedar products. There has been a noticeable increase in applications for matter of this sort, which I believe is a good indication and one that bespeaks for our association a standing in the trade.

"Our association might accomplish more if it were possible to devise some way of compelling members to maintain prices, but this is not possible or practical in an organization such as this. By having a recommended list, and keeping members in touch with the situation, together with a meeting once or twice a year, our association accomplishes a great deal of good, but beyond this we cannot very well go. If it were possible to gather tabulated statistics showing amounts of stock on hand at the different seasons of the year our association could be made more valuable to its members, and that some effort be made in this direction I would recommend.

"The getting out of freight-classification books each year, while expensive, has been found to be of great help to members. During the last year some changes were made in the tariff, so that our books could be relied upon during the latter part of the year. As the cost of issuing new books is quite large, it might be well in the future to issue supplements as changes in rates are made, and in this way members can keep their books corrected to date.

"On June 12th last our board of directors took favorable action regarding the adoption of the terms of the National Lumber Manufacturers' Association, of which you were all advised at that time. These terms are now, I believe, being quite generally adhered to by our members in the sale of posts and shingles to the yard trade. This movement puts our association in line with all of the wholesale lumber associations of the country."

Treasurer H. W. Reade then presented his annual report.

The report of the post and shingle committee was presented by F. J. Lange, the chairman, and it resulted in a long discussion on the trade and price situation. It developed that the cost of producing cedar stock has greatly increased during the last few years, necessitating members obtaining firm prices in order to realize a small profit. C. H. Worcester reported for the pole committee that it would not recommend any price list.

Hall L. Brooks reported for the official inspection committee as follows: "The committee on inspection recommends that the inspection rules remain as they now are."

The chairman appointed C. H. Worcester, A. P. Hopkins, E. H. Valentine, J. K. Wright and George Nicholson, Jr., as the nominating committee.

A recess was taken while the nominating committee prepared its report, which recommended the following-named officers and directors for the ensuing year:

President—H. W. Reade, Escanaba, Mich.

Vice-president—Daniel MacGillis, Milwaukee, Wis.

Directors—E. H. Valentine, Chicago; O. Erickson, Escanaba; M. H. Coolidge, Minneapolis; F. W. Robinson, Bovee, Mich.

The report of the committee was adopted and the officers declared elected. Chairman Bissell then called the newly elected president to the chair, which he took with the dignity of an old presiding officer. G. L. Lindsley invited the members present to attend a dinner at 6:30 p. m., as the guests of the Chicago wholesalers and others. A vote of thanks to the retiring officers was passed, after which the convention adjourned.

A meeting of the newly elected board of directors followed, at which the resignation of Fred H. Gilman, who has been secretary of the association for the last three years, was presented and accepted. Mr. Gilman gave as his reason for resigning that he expected to be absent most of the time the coming year on the Pacific Coast and would not be able to attend to the duties of the office. John F. Hayden of Minneapolis was elected secretary and W. B. Thomas of Manistique, Mich., was elected treasurer for the ensuing year. The secretary was instructed to issue a supplement to the freight-classification books, correcting them to date.

In the evening the members and guests attended a banquet at the Union League Club, as guests of the Chicago contingent. The arrangements for the banquet were made by C. H. Worcester, E. H. Valentine and George L. Lindsley, and the affair was most enjoyable. E. H. Valentine was toastmaster and performed his duties in his usual witty and satisfactory manner. Among those who responded to toasts were President Reade, Fred H. Gilman, J. T. Hayden, A. P. Hopkins, M. B. Cross, Marshall H. Coolidge, C. H. Worcester, George L. Lindsley, O. Erickson and Hall L. Brooks.

President Reade.

In electing H. W. Reade president, the members of the Northwestern Cedarmen's Association have made an admirable selection. Mr. Reade is one of the most popular men in the cedar-pole business and possesses those traits which characterize the successful business man. He is secretary and treas-

H. W. READE, PRESIDENT NORTHWESTERN CEDARMEN'S ASSOCIATION.

urer of the Pittsburg and Lake Superior Iron Company of Escanaba, Mich., which is numbered among the largest producers of cedar poles, ties, etc. His connection with this company dates back 16 years and he has been actively engaged in the cedar-pole business during the last 11 years. Mr. Reade has seen the Northwestern Cedarmen's Association grow from the first meeting of a handful of struggling dealers up to its present satisfactory proportions, and takes pride in the fact that the association is now recognized in all parts of the United States where cedar products are used and in the further fact that the output of the cedar firms composing the association represents several millions of dollars. Mr. Reade was treasurer of the association during the last five years. With so energetic a man as Mr. Reade at its head, it is safe to say that the Northwestern Cedarmen's Association will this year add to its standing and influence in the cedar trade.

Convention Notes

C. J. Huebel of the C. J. Huebel Company of Menominee, Mich., was, of course, on hand.

E. E. Kaufman of the Carney Bros. Company, Chicago, represented the interests of that well-known concern.

Messrs. Erickson and Bissell of Escanaba, Mich., were both on hand. They renewed acquaintance with many friends.

Hall L. Brooks of Tomahawk, Wis., accused of being the man with "the smile that won't come off," was a prominent figure at the meeting.

J. K. Wright, one of the oldest men in the cedar business, managed to find time to run down from Marinette, Wis., and give his advice to the association.

James Jeffrey represented the interests of the William Mueller Company of Chicago, in the absence of William Mueller, Jr., who was unable to attend the meeting.

A. Maltby, president of the Maltby Lumber Company of Bay City, Mich., though one of the new members of the association, was one of the most respected delegates.

M. B. Cross, manager of the cedar department of Francis Beidler & Co., Chicago, though a comparatively new man in the pole business, was instrumental in looking after the welfare of the visitors.

Mr. Cross also looked after the Beidler interests with his characteristic ability and was assisted by J. C. Schrader.

A. T. Naugle of the E. E. Naugle Tie Company, Chicago, was, of course, in attendance, for a cedarmen's convention would be lonely without him. This year Mr. Naugle was assisted by T. B. Conover.

The Valentine-Clark Company's interests were looked after by President E. H. Valentine. Mr. Valentine seldom attends conventions, but of late years he has managed to attend the cedarmen's meetings.

A. P. Hopkins, president of A. P. Hopkins & Co., Escanaba, Mich., who has not attended the meetings of the association for several years, was present, and it is safe to say that the convention felt honored by his presence.

John H. Fowler of Chicago was one of the conspicuous figures at the meeting. Mr. Fowler's pole interests have increased wonderfully within the last two years, and his untiring energy bids fair to bring him even nearer the top.

No member of the association is more highly respected than Marshall H. Coolidge of Minneapolis. Mr. Coolidge is one of the oldest cedar-pole men in the Northwest and his presence at this meeting was hailed with delight.

No convention would be complete without that representative cedarman, George L. Lindsley, president of the Lindsley Bros. Company of Chicago. He was ably assisted in looking after the Lindsley interests by Assistant Manager J. Allan Navarre.

D. M. Fulmer and J. W. Fulmer represented the interests of the Fulmer-Kuester-Schroeder Company of Chicago. This company was recently organized to handle its constantly increasing trade and is an outgrowth of the D. M. Fulmer Lumber Company.

J. A. McDevitt, superintendent of the Cloquet Tie and Post Company, came all the way from Cloquet, Minn., to attend the meeting and get acquainted with its members. Mr. McDevitt thinks the coming season will be a most prosperous one for the tie and pole men.

Although one of the most popular men in the pole business, the efforts of H. W. Reade, secretary and treasurer of the Pittsburg and Lake Superior Iron Company of Escanaba, Mich., to make everyone feel at home at this meeting, added to his already enviable reputation.

It was a matter of regret that two of the most popular delegates, President R. H. Downing and H. S. Gilkey, of Minneapolis, were unable to attend the meeting, owing to illness. The association, however, did not forget them, and Secretary Gilman was instructed to telegraph these members the best wishes of the association.

No more popular pole man exists than C. H. Worcester of the C. H. Worcester Company, Chicago. Mr. Worcester is and always has been one of the moving spirits of the association, and it is a pleasure to note the high esteem in which he is held by the members. Mr. Worcester was ably assisted in looking after the company's interests by Secretary and Treasurer W. P. Bowring, who has been accused of "saying little but doing much."

MEMBERS AND GUESTS.

Among those in attendance at the meeting were the following-named:

Bissell, M. K., Erickson & Bissell.....Escanaba, Mich.
Brooks, Hall L.....Tomahawk, Wis.
Bowring, William P., C. H. Worcester Company....Chicago.
Bruett, T. A., Wilbur Lumber Company.....Milwaukee.
Clark, L. C., American Telephone Journal.....Chicago.
Collins, W. Forman, Western Electrician.....Chicago.
Conover, T. B., E. E. Naugle Tie Co.....Chicago.
Coolidge, Marshall H., Marshall H. Coolidge Co..Minneapolis.
Cross, M. B., Francis Beidler & Co.....Chicago.
Erickson, O., Erickson & Bissell.....Escanaba, Mich.
Farnsworth, Geo. J., Bay DeNoquet Co.....Nahma Mich
Fitzgibbons, J. H., Wisconsin Timber and Land Co.....
..... Mattoon, Wis.
Forbrich, C. W., Western Electrician.....Chicago.
Fowler, John H., Fowler-Jacobs Co.....Chicago.
Fulmer, D. M., Fulmer-Kuester-Schroeder Co.....Chicago.
Fulmer, J. W., Fulmer-Kuester-Schroeder Co.....
..... Florence, Wis.
Gerich, J. E., MacGillis and Gibbs Lumber Company..
....Milwaukee.
Gilman, Fred H., American Lumberman.....Minneapolis
Haines, A. W., Holt Lumber Co.....Chicago.
Hayden, J. T., Mississippi Valley Lumberman..Minneapolis.
Hooper, J. R., American Lumberman.....Chicago.
Hopkins, A. P., A. P. Hopkins & Co.....Escanaba, Mich.
Huebel, C. J., C. J. Huebel Company....Menominee, Mich.
Jeffery, J., Wm. Mueller Co.....Chicago.
Kaufman, E. E., Carney Bros. Company.....Chicago.
King, J. C., King & Bartles Lumber Co.....Cleveland, O.
Lang, F. J., Wisconsin Land and Lumber Company....
....Hermansville, Mich.
Lindsley, Geo. L., Lindsley Bros. Company.....Chicago.
Maltby, A., Maltby Lumber Co.....Bay City, Mich.
Mackenzie, W. R., Brittingham & Hixon Lumber Co.....
....Madison, Wis.
McDevitt, J. A., Cloquet Tie and Post Co....Cloquet, Minn.
McDonough, W. H., American Telephone Journal.....
....New York.
McMeal, H. B., Telephony.....Chicago.
McQueen, W. W., Kellogg Switchboard & Supply Co.....
....Escanaba, Mich.
Mock, Ed. J., Telephony.....Chicago.
Naugle, A. T., E. E. Naugle Tie Company.....Chicago.
Navarre, J. Allan, Lindsley Bros. Co.....Chicago.
Nicholson, George Jr., White Marble Lime Company....
....Manistique, Mich.
Perry, Frank L., Western Electrician.....Chicago.
Raber, P. W., Raber & Watson.....Chicago.
Reade, H. W., Pittsburg and Lake Superior Iron Com-..
pany..... Escanaba, Mich.
Roberts, L. H.....Paton, Iowa.
Robinson, F. W., Robinson-Freeman Company..Bovee, Mich.
Schalck, Frank R., Western Electrician.....Chicago.
Shrader, C. J., Francis Beidler & Co.....Chicago.
Smith, Elmer E., Telephony.....Chicago.
Snell, Frank N.....Milwaukee.
Thomas, W. B.....Manistique, Mich.
Valentine, E. H., Valentine-Clark Co.....Chicago.
Werner, F. W., Bradley-Watkins Company.....Minneapolis.
Wheeler, W. G.....Rockford, Ill.
Worcester, C. H., C. H. Worcester Company.....Chicago.
Wright, J. K., Wright Bros.....Marinette, Wis.

SOME OF THE DELEGATES TO THE NORTHWESTERN CEDARMEN'S CONVENTION.

Spokane-Cœur d'Alene Electric Railway.

The electric line connecting Spokane, Wash., and Cœur d'Alene, Idaho, of which much has been written, has commenced regular service over its entire length of 34 miles. The first run was made in one hour and 35 minutes, with power supplied from the main power station; this time will be reduced to one hour when the sub-stations are ready for service. It is believed in Spokane that the enterprise will be a success from the start, and if it so proves extensions will be at once built to Medical Lake, 16 miles away, and into the Palous country, via Waverly, 40 miles south of Spokane.

As soon as possible arrangements will be made to operate freight trains over this line at night, using steam power. The new line runs through the Spokane Valley, touching at Post Falls, Idaho, and at Liberty Lake, which is another summer resort. The valley is now having several irrigation ditches constructed and will soon support a considerable population.

Institute Meeting in Chicago.

President Arnold was in the chair at the Chicago meeting of the American Institute of Electrical Engineers on January 12th. Lamar Lyndon's paper on "The Comparative Behavior of Floating and Booster-controlled Batteries on Fluctuating Loads," presented at the November meeting in New York city and printed, in abstract, in the Western Electrician of December 19th last, was read in abstract by J. M. S. Waring of Chicago. In the discussion George A. Damon of Chicago, Joseph Appleton of Philadelphia, John I. Beggs of Milwaukee, B. J. Arnold of Chicago and Ernest Lunn of Chicago took part. The second feature of the evening was the paper by J. R. Bibbins of New York on "Gas Power for Central Stations." Mr. Bibbins was present, and read an abstract of his own paper. This paper is in abstract elsewhere in this issue. Those taking part in the gas-engine discussion were Mr. Arnold, Mr. Beggs, George N. Eastman, C. E. Sargent and W. L. Abbott of Chicago, C. H. Williams of Madison, Wis., and Mr. Bibbins.

The meeting was of exceptional interest and well attended. The next meeting in Chicago will be held on February 2d and will be a telephone meeting, the important question of manual versus automatic operation being discussed.

An Edison Medal for Students.

In order to celebrate the twenty-fifth anniversary of the introduction and commercial development of the incandescent lamp, the friends and associates of Mr. Thomas A. Edison have taken steps to found a medal which will be entrusted to the American Institute of Electrical Engineers, and which it is proposed to award annually to graduating students in electrical engineering. The Institute has already accepted the trusteeship of this fund and announces that it is the intention that the medal shall be awarded each year to the graduating student who shall present the best thesis on some original subject, from the universities and colleges of the United States and Canada which have regular courses in electrical engineering. It is proposed that the medal shall be executed by some artist of distinction and that if possible a permanent fund of about $5,000 shall be established for its maintenance. To carry this purpose into effect an Edison Medal Association has been organized, and it is proposed to present the medal fund at the annual dinner of the Institute at the Waldorf-Astoria in New York on February 11th, at which Mr. Edison is expected to be a guest of honor. The Edison Medal Association has as its officers Samuel Insull, chairman; Charles Batchelor, vice-chairman; Frank S. Hastings, treasurer, and Robert Ten Eyck Lozier, secretary.

The Capelitas Mining Company, which is extensively engaged in copper mining in the Argentine Republic, is putting in a modern plant, including electric motors and an aerial railway operated by electricity.

Gas Power for Central Stations.[1]

By J. R. Bibbins.

At the present time two competitors of the reciprocating steam engine—the steam turbine and the gas engine—seem to be attracting attention. Engineers, particularly, are interested. Heretofore the interest taken in gas-engine plants seems to have been confined chiefly to those operating in foreign countries, but as there are a number of successful installations of this kind in the United States, it might be of interest to present a few facts about their operation. Possible future developments in this field of engineering activity will also be considered.

It is intended in this paper to offer testimony upon four contentions, viz.:

(A) That present gas-power machinery is suitable for central-station service.

(B) That a well-equipped gas-power electric plant can operate with far better economy than a steam plant under similar conditions.

(C) That its operation is much simpler and requires less running expense for the same results.

(D) That gas works, laboring under low load or output factor, can profitably install a gas-power electric generating station, and become its own largest customer, selling both gas and electricity at competitive rates.

The basis of this paper consists of data collected from various electric-light and power plants in the United States using gas engines as their principal motive power. A number of these plants being operated in connection with illuminating-gas works, it has been possible to observe the somewhat unique position of the gas-engine station as a direct though affiliated competitor of the gas works.

Equipment.—Table I. presents the most important data upon the general equipment and service rendered by the first 12 plants considered. The identity of the exhibitors is withheld, in most cases by request, thus making available more complete and valuable data. These plants are located in centers ranging from 2,000 to 20,000 inhabitants, and, in most cases, where the cost of fuel is high. The equipments average about 315 brake-horsepower capacity and operate every standard form of generator for arc and incandescent lighting and for railway or general power service. All the generators are belted, the majority directly, but a few through the medium of the jack shaft, the latter arrangement being employed in order to obtain the desired flexibility of service without installing a number of engines of small size. Figs. 1 and 2 are typical of these two styles of plants.

Plants 13 to 15 are somewhat larger and generate polyphase power for industrial works. These three plants average approximately 570 brake horsepower and the units are all direct-connected and run in parallel. Fig. 3 shows a typical installation. Operative results have been obtained from plants 1 to 11, inclusive, the first and last furnishing excellent data upon the comparative economy of the present gas engines and the steam engines which were replaced.

Table I.—Gas-power Plant Equipment.

Plant Number.	Engines: Rated Capacity Full Load BHP.	Engines: Number.	Engines: BHP.	Transmission: Character.	Transmission: Efficiency.	Generators: Incandescent Power.	Generators: Railway.	Generators: Arc.	Total Kilowatt Generating Capacity.	BHP Gen. / BHP Eng.
1	685	3	125-280	Belt	82.5	1 φ.	550 V.D.C.	....	370	.845 (a)
2	170	2	85	"	80	..		230 lts.	112	1.000 (b)
3	110	2	55	Jack-shaft	75	2 φ.	....		75	1.2
4	90	2	35-55	Belt	80	1 φ.			40	0.93
5	220	4	55-125	Jack-shaft	75	3 φ.		60 lts.	232	1.16 (c)
6	240	4	55-125	"	75	2 φ.			215	1.14
7	305	[illegible]	55-125	Belt	82.5	1 φ.			260	1.38
8	280	1	280	"	80	1 φ.		50 lts.	152	0.91
9	...	2	55-85	"	...	1 φ.		...	...	...
10	85	1	85	"	80	1 φ.			60	1.17
11	807	6 (x)	125-210	"	82.5	1 φ.		200 lts.	476	0.97 (d)
12	255	[illegible]	85	"	80	2			116	0.78 (e)
Average.	314									
13	775	[illegible]	125	Direct-connected	85	2 φ.			75	0.94 (f)
14	591	4	125	"	85	2			75	0.96 (f)
15	540	[illegible]	280	"	85	2			150	.85 (f)
Average..	568									

(a) Largely railway load—running 15-18 hours per day.
(b) Exclusively arc.
(c) Monocyclic system—runs 24 hours per day.
(d) Plants operate 24 hours per day—natural gas.
(e) Natural gas.
(f) Operates in parallel—natural gas.
(x) Eight-horsepower engine belted to air-compressor and pump.

Service Requirements.—In considering the subject in hand from an unbiased standpoint, it is important to enumerate the qualifications imposed upon the gas engine, in order to determine its actual merits.

1. Continuity of service at any cost.
2. Simplicity of operation, conducing to the above and securing low cost of attendance.
3. Reasonable cost of equipment.
4. Economy of fuel and supplies.

A 65-horsepower, two-cylinder vertical engine of the type employed in the plants here considered has made the following record:

Load	fan blower.	
Total elapsed time	8,472 hours.	100 per cent.
Hours run	8,230 hours.	97 per cent.
	Hours Shut Down.	
Changing igniters	38 hours.	0.45 per cent.
Taking up [illegible]	[illegible]	[illegible] per cent.
Painting	[illegible]	
Repairing blower	5 hours.	
Changing gas supply	[illegible]	
Total	242 hours.	[illegible] per cent.
Ditto chargeable to engine		0.6 per cent.

During this period the engine ran, without stopping, 1,157 hours, and was then shut down to repair a broken belt.

In a pumping station located on the Allegheny, a short distance from Pittsburg, five 85-horsepower engines of the same type operate regularly at full load through the week without stopping, except on Sunday; when the units are shut down in rotation for inspection and repair. Each engine operates from 96 to 98 per cent. of elapsed time. It is needless to state that such service would not be required in central stations, as reserve capacity should be available for use during peak loads. In the present exhibit, the majority of the plants operate from 18 to 22 hours per day, giving ample time for inspection and repair, even if no reserve capacity were provided.

In cost, the gas-engine equipment is quite comparable with that of a steam plant. The engine itself costs more than a steam engine of corresponding size, on account of the increase in metal required by the higher pressures dealt with. With the cost of condensing machinery charged to the steam engine, however, this disparity is much reduced. With natural or illuminating-gas supply available, the equipment cost would fall considerably below that of a steam equipment of boilers, engines, condensers, heaters, pumps, etc. In the case of a producer-gas plant installed to supply the gas engines, the cost of the respective equipments, each of 1,000 horsepower, is at a parity, although depending somewhat upon the gas-storage capacity provided. This, however, amounts to much less than electric storage. For producer gas the former costs in the neighborhood of $7.35 per horsepower-hour and the latter $100 (at $1 a thousand cubic feet). Considering the increase in productiveness of labor, which is stated by a prominent gas engineer to be fully 100 per cent. (owing to the fact that one man can handle twice the amount of coal), the advantage, if any, held by the steam plant, disappears.

In economy of fuel, the gas engine, admittedly, has no rival. The present limit of steam-engine practice is 10 pounds of water per indicated horsepower or 11 pounds per brake horsepower. With an evaporation of 10 pounds of water per pound of good coal (14,000 B. T. U. per pound) a performance of 1.1 pound coal, or 15,400 B. T. U., per brake horsepower, is realized. The gas engine at present delivers, at full load, a brake horsepower upon 10.5 to 11 cubic feet of gas (of 900 to 1,000 B. T. U. per cubic foot, calorific value), which is equivalent to 10,000 to 11,000 B. T. U. per brake horsepower. Fig. 4 shows a typical test log upon a 550-horsepower engine of the three-cylinder vertical type, employing the four-stroke cycle. The thermal efficiency shown is the true or "kinetic" efficiency, viz.:

$$\frac{\text{Output}}{\text{Input}} = \frac{\text{B. T. U., equivalent of work done.}}{\text{B. T. U., value of gas.}}$$

At full load this appears at 25 per cent., considering the comparative remoteness of the theoretical limit of gas-engine efficiency, and the fact that the theoretical efficiency of a steam engine working between the usual units of 150 pounds boiler and three pounds condenser pressure has already been exceeded, there appears to be an encouraging future for internal-combustion motors.

Advantages.—The advantages of the gas engine for central stations may be summarized thus:

1. Minimum fuel and heat consumption.
2. Light-load efficiency higher than steam engine of corresponding size.
3. Low cost of operation and maintenance.
4. Simplification of equipment.
5. Small number of auxiliaries required.
6. Absence of "standby" losses.
7. Quick starting.
8. Waste heat in jacket water suitable for building heating.
9. Ease of extending equipment.
10. Absence of high pressure except in engine cylinder. No danger from explosion outside, as a mixture of proper proportions is required.
11. Power can be stored during light loads at small cost in the form of gas in holder.
12. Subdivision of units more easily accomplished, yielding higher all-day economy.

An important source of economy in gas plants is the fact that as soon as an engine is shut down all heat losses cease. Also, during operation no heat is lost by the gas in transit from the producer, and the plant is not hampered by inefficient auxiliaries, such as steam pumps, condensers, return traps, etc., all of which largely increase the general complexity of the system.

In quick starting, the gas engine fulfills every requirement. The 280-horsepower pumping units of the Philadelphia high-pressure fire system have been repeatedly started cold, brought up to speed and the pumps loaded to the required pressure (300 pounds per square inch) within a period of 40 seconds from the starting signal. In plant No. 11, employing 133-cycle high-speed generators, the units are regularly started in two minutes, and this may be reduced to one minute in case of necessity.

A number of plants make use of hot-jacket water for heating offices and buildings, ordinary cast-iron or coil-pipe radiators being used for this purpose.

In the matter of parallel operation of alternating-current generators, plants 13, 14 and 15 have been

Fig. 1. Belted Station with Jack-shaft.

Fig. 2. Typical Belted Station.

GAS POWER FOR CENTRAL STATIONS.

1. Abstract of paper presented at the meeting of the American Institute of Electrical Engineers, held in New York, December 18, 1903.

distinctly successful, particularly in view of the variable character of load incidental to large industrial works operated by induction motors. All the units are of the direct-connected type with standard flywheels. A spring coupling provides a flexible connection between engine and generator, to absorb cyclical speed variations. The usual copper dampers on the pole pieces assist in preventing hunting. In general, a low frequency seems to be desirable, with high peripheral speed and moderate reactance in the generator to assist in damping current fluctuations. The suddenness of the impulse in a gas-engine cylinder offers, to be sure, greater difficulties than in the case of a steam engine, but the remedy has apparently been found.

Fuel Gas.—Several distinct fuel gases suitable for gas-engine use are available. When reduced to holders for the air or blast gas made during the period when the producers are under blast.

Producer gas offers at present the greatest possibilities in the field of power for use in manufacturing centers. This is due to its comparative cheapness, simplicity of installation and general efficiency when gas for power purposes is alone considered.

A comparison of the approximate thermal efficiencies of the various processes gives the following results:

Coal gas without coke	21 per cent
Coal gas (with coke)	60 per cent.
Water gas	60 per cent.
Water gas, special quick-blast	75 to 80 per cent.
Producer gas	80 to 85 per cent.

Assuming the calorific value of coal as 14,000 B. T. U. per pound and the efficiency of the gas-

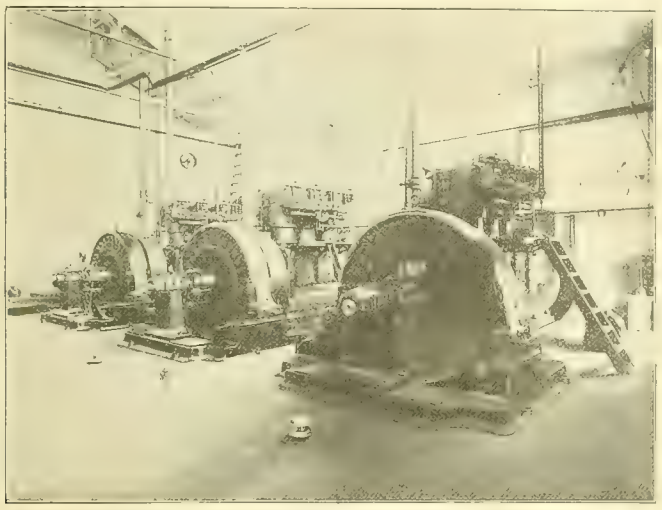


Fig. 3. Typical Direct-connected Station.

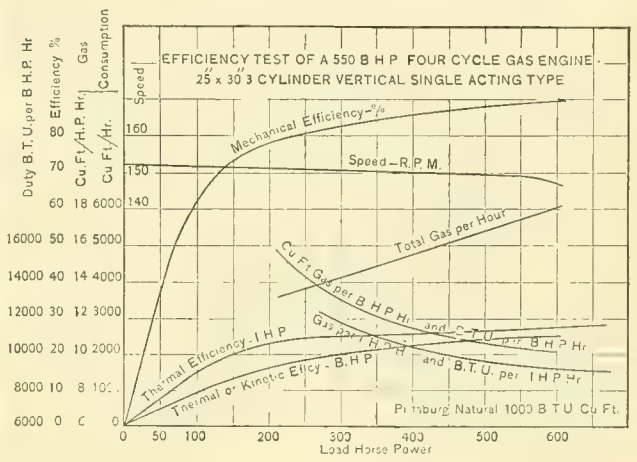


Fig. 4. Test Log Upon a 550-horsepower Engine.

GAS POWER FOR CENTRAL STATIONS.

calorific values per foot of explosive mixture of proper constituency, the ratings are nearly equal:

	Approximate B. T. U. Per Cubic Foot. Gas	Mixture.
1. Natural gas	1,000	91.0
2. Coal gas	650	91.7
3. Water gas	300	88.6
4. Carburetted water gas	600	92.0
5. Producer gas	120 to 145	60 to 68
6. Coke-oven gas	600	90.0
7. Blast-furnace gas	90	53.0

The power to be developed by an engine of given proportions does not, therefore, vary within appreciable limits, except on producer gas and blast-furnace gases, when larger engines are required, or larger cylinders on the same engine frames. The rate of combustion is, however, less rapid with these than with other gases, due to the large amount of inert gases, such as N and CO_2 present in the mixture. The compression may also be carried much higher without risk of pre-ignition or "back-firing," thus increasing the efficiency of the cycle. With water gas the high percentage of hydrogen occasions quicker combustion and higher flame temperatures with so considerable a tendency to pre-ignition and back-firing that this gas is not well adapted to gas-engine work.

In water-gas plants a great saving may be made and the gas rendered much more suitable for the operation of gas engines by providing additional making process 80 per cent., the heat available at the engine is 11,250 B. T. U., which is equivalent to about one brake horsepower. This duty, one brake horsepower per pound of coal, should, therefore, be expected from a well-equipped gas-power plant.

The comparative cost of steam and gas power is well shown in Table II. In this table the output was not measured, but the costs indicate the general balance of economy on the side of the gas station. The steam plant started operation on natural gas at 10 cents a thousand cubic feet, with a minimum of $3,000 per year. It employed boilers fired by gas. One year after starting the gas plant, this minimum was reached and the company is now paying at the rate of over 16 cents a thousand cubic feet. The saving in total operating cost amounted to 40.5 per cent. In the face of a 30-per cent. increase in station output, the gas consumption has been reduced by 93 per cent. Previous to the replacement of the steam equipment an economy test was run on the station throughout 24 hours. The gas consumption at the boilers was 51.09 cubic feet per indicated horsepower developed at the engines, equivalent to about 86 cubic feet per kilowatt-hour. All engines were of the simple high-speed type, running non-condensing. During the six months ended August, 1902, the total gas consumption of the station, including heating, was 23.8 cubic feet per kilowatt-hour. Deducting approximately 7.5 per cent. for heating, the net consumption was 21.5 cubic feet, which is about 24 per cent. of that recorded on the steam station. It is equivalent to 12 cubic feet per brake horsepower, or a duty of 14,100 B. T. U. per brake horsepower.

Combined Gas and Electric Stations.—The theory of increase of profits from the operation of combined gas and electric plants is based upon the fundamental principle of reduction in cost per unit with increased output. If the net saving is sufficient to cover fixed charges upon the electric station, the way is clear to reap a double revenue, one from the electric station operating at a cost far below its steam-driven competitors, and the other from the gas station, operating at a lower cost of production than before. The balance may, of course, be applied proportionately to the disbursement of fixed charges on both stations. It is usually the gas station that reaps the profit at the expense of the electric station. An adjustment of gas and electric rates can easily be made to prevent embarrassing competition.

TABLE II.—COMPARATIVE COST OF OPERATION OF STEAM ENGINES VS. GAS ENGINES ON NATURAL GAS. (PLANT NO 11.)

Year.	Gas, Cubic Feet.	Labor.	Repairs.	Oil and Waste.	Total	Remarks
		Steam	Plant	Gas Fired Boilers		575 indicated Horsepower.
1897	$6,753.20	$725.26	$600.00	$185.06		Gas rate, 10c. per 1,000 cubic feet minimum reached in 1900. Average, 1902, 15.9 cts. per 1,000.
1898	9320.70	$258.33	100.00	296.14	$19,024.31	
		Gas Engine Plant.				800 Brake Horsepower.
1899	6318.02	6828.74	271.85	532.56		Increase Revenue, %
1900	3000.40	6-82.01	190.01	592.92		1897
						1898 5.75
1901	3000.00	768.83	196.99	107.01		1899 7.5
						1900 11.0
1902	3000.00	626.67	261.04	370.70		1901 13.5
					$11,876.41	1902 18.5
						Increase load 1898-1902, 30%.

Saving.....$8087.93=40.5%.
Steam....$36.40 per year per horsepower.
Gas..... 14.80 per year per horsepower capacity of station.

Saving..$21.60 =59.4%.

ECONOMY TESTS.

Steam Station:	Gas Station:
1898—24 Hours.	Gas per kilowatt-hour, average six months, 21.50 cubic feet.
Gas per indicated horsepower-hour, 51.09 feet.	Calorific value gas, 1175 B. T. U. per cubic foot.
Gas per kilowatt-hour, 86 feet.	

Arc-lamp Hanger.

Among the specialties manufactured by Thomas Wrigley & Co. of Chicago is one that is proving unusually effective. It is the arc-lamp hanger illustrated herewith. Some of the merits claimed for this device are that it is always ready for immediate use and is easily adjusted, is durable, compact, attractive in appearance and an effective "ground" breaker. Moreover, it is fully approved by the National Board of Fire Underwriters. Though in general use by many of the largest lighting concerns, it is said that none of these hangers has yet failed to give complete and lasting satisfaction.

Salt Lake Light and Railway Companies Merged.

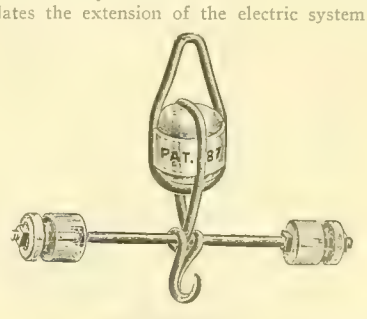
The long-expected merger of the Utah Light and Power Company and the Consolidated Railway and Power Company, both of Salt Lake City, has at length been effected, and the consolidation is known as the Utah Light and Railway Company. After the stockholders had met and concluded upon the terms whereby the two big companies were to become one, the following board of directors was elected: For the New York and English interests, W. S. McCornick, L. S. Hills, W. J. Curtis; for the trustees of the Mormon Church and local interests, Joseph F. Smith, J. R. Winder and Anton H. Lund; for the McCune interests, A. W. McCune, John S. Wells and W. P. Reed. At a subsequent meeting of the directors President Joseph F. Smith of the Mormon Church was chosen president of the company and R. S. Campbell secretary and general manager.

The capitalization of the new company is $10,000,000, and of this, $6,000,000 will be issued at once, to be taken up by the old stockholders in exchange for their old paper. The remaining $4,000,000 will be held for future sale for repairs and improvements. The two companies were so nearly at a par in the matter of dividends that the exchange of shares will be on the same basis, two preferred and one common share of stock in the new company being given for three shares of the old.

Several meetings of the stockholders have been held, at which it was decided to introduce early and extensive improvements in the plant and system. The manager has recommended the expenditure of $500,000 at first, and the board of directors has discussed the proposition of expending $1,000,000 on improvements and extensions in the next five years.

Electric-railway Extension in Italy.

A recent meeting of interested persons at the instance of the Chambers of Commerce of Milan, Lecco and Chiavenna, Italy, resulted in a request to the Italian government to establish immediately the trolley system on the lines of Lecco to Milan. The electric trolley over the 90-odd miles of the standard-gauge railroad along Lake Como has met all requirements, and the results with the third-rail system over the 45 miles of the standard-gauge Milan-Varese-Porto Ceresio railroad have been entirely satisfactory. The Mediterranean railroad contemplates the extension of the electric system with



ARC LAMP HANGER.

a third rail over the lines, Varese-Laveno-Gallarat-Sesto Calende-Arona, so that then Milan will be directly connected with the upper Italian lakes by four electric standard railroads. The Frankfort Journal of Commerce states that electric traction, by means of accumulators on the Italian Meridional route, has not proved a success. The management of the road has therefore been authorized to discontinue this electric system on certain lines.

BOOK TABLE.

WESTERN ELECTRICIAN'S LAMP-LIGHTING SCHEDULE, MOONLIGHT SYSTEM, FOR 1904. Chicago: Electrician Publishing Company. Pp. (3½ by 5⅝ inches), 28. Price, 10 cents.

This schedule is based on mean local time and is approximately correct for localities from New York city as far west as Nebraska, and north and south between the limits of Southern Nebraska and Southern Michigan and Wisconsin. Outside of these limits the error may be 10 minutes, to be added or deducted. A short article by F. B. Badt on "Moonlight Schedules for Arc Lighting" is given in the front of the pamphlet, after which follow the tables for the 12 months in the year. These tables are based on what is usually called the "Philadelphia Moonlight Schedule," viz.: "Light one-half hour after sunset and one hour before moonset. Extinguish one-half hour after moonrise and one hour before sunrise." They contain in parallel columns the day of the month, the hour of lighting, the hour of extinguishing and the number of hours burned, the time being given to the nearest 10 minutes. The tables are carefully calculated, and may be relied upon.

EXPOSITION HANDBOOK. By Charles M. Kurtz, Ph. D., St. Louis: Gottschalk Printing Company. 1903. Pp. (5¾ by 8¾ inches), 136, with 106 illustrations.

So favorably has this handbook of the Louisiana Purchase Exposition been received that the present edition is the fifth that has been printed. This book is not intended as a guide book, for it is early as yet to print anything of that nature. It is intended rather as an outline of the exposition, giving as an introduction something of the historical events which the exposition is to commemorate and of the present facts about St. Louis. The general plan of the fair is next taken up by departments, and the principal officers are mentioned, with the portraits of not a few, including those of the members of the national commission and a fine tinted halftone in the front of President David R. Francis. Under each department head are illustrations of the buildings in that department. A long list of foreign countries to exhibit is given with the names of commissioners from each. In the back is given a list of all the officers and directors of the fair. The board of lady managers is included, together with the officers of the state and territorial commissions.

A HANDBOOK FOR THE ELECTRICAL LABORATORY AND TESTING ROOM. (Vol. II.) By J. A. Fleming, M. A., D. Sc., F. R. S. New York: The D. Van Nostrand Company. London: The Electrician Printing and Publishing Company. 1903. Pp. (5⅜ by 8½ inches), 618, with 187 illustrations. Price, $5.

Just why the work is called a handbook for the laboratory and testing room is hard to determine. It seems rather to be a treatise on the mathematical derivation of the laws and principles upon which laboratory instruments for the measurement of electricity operate, with almost as much calculus as is contained in the ordinary textbook on the latter subject. For instance, quite a number of pages are devoted to finding out, with much differentiation and integration, just why the needle of a ballistic galvanometer swings as it does—a very good exercise in calculus, but not what one would expect to find in a handbook, which is generally conceded to be a book of ready reference, not one of intricate mathematical demonstrations.

As a textbook the work has much to recommend it, the subjects being treated thoroughly and completely. Photometry especially is gone into to a much greater extent than is usual in a book not devoted exclusively to the subject, and the chapter devoted to it is excellent. Another subject which has received careful attention is the matter of "Magnetic and Iron Testing." This is of no small importance in the building of high-grade electrical machinery, as is now fully realized by all manufacturers.

THE MECHANICAL ENGINEER'S HANDBOOK. By Henry Harrison Suplee, B. Sc., M. E. Philadelphia and London: J. B. Lippincott Company. 1904. Pp. (4 by 6¾ inches), 834, with 440 illustrations. Price, $5.50 (without thumb index, $5).

A large stock of valuable information has been gathered into a form intended to make it especially valuable to the draughtsman or designer, and calculated to save much time in mathematical computations. The tables are exceptionally thorough. For instance, the squares and cubes of all the numbers from one to 1,600, are given. The trigonometric and logarithmic functions of all the angles from zero to 180°, are given down to the minute, requiring very little interpolation. Portions of the book are devoted to the subjects of geometry, trigonometry, calculus and graphic statics, and, though not pretending to be a textbook on these subjects, these chapters will be found of great help to the busy engineer, who, in working out some problem, finds he must brush up on some hazy point in his mathematics. Materials of engineering and mechanics naturally come in for a large share of space and the usual tables on materials of construction are to be found. Steam and hydrostatics are departments of the book well taken care of, steam tables being given along with methods of testing steam plants, practical engine performances, design of plants, etc. Quite a little space is devoted to electricity, including besides wiring formulas the national electrical code and some good matter on electrical driving. In the short space available for a review notice it is, of course, impossible to give the whole scope of the book. In general it will impress the reader at first glance as containing much mathematical data in the way of handy reference tables, easily turned to by means of the thumb index, which is good for all time, and not be out of date in a few years. The binding is of bright red morocco, the thumb index of the more expensive book making it more useful for quick reference.

WIRELESS TELEGRAPHY: Its Origins, Development, Inventions, and Apparatus. By Charles Henry Sewall. New York: D. Van Nostrand Company. 1903. Pp. (5½ by 8¼ inches), 229, with 85 illustrations. Price, $2.

Space telegraphy has asserted itself as not only of scientific but of commercial importance, and information concerning it is eagerly sought. There is quite an extensive literature of the subject, but it is not so large that another book will fail to find a valuable place. The scope of the present work, as the author states in his preface, is to give "a comprehensive view of wireless telegraphy, its history, principles, systems and possibilities in theory and practice." Credit should be given to the writer for the logical arrangement of the subject matter of the book, which is divided into four parts.

Part I. is divided into five sub-heads, "Prophecy," "Discovery," "Achievement," "Explanatory" and "Descriptive," the greater portion dealing with the descriptions of the various systems and of the details of the apparatus now in use. Part II. takes up the subject of inventors and inventions, giving descriptions of the systems as devised by the several well-known inventors in this line. No allusion is made, however, to the Clark system, which is at present attaining considerable prominence on the Great Lakes, and is deserving of attention. Part III. discusses the comparative merits of the various systems, while Part IV. deals more specifically with the details of apparatus, such as transmitters, shields, wave-gates, etc. Also under this head nomenclature is discussed to some extent, and as the art is still in its infancy this is important, for, as the systems become of wider application, a standard nomenclature cannot be reached too soon. Among the names suggested for the transmission of intelligence through the ether are "wireless telegraphy," "radio-telegraphy," "wave telegraphy," "etheric transmission" and "Hertzian-wave telegraphy." These names either are not a correct designation or are too long or lack euphony. The term "space telegraphy" is not mentioned, although it is perhaps the best of all. An appendix to the book contains the specifications of the patents of Dolbear, Lodge, Marconi and Tesla.

BEGINNERS' MANUAL OF SUBMARINE CABLE TESTING AND WORKING. By G. M. Baines. London: The Electrician Printing and Publishing Company (New York: The D. Van Nostrand Company). 1903. Pp. (5⅜ by 8½ inches), 217, with 71 illustrations. Price, $3.50.

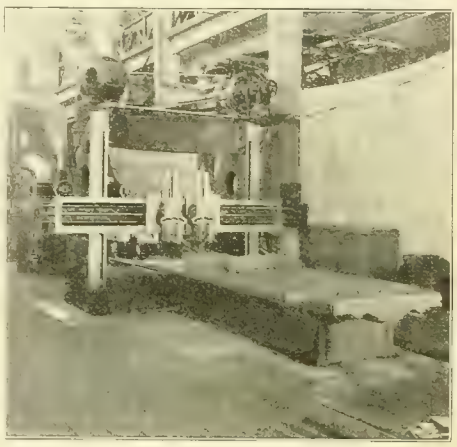
Within recent years submarine cables have been developed to such a remarkable degree that their manufacture, installation and operation form, practically a branch of engineering distinct in itself. Many who would enter this field of work have been deterred by the seemingly great amount of technical knowledge required at the outset to become a successful engineer in this line. The author's aim in this book is to help those interested in the work to obtain a sufficient understanding of the fundamentals of electricity and their application to cable testing and operation to take up the work intelligently. This is also done under the supposition that the reader is not well versed in algebra, which is thought by some to be essential to even an elementary work of this nature. The general scheme of the manual is, first, to introduce to the student the more simple things in direct currents, such as Ohm's law, the resistance of parallel circuits, resistance of shunt, compensating resistance, and from this to the operation of the Wheatstone bridge. Having mastered these principles, the student is ready for the subject of measurement of resistance of cables and the simpler tests. After this the more difficult tests are taken up, such as the location of breaks and faults of different kinds by all the most approved methods.

Necessarily, in a book of this nature, a great deal of the matter given is only the "A B C" of electricity, and it would be time thrown away for those who are well informed on electrical subjects and testing generally to study it from cover to cover. But for the man who has not had the advantage of an electrical training, either theoretical or practical, the work is one which, if thoroughly mastered, as it may be by anyone, will make him conversant with the latest and most approved methods of operating and testing submarine cables. Moreover, the work has the advantage of a comparatively clear field, as the ordinary textbook on electricity gives very little, if any, specific attention to submarine cables.

A resolution has been passed by the Evanston (Ill.) City Council ordering the Chicago and Milwaukee Electric Railway Company to run all its cars through the city, as required by its franchise. It is said the company has been running cars only to Central Street, thus causing great inconvenience.

A Motor-driven Planer.

The planer illustrated herewith was built by the G. A. Gray Company, Cincinnati, Ohio. It is of the widened pattern, giving a total distance between uprights of 84 inches; otherwise it is similar to the standard 60-by-60-inch planer, as built by this company. These planers are intended for use where the work is of unusual width in proportion to its height, but is not so excessively heavy as to warrant a larger size. It will be noticed that the widening is effected at one side, the advantage being that the ordinary handy relation of the parts on the front side of the planer is not disturbed. The bed is 12 feet long, and is moved by a spiral-geared driving system, familiarly known as "Sellers' motion." This consists of a spiral pinion which engages directly with the rack under the table. This pinion is mounted on a shaft which crosses the bed diagonally



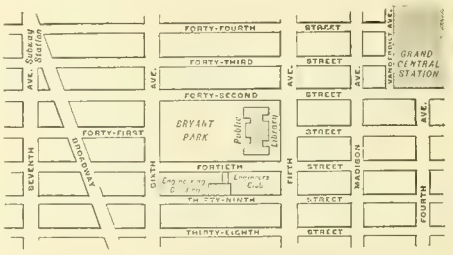
A MOTOR-DRIVEN PLANER.

and is driven by a pair of bevel gears from the pulley shaft. The other characteristics of the machine are the duplex-shifter motion and the universal feed. The duplex shifter embodies the provision of shifting levers and dogs on both sides of the machine. This gives the operator perfect control from either side, so that he need not lean over the table or walk around the planer in order to stop or start it. The universal-feed mechanism makes it possible to feed at either end of the stroke, to stop and start all feeds simultaneously and to change from coarse to fine feed, or vice versa, without stopping the planer. The cross-rail is raised and lowered by power and is of extra length, so that either of the two heads will plane the full width of the machine. The V's of the bed and table are oiled automatically by double-cone brass rollers, supported in pockets in the V's of the bed.

The motor is a Crocker-Wheeler 20-horsepower semi-enclosed machine, running at about 775 revolutions per minute at 230 volts, supplied on a three-wire system, with 115 volts in each leg, giving two fundamental speeds. It is mounted on a special bracket over one of the uprights and drives a countershaft mounted in a corresponding location over the other upright. From the countershaft the open and crossed belts for the two directions of the table travel and the raising and lowering of the cross-rail are taken—the first vertically down to the side of the bed and the second horizontally back to the left-hand upright. The pulleys run continuously in the same direction, and, especially the one on the motor, are made with heavy rims, to give a flywheel effect, and by their momentum assist in reversing the table at the end of its stroke, and reduce the sparking of the motor.

Union Engineering Building.

The accompanying sketch plan shows the location of the proposed Union Engineering Building in New York city on Thirty-ninth Street, between Fifth and Sixth Avenues. This building, made possible by the



UNION ENGINEERING BUILDING AND VICINITY.

generosity of Andrew Carnegie, is to house the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and very likely the American Society of Civil Engineers. A glance at the map shows the excellence of the location, which is near the new Public Library, in the heart of the theater and hotel region of New York and con-

venient to many lines of transportation. The sketch was referred to in the "second circular" of the American Society of Mechanical Engineers, reprinted in the Western Electrician last week, but was inadvertently omitted.

Chicago Street-railway Situation.

It is apparent from recent developments in the Chicago traction situation that the hearing on the validity of the 99-year claims will not take place until the latter part of February, if then. This decision was reached at a conference between representatives of the Chicago Union Traction Company and the City Council before Judge Grosscup. At this conference objection was also raised to the plan of conducting the hearing in Washington, D. C., at a time when Judge Day could be able to sit with Judge Grosscup. It is now probable that Judge Grosscup will hear the case alone.

During the week the local transportation committee of the City Council has been hearing arguments from attorneys and experts bearing on the probable earnings and expenses of the Chicago City Railway Company during the 20 years the proposed franchise under discussion has to run. Attorney John P. Wilson argued that the city should not require a cash compensation and that the waiver of rights under the 99-year act should be taken into consideration. He entered a plea of the decreasing earning ability of the lines because of the hauls growing longer.

Some interesting figures were brought out before the committee by expert accountants, who argued on behalf of the company and explained the figures in the company's expert report which forms the basis for its contention that the compensation to the city should be small. The experts assumed that the city at the end of 1924 would have a population of 3,400,000. Taking this as a basis, it was argued that, in proportion to the company's present business, the increase in earnings would average $300,000 a year, with expenses also increasing but not in proportion. It was asserted that the present plant would give a salvage of $10,000,000 and that it would require a $15,000,000 bond issue to improve it, a total of $25,000,000. Estimating operating expenses at 60 per cent. of gross receipts and allowing for interest and sinking fund for bonds and six per cent. on $18,000,000 of stock, it was figured that for seven years there would be a deficit, but after that a continually increasing surplus. The total estimates presented by the company's experts were as follows: Earnings for 20 years, $197,000,000; operating expenses, $118,000,000; taxes, $7,030,000; personal-injury cases, $1,000,000; new equipment, $3,000,000; strikes, $2,000,000; interest on bonds, $9,326,150; to pay off bonds $12,092,000; dividends, $21,600,000; maintenance, $17,088,000. At the end of 20 years they estimated there would be left $5,863,850 for the city. This is equal to 2½ per cent. of the average gross earnings, and this, the company maintains, is the highest percentage which should be put into the franchise ordinance as compensation.

Later a proposition was made to the city by Col. E. R. Bliss in which the street-railway company offers to pay the city five per cent. on the gross receipts for 20 years up to its total estimate of $197,000,000. Should the gross receipts exceed the estimate it is further agreed to pay 20 per cent. on all money earned in excess of these figures. "These receipts," said Mr. Bliss, "are to be computed annually, and if in any one year the receipts run beyond our calculations the city is to get 20 per cent. of the excess. It is to get five per cent. anyhow, whether they come up to our figures or not. This compensation is to be in lieu of all public charges except the taxes on tangible property. For example, the license fee for cars must be subtracted. The taxes on real and personal property we will pay."

A number of the new cars for the Union Traction Company are now being equipped with electric motors and will be put in operation soon. They are built for both summer and winter use.

Telephone Competition in the Middle West.

In answer to the report from Boston that the American Telephone and Telegraph Company, through the Central Union company, expects to make a special effort this year to combat the Independent movement in the Middle West, S. P. Sheerin of the strong Independent companies centering in Indianapolis cites the financial embarrassments of the Michigan and Central Union companies as a warning to Bell investors. He says:

"In the next three years the Independents of Indiana will add 150,000 to the number of their telephones [now said to be 110,000], and this wholly without reference to whether the parent Bell company furnishes $1,000,000 or $8,000,000 to keep company with the eight and a half millions already wantonly wasted, and now lying at the bottom of the well. It would be a good thing for some of those credulous New England people, who have been made to believe that there is but one telephone company in this country, to take a trip through the Middle West. The experience would possibly be profitable to them in more senses than one."

Indiana Telephone Items.

The Central Union Telephone Company has decided to expend $50,000 in improving and extending its service in Muncie and Delaware counties. This is brought about, it is said, by the competition of the Delaware and Madison Counties Telephone Company, which recently expended a large sum in completing a new plant in Muncie, and which is now giving excellent service over a wide territory.

The ten-party lines of the Central Union Telephone Company in Indianapolis are to be replaced as rapidly as possible by a four-party line system. The ten-party line subscribers paid $1 a month, but the four-party line service will cost $1.25. More than $30,000 will be expended by the company during this month in new switchboards and dynamos for the Central plant. A new switchboard will also be placed in the exchange at Irvington.

The New Long Distance Telephone Company has paid its regular quarterly dividend of one per cent. The company is planning extensions and improvements during the summer. It is also doing a telegraph business between Indianapolis and all the large cities in central Indiana. The Associated Press has attached its telegraphic instruments to the New Long Distance Company's lines and has conducted quite a business for nearly two months.

The stockholders of the Peoples Mutual Telephone Company of Silver Lake have elected H. L. Oldfather, Arthur Smith and Omer N. Igo directors. The company now has 525 telephones and 90 miles of toll lines. Last year 184 telephones were installed. The plant is valued at $16,000, for which 668 shares of stock have been issued. The company began doing business 17 months ago.

The Richmond Home Telephone Company and all the telephone lines in that section of the state and adjoining Ohio counties were much disturbed on January 2d, and for the most part the lines were rendered useless on account of a peculiar condition of the atmosphere, which seemed to be charged with electricity. F.

Telephone News from the Northwest.

Joseph Maland has bought the local telephone exchange at Frost, Minn.

The Ripon (Wis.) Telephone Company has moved into larger quarters.

A farmers' line is being constructed from North Porter Township to Ellendale, N. D.

The council of Duluth contemplates installing a storage-battery system for the police-telephone system, replacing a galvanic-battery plant.

The Minnesota Valley Telephone and Telegraph Company has reached Windom, Minn., with its long-distance lines from Mankato and the Twin Cities.

E. P. Bacon of Pillager, Minn., proposes a local telephone exchange for that village.

Benjamin Simpson has purchased the Hecker stock of the Audubon County (Iowa) Telephone Company.

The farmers between Palmer and Pomeroy, Iowa, have formed a company and will build a telephone line. Charles Swaline is president and O. Sodestrom is secretary.

Owing to a raise in rates by the Western Electric Telephone Company at Estherville, Iowa, the business men there have agreed to dispense with the service unless the old schedule is restored. The company is contemplating building a line from Fort Dodge to Estherville.

The Citizens' Mutual Telephone Company of Bloomfield, Iowa, has organized with a capital stock of $4,000.

The Lawton Telephone Company has been formed. J. A. Smith has been elected president and Dr. C. M. Ray secretary.

The Reinbeck (Iowa) Mutual Telephone Company has organized. E. K. Greene was elected president and H. A. Horstman secretary.

The grand jury at Green Bay, Wis., is investigating the charge that certain aldermen were retained in the interests of the Wisconsin Telephone Company in preventing a franchise being granted to the Valley Telephone Company. R.

TELEPHONE MEN.

G. Y. Stamp has purchased the telephone plant at Stithton, Ky., which has been the property of H. W. Bryant for some time.

H. J. Pettingill of Boston, vice-president of the Northwestern Telephone Exchange Company, was in Minneapolis recently, for a brief visit.

Hunt Chipley of Louisville, Ky., has been appointed general counsel for the Southern Bell Telephone Company, with headquarters at Atlanta, Ga.

A. W. Bennett, who has for some time been manager of the East Tennessee Telephone Company at Harrodsburg, Ky., has been appointed inspector, with headquarters at Nashville. His brother, George W. Bennett of Lexington, succeeds him at Harrodsburg.

Mr. W. E. L. Gaine, general manager of the National Telephone Company of Great Britain, accompanied by Mr. Frank Gill, engineer-in-chief of the same company, is making a tour of the United States, inspecting telephone exchanges. The gentlemen were in Chicago last week, in company with Mr. Herbert Laws Webb, the well-known telephone engineer, who now makes his headquarters in London.

Transmitter Litigation.

A decision on appeal has been given by the Circuit Court of Appeals in the Seventh Circuit at Chicago sustaining the patent of the Stromberg-Carlson Telephone Manufacturing Company in its infringement suit against the American Electric Telephone Company and others. In its decision the Appellate Court says: "The prior art, as we view it, fails to show a combination or foreshadow a concept of any of the claims in suit. It follows without further elaboration that in our judgment the claims are valid." The court then finds infringement by the defendants and orders a decree for an injunction and an accounting.

GENERAL TELEPHONE NEWS.

The Kirksville Telephone Company of Kirksville, Ky., has been incorporated with a capital stock of $7,500.

The Elyria Telephone Company of Elyria, Ohio, has filed notice with the secretary of state of an increase of capital stock from $50,000 to $100,000.

G. F. Cowden, A. L. Camp and others have organized the Automatic Telephone Company at Midland, Texas. The company is incorporated with a capital of $10,000.

The Du Funiak Springs (Fla.) Telephone Company, with a capital of $9,000, is among the recently incorporated telephone companies. S. K. Gillis is among those interested.

The government of the state of Sinaloa, Mexico, is constructing a telephone line from Culiacan to Maxatlan. It is stated that the construction of other lines is contemplated.

The Smithville Telephone Company of Smithville, Texas, has purchased the telephone line of the Smithville and Red Rock Telephone Company, and will extend it to Lockhart.

The Keystone Telephone Company of Philadelphia shows for its first fiscal year earnings of $230,418, being twice the amount required to pay five per cent. dividend on the $2,500,000 capital stock.

The Southwestern Telegraph and Telephone Company will erect an office and exchange building at Beaumont, Texas. J. E. Farnsworth, general manager, Dallas, Texas, can give information.

The Tibbe Electric Company, with an exchange in Washington, Mo., serving 250 stations, has recently installed an automatic exchange in the town of Union, Mo., with a capacity for 100 subscribers.

The Carthage and Coluca Telephone Company of Adrian, Ill., incorporated recently with a capital of $2,500, will install and operate a telephone system in Adrian. The incorporators are William Black, J. L. Haines and William Bush.

The Kensington (Md.) Telephone Company has been incorporated for the purpose of constructing a long-distance telephone service. The officers of the company are: President, B. A. Chapin; vice-president, Eugene Jones; secretary, G. R. Taylor; treasurer, C. E. Bruington.

The government of the state of Sonora, Mexico, is constructing an extensive system of telephone lines. It is proposed to extend the system to all parts of the state. A considerable amount of material will be required in addition to that already used. One of the new lines which will soon be completed is that between Coyotitlan and Elota.

The Home Telephone Company of Kansas City made good progress during last year in the development of its Independent plant. It is stated by one of the directors that by April 1st there will, in all probability, be 10,000 telephones in operation. The company is about to move into its own building on Baltimore Avenue, where about 250 employes will operate the system. The Western Independent Company, the long-distance representative of the Home company, covers all the eastern part of Kansas and the western part of Missouri.

At the regular meeting of the stockholders of the Peninsular Telephone Company of Tampa, Fla., the following-named officers were chosen for the year 1904: President, W. G. Brorein, Tampa; vice-president and treasurer, Guy Huffman, St. Marys, Ohio; secretary, H. W. House, Wapakoneta, Ohio; general counsel, J. J. Lunsford, Tampa. The business of the company and the extension of its properties have increased to such an extent that it was decided to have Mr. Huffman assume active business management to relieve Mr. Brorein, who has heretofore been in sole management, of some of his duties.

The following-named telephone companies have recently been incorporated in Ohio: Kirtland Telephone Company, Kirtland; capital stock, $2,500; incorporators, Arthur G. Tryon, Ada A. Harris, Henry Hooper, W. R. Crary and W. A. Creswell. Yoker Valley Telephone Company, Quaker City; capital stock, $550; incorporators, W. H. James and others. Vale Telephone Company, Vale; capital stock, $5,000; incorporators, W. W. Scott, John Malone, John Hull, C. M. Simma and A. P. Vale. Ohio Valley Telephone Company, Proctorville; capital stock, $2,000; incorporators, H. P. Gerlach, L. D. Eaton, S. E. Crawford, G. P. Eaton and E. R. Miller.

High-frequency Electric Currents in Medicine.[1]

By Emil H. Grubbe, B. S., M. D.

The physical and dynamic properties of high frequency currents are so radically different from those with which we are familiar in other electrical manifestations that they are really startling. The human body conducts these currents so readily that incandescent lamps held in the hand become luminous. It is not even necessary to bring the body in contact with an electrode. Ozone in large quantities is liberated in the atmosphere surrounding the instruments. Geissler vacuum tubes become luminous at a considerable distance from the generator and without direct connection. Currents which are capable of doing these things certainly ought to have a pronounced effect upon the tissues and functions of the human body. As regards physiological properties, these currents are very different from other forms of electricity.

The fact that patients may be treated with large quantities of these currents without even becoming conscious of any action would indicate that the motor and sensory nerves are not active during treatments. The presumption is that, due to the high frequency of interruption in the circuit, the number of excitations of the neuro-muscular systems reach such a height that all reaction is arrested. According to Williams, the following is a brief resume of the physiological effects of high-frequency currents: They are able to produce modifications in the general nutrition of the patient; there is an increase in arterial tension; respiration is increased and there is greater elimination of carbon dioxide; the blood becomes rapidly oxygenated; an abnormal ratio between urea and uric acid is reduced to normal readily; there is an increase in the production of bodily heat; excitability of tissues to other forms of stimulation is decreased; local anesthesia, lasting up to 20 minutes, may be produced in some parts of the body.

The most notable results with this treatment have been obtained in the very common disease—eczema. Dr. Bloch of Paris, one of the most able electro-therapeutists and an associate of the late Apostoli, recently reported a large number of cases of acute and chronic eczema, in all of which remarkable results had been obtained by high-frequency currents after all other methods of treatment had failed to bring relief. Similar reports came from other eminent observers. It is true that for a number of years we have known of the good effects of the static spray when applied locally in cutaneous diseases characterized by pruritus, heat and scaling, but at best the remedy was only palliative. With the high-frequency currents we can sometimes actually cure these conditions with a few short treatments. Many cases of eczema of 10 years' standing, have been cured with half a dozen treatments. The currents are applied locally, and occasion no discomfort whatever. Most sensitive parts may be treated without aggravation.

Acne in all forms yields readily to this treatment. Here, when the condition is purely local, we use the local method of treatment, but if there is a systemic cause or complication, we also give the patient a general treatment, and thus we get the benefit of the nutrition-regulating power of these currents.

Psoriasis also is amenable to this treatment. We have personally treated three physicians having this disease, and although time enough has not elapsed in two of the cases to verify the results, in the other the disease has not returned after 10 months.

Malignant growths, particularly epithelioma, react favorably in the majority of primary cases. Of course, it would be folly to expect a good result from this or any other form of treatment after general carcinosis has set in.

Indolent and fissured ulcers respond rapidly to this treatment, and clinical tests reveal results which must be considered permanent.

Since the X-ray and the ultra-violet ray have done so well in the treatment of lupus, we would hardly expect to find any other agent to supplant them in fighting this disease. However, there are many cases which do not do well under either of the above forms of treatment, and many of these have been cured by high-frequency currents.

Probably the results are obtained more rapidly due to the fact that every time we apply these currents a general electrification occurs; i. e., the whole system is influenced at each sitting. By many operators this treatment is preferred to the X-ray, because, as a rule, the results are obtained more rapidly; there is better control of the inflammatory reaction, and the scars are most perfect.

High-frequency currents have also proved of great value in the treatment of catarrhal conditions of mucous membranes and for neuralgias. Even for sciatica, ticdouloureux, choreaic and hysterial spasms they offer a very effectual method of relief.

Among the many general diseases, which have been favorably affected may be mentioned neurasthenia, rheumatism, gout, tuberculosis and obesity.

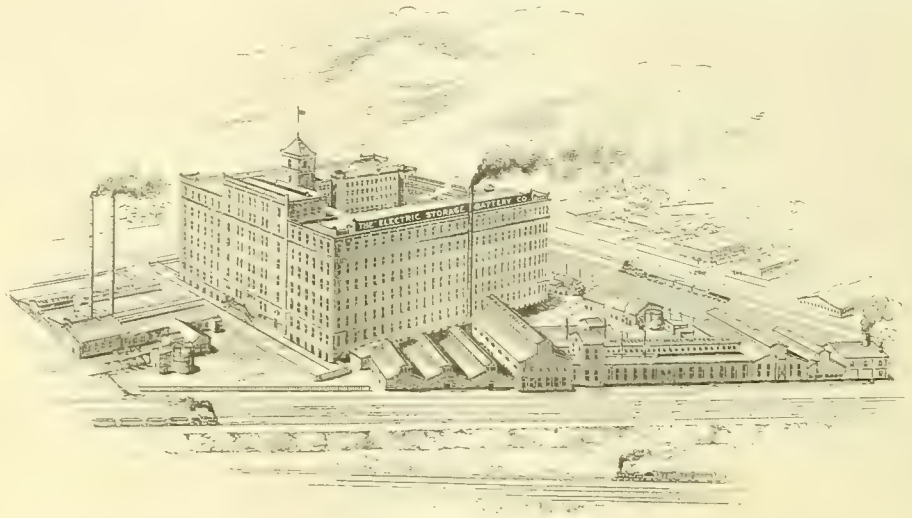
In diabetes many observers have obtained such good results that the claim has been made that we now actually have a remedy which can cope with this disease. When we remember that diabetes is a nutritional disease and also the pronounced effects of the high-frequency currents upon metabolism, we can readily understand how such favorable results are possible. Due to the fact that these currents decompose the atmosphere, generating thereby nascent oxygen, and also due to the fact that the human body offers comparatively little resistance to the passage of these currents, it will be plainly seen that diseases of the blood could be subjected to this treatment. The decided results obtained in treating anæmia and chlorosis by high-frequency currents have been reported by quite a number of observers.

Although from the list of diseases cited you may form an idea as to the wide action of this new therapeutic agent, it may be further stated that it brings results if properly applied in the majority of cases. If time were not limited, I could report an extensive list of cases, and if verification were necessary, I could, in many instances, even produce the patients.

[1] Part of a paper read before the Chicago Electro-Medical Society.

Electric Storage-battery Factory.

The Electric Storage Battery Company of Philadelphia, manufacturer of the "Chloride" and "Exide" accumulators, has recently completed arrangements with the trustees of the estate of W. G. Warden, by which the company acquires the entire property situated on Allegheny Avenue, between Eighteenth and Twentieth Streets. The main building on Allegheny Avenue is a seven-story-and-basement brick structure, having two wings, and containing over 280,000 square feet of floor space. Aside from this building, there are 16 other structures utilized for the different processes of manufacture. The property covers over three acres of ground and has a frontage on Allegheny Avenue of nearly 600 feet, and is bounded by the Philadelphia and Reading railway and a branch of the Pennsylvania railroad, thus giving unusual facilities for the handling of freight and express. The picture shows the imposing group of buildings that constitutes the factory.



ELECTRIC STORAGE-BATTERY FACTORY.

A School for Salesmen.

The fifth annual salesmen's meeting of the Electric Appliance Company of Chicago was held last week, from the 4th to the 9th. These meetings are for the purpose of familiarizing the company's salesmen with the best points in the important lines of goods which they carry.

Manufacturers of the various articles sold by this company come with complete testing apparatus, and, together with experts from the company's force, make exhaustive tests upon the apparatus that the salesmen are to handle, so that they may see for themselves what the different appliances will do, and not have to rely solely upon the printed matter of their catalogues.

These meetings were originated by the Electric Appliance Company and are based on the belief that truth is the essential of confidence and that from it results the enthusiasm which may account for the success of the salesmen.

Salesmen from all over the country were present and witnessed tests upon the arc lamps, incandescent lamps and various other pieces of apparatus which they are selling each day to their customers. By these demonstrations they obtained a more comprehensive idea of the apparatus and will be enabled later to show up the good points to better advantage.

The following-named manufacturers and representatives were present to help with the work: W. D. Packard, of the Packard Electric Company and New York and Ohio company, with factory expert on transformers, Warren, Ohio; Robert Lanphier, superintendent of the Sangamo Electric Company, Springfield, Ill.; E. J. Bagnall, Adams-Bagnall Electric Company, Cleveland, Ohio; A. N. Palmer, Phillips Insulated Wire Company, Pawtucket, R. I.; Mr. Sieberling, Indiana Rubber and Insulated Wire Company, Jonesboro, Ind.; Mr. Knight, American Mica Company, Newton Lower Falls, Mass.; Mr. Berry, F. H. Lovell & Co., New York city; Mr. Beatty of Chicago, Cutler-Hammer Manufacturing Company, Milwaukee; George Cutter, George Cutter Company, Chicago, and a representative from Machado & Roller, New York city.

The week's work concluded with a banquet at the rooms of the Chicago Athletic Association.

Automobile Train Traffic.

The Western Electrician has recently made mention of successful tests which have been made with trackless trains in Paris. Messrs. Renard and Surcouf of Paris have invented an "auto-motor railless train" which, according to Maurice Levy of the Academy of Science, will revolutionize road traffic and may to some extent supersede railways. A full-sized train of 10 cars, weighing 30 tons, has been tested and put on exhibition at the Automobile Salon, Paris. The principle of the invention is described as follows by a correspondent to the London Telegraph:

While the leading vehicle carries the motor, it is in no sense a traction engine. The cars are respectively connected one with another, not by mere couplings. Each vehicle is provided with transmission gear actuated by the motor on the leading car. Each portion of the train is practically, therefore, an automobile, as the engine on the first vehicle propels all the others individually, as if each of the latter had a motor of its own. The second point in the invention is the steering gear. This has been devised on the same principle as the transmission gear. That is to say, the train of cars is not drawn in the wake of the engine, but the latter commands the steering gear provided on each car. Thus the train forms a completely linked system.

The advantages of the invention are apparent. Traction being done away with, each car, as it were, propels itself, and friction of all the wheels upon the roadway is utilized, instead of being a useless resistance which the engine must overcome. Consequently, a far less powerful motor will, other things equal, draw a far heavier load than is the case with the traction engine. Moreover, the direction given to the train is not merely a straight line drawn from the leading car, as must occur with a railless train tugged by a locomotive. On the contrary, the steering gear of each car being commanded by the leading vehicle, the convoy can negotiate practically any curve. Finally, it is said that the invention minimizes the risks of side slipping. A special device to this end is a differential system by which, if needful, various speeds can be imparted at the same moment to various parts of the same train.

A test to which the invention has been successfully submitted will give an idea of the advantages of the system. A racing car which ran in the Paris-Bordeaux contest recently has been employed as the engine of the new train. The motor was capable of propelling the car alone, weighing 1,500 kilos, at 44½ miles an hour. Now the same engine propels the train of 30 tons at over 11 miles an hour. Another test was a trial trip, in which the train, having the same motor, climbed successfully the tremendous hill up to the heights of Bellevue from the banks of the Seine. The inventors say that "every single high road in France is now open to train traffic of moderate speed."

Two ordinances, the product of Mayor Tom L. Johnson of Cleveland, providing for and regulating three-cent street-car fare in Cleveland, were passed by the City Council of Cleveland at its last session. One of the ordinances confers upon the Forest City Railroad Company the franchises now held by the Cleveland electric railway upon Woodland and Central Avenues. The other establishes a large district in which only three-cent fares can be charged. The effect of the passage of the ordinances, if sustained by the courts, will be to do away with the universal transfers now granted by the company. It is expected the matter will be taken into the courts and a long fight will ensue.

CORRESPONDENCE.

Great Britain.

London, January 2.—Some very interesting evidence has, at one time or another, been given before the Royal Commission now inquiring into the difficulties connected with locomotion in London, but it must be confessed that not many witnesses have dared to grapple with the problem in a practical manner. Recently, however, the mayor of Westminster, who, professionally, is an architect, put before the commissioners an eminently practicable, if somewhat expensive, system of subways serving the dual capacity of carrying a double line of tramways and affording accommodation for pedestrians, at the same time allowing of sufficient space being devoted to the use of statutory companies for placing their wires, pipes, etc., therein. The estimated cost of constructing such a means of communication was put at £1,000,000 per mile, inclusive of the tramways, against which has to be set the profits from the latter and the rents received from the companies using the subways for their pipes, cables, etc. A tremendous amount of inconvenience is at present caused through the repeated breaking up of the streets for the purpose of laying new, and repairing old, mains, all of which would be saved under such a system. The idea was very favorably received by the commission, especially as the estimates were made on the basis that the subways were to be added to the existing narrow streets without encroaching upon the rights of the frontages.

A scare was created a few days ago when it was announced that Queen Alexandra had narrowly escaped being burnt by her bedroom catching fire, due, it was said, to defective electric wiring. Everyone was deeply concerned, but it was strongly suspected that defective electric wiring on a royal residence was hardly likely to be the case. In the end it turned out to be another of those instances in which the daily-newspaper reporter falls back upon the electric wiring as the cause of a fire of which he does not know the origin. As a matter of fact the fire originated through an overheated flue.

Trial trips have been run upon the "electrified" portion of the Lancashire and Yorkshire railway, between Liverpool and Southport. It will probably be remembered that the company decided to convert its old steam line to electric traction, owing to the diminished receipts of the local traffic through the competition of electric tramways in the neighborhood, much in the same way as the Mersey railway had to be converted. The work has been carried through very rapidly, but no detailed particulars are yet available.

The purchase of tramway rails has again been largely discussed by the London County Council. The recommendation recently to appoint a committee to inquire into the conditions of labor, rates of pay, etc., under which Belgian rails are produced has been adopted and a sum of money voted for the necessary expenses. Large reductions are being made by British firms in their prices for rails, evidently the outcome of the recent agitation. So great have these reduction been that the London County Council has been able to place a couple of large orders for rails with British manufacturers.

The Glasgow corporation, in considering extensions to its electricity works, is inclined to favor steam turbines, and a deputation is to be sent around to various important cities in Great Britain where this type of machinery is in use. These extensions are estimated at $675,000.

Some friction has arisen at Brighton between the corporation and the National Telephone Company as to the manner in which the former is carrying on its municipal telephone system, i. e., as to the inducement to subscribers. The company alleged that an unfair preference was being given to persons in order to induce them to subscribe to the municipal system, and an appeal was made to the postmaster-general. The latter has spoken somewhat strongly of the methods employed, and laid down certain regulations or wishes, which the corporation has assured him will be adhered to in the future.

The members of the Institution of Electrical Engineers are now being circularized with a view to ascertaining the number of those likely to take part in the contemplated visit to the United States next autumn. It is proposed to spend three weeks visiting the St. Louis exhibition, Albany, Chicago, Montreal, New York, Niagara, Philadelphia, Pittsburg, Schenectady, Washington, etc. The probable expenses are put at over $400 a man, and unless there is a guaranteed party of 40 the trip will be abandoned.

For a long time there has been a strong desire on the part of electrical contractors and manufacturers here to band together with the object of preventing, as far as possible, the price cutting now so prevalent. An agreement has now been entered into between the National Electrical Contractors' Association and the National Electrical Manufacturers' Association which will have the effect of abolishing trade discounts to architects, consulting engineers and other persons or firms who cannot be fairly called electrical engineers, wholesale factors, or a trade house. Exceptions are to be made, however, in the case of railway companies, government departments and others requiring goods by public tender. By this agreement also arrangements are made whereby the members of the two associations shall confine their dealings to each other. This agreement went into effect on January 1, 1904, and a joint committee has been formed which will deal with all questions arising out of the agreement.

So many opinions have been expressed during the last year concerning technical education that it is comforting to find that one scientific society has taken the matter up seriously. The Northeast Coast Institution of Engineers and Shipbuilders, an influential body in the Tyne district, appointed a committee which has now made a report in which are embodied some regulations apropos of apprentices and pupils. For the former it is proposed to apply a system of marks which will not only materially affect their wages but also give them the option, in the case of maximum marks, of spending their fourth or fifth year at a college during the daytime, the fees being paid by the employer. For pupils who have already passed through an engineering college course before entering the workshop similar arrangements are proposed. The drift of the proposals is to give some inducement to apprentices and pupils to take a greater interest in their work than is very often the case at present. They will no doubt be largely adopted by the members of the Northeast Coast Institution and others.

Owing to the high rates charged by fire insurance offices here in respect of electricity works and other municipal buildings a scheme of municipal insurance has always been greeted with much favor. Several London borough councils have started such a venture under the title of municipal mutual insurance, and a number of additional councils is now coming into the scheme. The city of London corporation also has been petitioned to take steps in this direction, but the committee to whom the matter was referred has reported adversely on the matter.

An echo of the past is the announcement that the London Electrical Cab Company has been struck off the list of companies registered. It will probably be remembered that several years ago this concern placed a large number of electrical cabs on the London streets, but that after about 18 months the company was wound up. The company worked the patents of a Mr. Walter Bersey, who disposed of his patents to the company. Since then practically nothing has been attempted in the direction of placing an efficient service of motor cabs on the streets of London.

Some optimistic statements were made at a meeting of the District railway (the electrification of which is in Mr. Yerkes' hands) the other day. Although it was anticipated that the work of conversion to electric traction would have been completed next spring, this will not be possible until the end of the year. The cause of the delay was attributed to the gigantic proportions of the Lots Road power house, which, originally to have cost $2,000,000, is now to cost $6,250,000. When the work is completed it will be possible to carry 100,000,000 passengers a year, it is stated. G.

New York.

New York, January 9.—Mayor McClellan met for the first time with the board of rapid-transit commissioners on Thursday. At this meeting Commissioner Orr of the committee on plan and scope reported favorably on the Parsons plan for a four-track subway to connect the Brooklyn, Manhattan and Williamsburg bridges. The report was approved and then referred to the chief engineer to prepare plans and specifications. The plan is for a subway running from the Brooklyn Bridge up Center Street to Delancey and over to the Williamsburg Bridge, with a spur off at Canal Street to connect with the Manhattan Bridge when completed. Controller Grout brought up the matter of having a model of the rapid-transit subway shown at the St. Louis Exposition. At the previous meeting of the board permission had been given to Chief Engineer Parsons to exhibit such a model at his own expense, but Mr. Grout moved that the permission be reconsidered, saying that the model should be shown at the expense of the commission and not of the chief engineer. The matter was allowed to lie over for a week.

The annual ball of the New York Telegraphers' Aid Society was held at Lexington Opera House on January 7th and was attended by 1,500 persons. An excellent vaudeville performance preceded the dancing. A substantial sum was realized. The officers of the society are: President, E. E. Grannen; vice-president, J. C. Watts; treasurer, Thomas M. Brennan; recording secretary, C. J. Power; financial secretary, A. C. Kilfoyle; chairman of the executive committee, J. F. Ahearn.

Fifteen systems of delivery of electrical current to moving cars are being examined by engineers and consulting electrical experts of the Interborough Rapid Transit Company, who are working upon a solution of the third-rail problem. It is expected that a report will be made within a few weeks to the board of directors, proposing several plans which would be feasible, by which the dangers of an exposed contact rail may be obviated or greatly lessened. It is understood that the engineers have eliminated from the list all plans which involve an overhead conductor. One of the principal things that the engineers want to find is some system by which all danger from the electrical current may be obviated when firemen are fighting fires from or near the elevated structure. It is said the engineers favor a plan by which the contact rail will be in short sections, which can either be cut out altogether or may be automatically rendered alive as the trains pass along, and be dead at all other times.

Among the incorporations from this city during the last week were the following electrical companies: The Walter H. Foster Company, manufacturing electrical apparatus, capital, $75,000; incorporators, Walter H. Foster, Frank H. Robinson and Walter E. Flanders. Russell Electric Company, capital, $10,000; directors, G. W. Russell, Jr., Minnie G. Reddon and J. H. Taylor of New York.

A fire occurred in a conduit beneath the sidewalk on the Broad Street side of the Stock Exchange early to-day, fusing hundreds of cables together and crippling the Western Union service in the downtown district. The only telegraph service that can be done by the Western Union with the Stock Exchange now is by messenger boy and pneumatic tube, there being a small tube connecting the exchange and the main office of the company at 195 Broadway. The telegraph wires to the Cotton, Coffee and New York Produce Exchanges were cut off entirely by the fire. There is confusion in all the exchanges.

Dr. Samuel G. Tracy, who has been using radium for about three months in this city and expects to make a report in a short time, believes radium fluid or a saline solution impregnated by induction with the properties of radium to be endowed with therapeutical possibilities that may work a revolution in the treatment of many diseases, and may strike the root of such scourges as tuberculosis, diphtheria, typhoid and other infectious maladies and protozoal diseases, such as malaria and perhaps scarlet fever.

Clarence Mackay, president of the Commercial Cable Company, was a witness in Part XIII. of the Supreme Court in the trial of the suit which he has brought against the Metropolitan Street Railway Company for $5,000 damages for the wrecking of his cab by a car of the company at Fifth Avenue and Twenty-eighth Street in February, 1901. Mrs. Mackay was in the cab, the coachman, John Mackie, told the court, but was not injured. The case was not concluded.

At a meeting of the board of directors of the Mercantile Electric Company on Wednesday, William H. McIntyre was elected a vice-president and Alvin W. Krech a director.

The employes of the Union Switch and Signal Company of Swissvale, Pa., have resumed work, the men being put to work on the $1,000,000 order for equipment of the railway connections for the New York subway. O.

New England.

Boston, January 9.—The annual meeting of the Boston Elevated Street Railway Company took place on Monday, January 4th, and the board of directors was re-elected. There are some interesting statements in the annual report of President William A. Bancroft, chief among them, perhaps, being the announcement that the revision of wages made earlier in the fiscal year has increased the payroll by about $200,000 since it went into effect. The increase in the number of revenue passengers for the last year was five per cent., against an increase of 4.1 per cent. in the previous year. The total number of passengers carried during the year from the subway stations alone was 32,018,986, and the whole number carried by the company was 233,563,578 revenue passengers. Extensions of surface tracks during the year amounted to 5.16 miles, and the total length of surface tracks now controlled by the company, including the leased portion of the Old Colony system, is 421.48 miles. The elevated trackage is 16 miles. In the plans for further equipment the ordering of 61 new surface cars and 24 new elevated-system cars is mentioned. Total receipts from car operation for the year were $11,693,269.43, including $26,362.83 from the United States government for mail-car service.

In the Superior Court of Suffolk County, Mass., on petition of Sidney Gleason of Medford, Chandler Hovey of Brookline, Frank S. Jones of Boston, and others, N. Sumner Myrick of Boston has been appointed receiver for the Natick and Needham Street Railway Company. This action is the outcome of the refusal of the receiver appointed for the South Middlesex Street Railway Company, to whom the Natick and Needham line was leased some time ago, to operate the latter road.

The Pittsfield Electric Street Railway Company of Pittsfield, Mass., contemplates the building of a line to Onota Lake in the spring, and has other extensions of the system into the suburbs planned.

The committee of creditors of the Worcester and Southbridge Street Railway Company, whose affairs have been in a tangle for several weeks, sent out a notice on January 6th advising the acceptance of 50 per cent. by the creditors, stating that in its judgment more can be realized in that manner than by forced sale or legal proceedings against the note indorsers. Upward of 70 per cent. of the creditors, it is stated, have agreed to accept the 50-per-cent. offer.

Sears B. Condit, Jr., manufacturer of electrical construction specialties, has brought suit against John A. McCoy, superintendent of construction of the New England Telephone Company, and George Cameron of Somerville, an electrical engineer and inventor, is named as co-defendant. Condit alleges that he had a contract with the parties against whom suit is brought and that revocation of a license under which he was manufacturing and selling an electrical appliance, of which Cameron is the patentee, has damaged him to the extent of $20,000. B.

Southeastern States.

Charlotte, N. C., January 9.—A meeting was recently held to consider a proposition for the pur-

chase of large holdings of two banking firms in the Macon (Ga.) Street Railway and Light Company. The meeting was held in Baltimore and was presided over by Robert L. Davidson. Southern interests made a proposition for the holdings. The matter will be taken up again, as no agreement was reached.

The Passenger and Power Company of Richmond, Va., is receiving the first shipments of an order of 22 electric cars, which will cost over $6,000 each.

The electric cars of Atlanta, Ga., are now under the control of a train dispatcher, who, by means of a new telephone system just put in, directs the cars of the Georgia Railway and Electric Company in cases of confusion or when any trouble arises. There are 30 telephones located at various parts of the city.

The Chattanooga electric railway of Chattanooga, Tenn., will issue 30-year five per cent. bonds to improve the system and build additions to the lines now in operation. An extension of 1½ miles will be built, giving a connection with Rossville, Ga. A part of the issue will be used in refunding old bonds.

The Birmingham Railway Company has abolished the office of general manager, held by J. B. McClary, who retires from the company. G. H. Harris succeeds Mr. McClary, with the title of superintendent of the street-railway department of the corporation.

The Mexico (Mo.) Electric Light Company, recently bought in by local capital, is purchasing machinery for installing a 24-hour service.

The Westinghouse Company of New York is preparing plans and estimates for a new electrical equipment for the Hendersonville (N. C.) Electric Light and Power Company.

There is talk of organizing a company to build an electric line from Mayfield, Ky., to Paducah, and also from Mayfield to Cairo. The prospects of an organization are said to be good.

W. T. Brown and others have been appointed a committee to investigate the feasibility of an electric-lighting plant in the city of Winston, N. C.

The largest stockholders of the Rapid Transit Company of Chattanooga inspected the lines recently and stated that a large sum would be spent in improvements.

The Electrical Construction Company of Richmond, Va., has just been awarded the contract for overhauling and inspecting all the electrical wires in the theaters under the Wells management.

Ladshaw & Ladshaw of Spartanburg have secured the contract for three important electrical developments in Putnam County, Georgia. Among them is the supplying of light to the town of Eatonton, Ga. Construction work will begin by May 1st.

The city of Albany, Ga., has agreed to take 300 horsepower electrical power for lighting the city and supplying power at the water plant from the Florida capitalists who have in hand the proposed development of Big Shoals on Muckafoonee Creek. It is proposed to develop from 15,000 to 25,000 horsepower.

Rush Taylor has secured a franchise to build an electric line from Opelika, Ala., to Auburn. The line will be known as the Opelika Electric Street and Interurban Electric Railway.

The Goldsboro and Seven Springs Securities Company is a new North Carolina concern, which among other rights has the privilege of building street-car and trolley lines, hotels, roads, etc. The company's capital is $150,000. L.

Texas and Mexico.

Austin, Texas, January 7.—The Houston Electric Company of Houston, Texas, will begin the work of extending its line to Harrisburg upon the completion of the subway that is to be constructed under the railroad tracks there. This company will remodel its general offices.

The Sour Lake Electric Light and Power Company of Sour Lake will install an electric-light and power plant at Saratoga, Texas.

It is stated that J. B. Dennis of Durango, Mexico, and associates are making satisfactory progress in their plans to establish a large electric power plant on the Piaxtle River in the state of Sinaloa, Mexico.

Good progress is being made in the construction of the new electric street-railway system at Aguas Calientes, Mexico.

A new electric-light plant has just been installed at Tamalpa, state of Jalisco, Mexico. H.

Kentucky.

Louisville, January 9.—Officers of the various insurance companies operating in Louisville have notified their agents that the electrical equipment of many of the buildings is out of date. It is recommended that some standard system be adopted, or that an electrical inspector be appointed by the local board of underwriters, who can spend all his time in the work. At present an inspector engaged in another line of work is giving a portion of his time to inspections.

A bill has been prepared to be introduced in the Legislature which provides among other things that franchises of all electric-railway companies, electric-light companies, telephone and telegraph companies and other corporations of this character operating in Louisville shall be taxed in a sum to be fixed by the City Council, and on refusal or neglect to pay the same a fine of five per cent. shall be assessed and added to the sum which would otherwise be collected. A tax on automobiles and other vehicles is also provided.

Two ordinances have been introduced in the City Council at Louisville, one of them creating a franchise for a viaduct from the middle span of the Big Four bridge to the corner of Franklin and Wenzel Streets, and the other allowing the construction of an electric-railway line over portions of Wenzel, Madison, East, Green and Third Streets to Main Street. The ordinances were referred to the committee on railroads. If passed they will give entrance to the Louisville and Southern Indiana Traction Company to the city.

It is reported that the Kentucky Traction Company is about to float $4,000,000 bonds in New York, but officers say that this amount will not be needed at this time, as the line will be built from Louisville to West Point first, and then arrangements will be made to secure funds for the construction of the line on to Nashville. In this way a portion of the road will be producing before the remainder is completed. The officers have been in consultation with the Tennis Construction Company for some days in regard to building the line to West Point, but as yet the contract has not been awarded.

The Joseph McWilliams Company of Louisville has secured the contract for the heating and lighting machinery and apparatus of the new Seelbach Hotel at Louisville, amounting to $125,000. The contract includes elevators and all other machinery used about the new building which is now in course of construction.

Jackson, Ky., is now without electric lights, the superintendent having closed down the plant, it is said. The assertion is made that Lewis Enricht, manager of the plant, is now in South America, and that creditors have taken steps to have a receiver appointed for the business. An attempt was made some time ago to sell the plant to the Jackson Development Company, but the deal did not go through C.

Ohio.

Cleveland, January 9.—A meeting was held at Napoleon a few days ago to discuss the plans of the Cincinnati, Detroit and Toledo Short Line. J. Morgan of Toledo, representing a number of eastern capitalists, explained the purposes of the company. Plans have been made to build a line from Detroit to Cincinnati, a distance of 300 miles, by way of Toledo, Napoleon, Defiance and some other western Ohio towns. The capital stock was at first fixed at $500,000, but has since been increased to $6,000,000. Mr. Morgan stated that the company that is to build the road has given a $100,000 bond to have it completed within two years. Napoleon is asked to guarantee a subsidy of $25,000 in return for the location of the shops in that city.

A public hearing of the ordinance fixing the maximum limit of price for electric lights for private consumers in Cincinnati will be held next Thursday. Considerable interest is evinced in the ordinance, as the price fixed will continue for 10 years.

About 200 inside wiremen at Cincinnati are striking for an increase in wages. The scale calls for an advance of 50 cents a day for 1904, which would make the wages $3.50 a day. Employers are said to be willing to grant the advance, but desire the men to pledge themselves to take no part in sympathetic strikes during the year.

The Circuit Court at Cincinnati has decided that the franchise of the Millcreek Valley Street Railway Company to operate on Carthage Pike is valid. The citizens of Carthage brought the suit on the ground that the company is charging a higher fare than the grant provides and that the route had been changed from the original plans. The court held that the company operates under a later grant from the commissioners and that the fare is not higher than provided.

The annual dividend of the Columbus Gas Light, Heat and Power Company has been increased from seven to eight per cent. A semi-annual dividend of four per cent. has been declared, payable on February 5th. O. M. C.

Michigan.

Detroit, January 9.—Last week saw the organization of two more electric-railway companies, the Ionia and Owosso and the Jackson and Lansing, with E. M. Hopkins of Detroit and New York as president. These, with the Grand Rapids and Ionia Railway Company, organized with the same head some time ago, make a triplicate system of electric lines through the heart of the central portion of Southern Michigan. A strong connection is thus made between the cities included in the titles of the railways, and a large number of towns of good size along the lines projected, linking together sections of the best-populated portion of the state. The Ionia and Owosso line is organized with a capital stock of $1,500,000, and the Grand Rapids and Lansing is capitalized at $1,200,000. The road organized previously between Grand Rapids and Ionia has a capital stock of $1,000,000, and the same men, practically, are behind all three companies. Mr. Hopkins will direct affairs as the executive head of the triple system aggregating about 125 miles of track. The Grand Rapids and Ionia and Ionia and Owosso lines will be operated also by the same set of officials, greatly simplifying the management of the two roads. The officers and directors are as follows: President, E. M. Hopkins; vice-president, John T. Rich; treasurer, C. H. Pomeroy; secretary, Frank Westcott; directors, J. L. Hudson, Governor Bliss, W. E. Harris, Judge Porter and M. D. Sly.

The Detroit Association of Street Railway Employes was represented in the convention of the American Federation of Labor by Chairman D. L. Dilworth of Detroit and Fred Fay of Ypsilanti, Mich.

A fight is on between two interests which are trying to obtain a franchise from the Lansing council for a central heating and electric plant. John H. Chase, William L. Haag and others urge the enactment of a franchise they presented a year ago, but the council wishes to grant one also to A. A. and F. B. Platt, who heat the capitol, and already have a plant in operation.

The Detroit United Railway has sold $500,000 of general-mortgage 4½ per cent. bonds to E. H. Gay & Co. for a price near 98. This leaves the road with a floating debt of $700,000. Another $500,000 of the bonds will be sold, and the road then put on a five per cent. basis.

A construction company is being organized by George E. Fisher of Detroit to build steam and electric railways. E. N. Chase and B. M. Hopkins will be associated with the company.

As a result of the Iroquois Theater fire, City Electrician George Cotton of Grand Rapids has made an inspection of the wiring of the theaters of that city, and found three of them in perfect condition and recommended changes in a fourth. The electrical apparatus of every theatrical company will be given a careful inspection before it is permitted to be used in any theater in that city. C. G. W.

Pacific Slope.

San Francisco, January 7.—O. J. Smith, a capitalist of Reno, Nev., was in town last week. He is interested, together with John Sunderland and J. B. O'Sullivan, in the proposed electric line from Reno to East Reno, where the Southern Pacific shops are located.

Hetty Bros., electrical contractors, have the contract for installing the electric-lighting apparatus in the large apartment house on Sutter Street, near Jones.

The Joshua Hendy Machine Works has secured the contract for the electric wiring in the nine-story building being erected by Isaac Liebes at the corner of Jones and Turk Streets for $3,650.

The Los Angeles Electric Company has obtained R. Hart's franchise for the establishment of an electric-light plant in the Santa Maria Valley.

The first generating unit was recently started at the new waterpower electric station of the Vancouver Power Company, located about 16 miles from Vancouver, B. C. The lighting load of the city is carried by the new plant, which was installed under the supervision of Wynn Meredith of San Francisco. A part of the steam plant in Vancouver has already been shut down. The street-railway lines will be supplied later with current from the new power station.

Frank Webster, chief clerk to Superintendent Lynch of the United Railroads, was chosen manager of the Stockton Electric Railways on January 1st. The company will reconstruct its lines during the coming year on Main, California and Eldorado Streets. Ties will be laid on a roadbed of crushed rock, and 65-pound rails will take the place of 40-pound rails now in use. When the reconstruction work is completed extensions will be made to reach the northwestern, northeastern and southeastern portions of the city. The first suburban line will be laid to Lodi, but no prediction is made as to when it will be accomplished.

It is expected that the Pacific Electric Company of Los Angeles will absorb the new electric line now being built to Glendale and Tropico. Grading has been finished as far as Tropico, a distance of four miles. When completed the road will be 10 miles long.

Allan Pollak, formerly manager of the San Francisco Gas and Electric Company and now manager of the St. Francis Hotel, was presented a beautiful chest of silver from the management of the San Francisco Gas and Electric Company and a handsome desk set from the employes of the same company on Christmas. Mr. Pollak resigned as manager of the San Francisco Gas and Electric Company some time ago to become manager of the new hotel, his place being taken by Mr. Lawless.

McLees Bros. and William McIndo intend to install an electric pumping plant on their property west of Lindsay, Cal.

Mortimer Fleishhacker of the American River Electric Company states that the new electric-power plant of the company, located at the mouth of Rock Creek, near Placerville, is ready for commercial operation. The machinery is of one unit, including a 1,500-kilowatt, Westinghouse generator. A direct-connected Pelton waterwheel has been operated at slow speed as a test. The first load carried by the new plant will be the lighting of Placerville and the operation of the two large gold dredges in which W. P. Hammon is interested at Jenny Lind, on the Calaveras River. Stockton will also be supplied with light and power. Two large gold dredges will be ready for operation about January 15th near Folsom, under a contract by which the American River Electric Company is to supply current during a period of years to the Folsom Development Company, of which W. E. Gerber is president.

The Ferndale electric-light plant of Ferndale, Cal., has been sold to W. W. Barnes, late consulting engi-

neer for the proposed Van Duzen power venture, and a company which he represents. It is reported that a number of improvements will be made in the local system, including day as well as night current.

The City Council of Santa Rosa will offer for sale a franchise covering many important streets in Santa Rosa. The petitioner is Burke Corbett of San Francisco, who represents the Petaluma and Santa Rosa Electric Railway. The company is now building from Petaluma toward Santa Rosa, and proposes to establish an interurban line through Green Valley to Forestville. Santa Rosa will then be connected to this system. A.

PERSONAL.

H. E. Johnson, owner of the Stewartville (Minn.) electric-light plant, died recently.

Harry S. Wauzer has accepted the position of superintendent of the Santa Cruz (Cal.) Electric Light and Gas Works and will take up his new duties at once.

The death of W. L. Elliott, president of the Antigo (Wis.) Electric Light, Power and Heating Company, is reported. Mr. Elliott was also manager of the Antigo Telephone Company.

A. P. Munning, the energetic sales manager of the Cutler-Hammer Manufacturing Company of Milwaukee, was in Chicago last week and left immediately on a flying visit to the western territory.

Irving H. Reynolds, formerly with the Allis-Chalmers Company and for many years identified with the design and construction of steam engines, has accepted a position with the William Tod Company of Youngstown as consulting engineer.

C. F. Hewitt, treasurer and manager of the Elkhart (Ind.) Electric Company and general manager of the St. Joseph and Elkhart Power Company, has tendered his resignation, to become effective February 1st. He goes to St. Joseph, Mo., to take a similar position.

Hamilton Ruddick, a mechanical and electrical engineer, died in his apartment in Montague Street, Brooklyn, on January 8th. He was born at St. John, N. B., Canada, in 1826. He came to this country as a young man and has held many positions throughout the East.

W. H. Atkins, general superintendent of the Edison Electric Illuminating Company of Boston, accompanied by Auditor Wallace and Electrical Engineer Elden of the same company, have been in Chicago for several days inspecting central-station methods in this city.

Martin Sheehan has been appointed superintendent of the Buffalo, Lockport and Olcott division of the International Railway Company (electric) of Buffalo. Mr. Sheehan will have headquarters at Lockport and his former position with the company at North Tonawanda will be filled by D. H. Dewey.

Mrs. Cora P. McCulloch, wife of George F. McCulloch, head of the Indiana Union Traction Company, died in Chicago on January 8th, after a long illness. Her death occurred at 2724 Michigan Avenue, the temporary residence of Mr. and Mrs. McCulloch. The funeral took place last Monday at Muncie, Ind.

James Ross of Montreal, president of the Mexican Light and Power Company, has left for the City of Mexico to inspect the work of installation already carried out by the company as well as the condition of the other companies secured by the Mexican company. Mr. Ross is accompanied by F. L. Wanklyn.

Herbert Taft Richards died in Brooklyn, N. Y., on December 26th. Mr. Richards was secretary of the Safety Insulated Wire and Cable Company at the time of his death and was at one time upon the staff of the Electrical Review. The funeral took place on December 28th from the home of Mr. Richards' brother at Montclair, N. J.

R. L. Andrews has resigned as manager of the Eastern Ohio Traction Company, with headquarters at Cleveland, and has gone to Youngstown, where he will assume charge of the construction of the Youngstown and Southern Railway Company. Mr. Andrews has great faith in the future of the new line between Youngstown and East Liverpool.

Augustus B. Sanders, who for a number of years was connected with the engineers' department of the American Telephone and Telegraph Company, and later with the Electric Storage Battery Company of Philadelphia, is now connected with John B. Watson, Drexel Building, Philadelphia, taking charge of the electrical department. Mr. Watson is an agent for railway equipment.

Richard T. Laffin, the retiring general manager of the Worcester (Mass.) Consolidated Street Railway Company, who was succeeded at the beginning of the year by Frederick A. Huntress, intends to sail for Manila on January 25th from San Francisco. He will begin immediately the construction of the first electric-railway, light and power plant combined in the Philippine Islands.

The complete reorganization of the Columbus (S. C.) Street Railway, Light and Power Company has brought a change in the management of the company. W. B. S. Whaley has been succeeded as president by E. W. Robertson and P. I. Welles succeeds E. B. Clark as general manager. The company has prospered under the guidance of Mr. Whaley and Mr. Clark, and their retirement is regretted. The large capital associated with Mr. Robertson will bring extensive improvements, it is said.

Joseph B. Crockett, who for several years was president of the San Francisco Gas and Electric Company, and well known in San Francisco business circles, died at the home of his daughter, Mrs. Lawrence Scott, at San Mateo, Cal., on December 24th, having been stricken with heart failure. Mr. Crockett came from St. Louis while yet a young man and held a position as engineer at the old City Gas Company's works. He gradually rose from that station and remained with the concern when it became the San Francisco Gas Company, and when this firm was merged into the San Francisco Gas and Electric Company about 10 years ago, Mr. Crockett was made president, a position he filled until two years ago, when he resigned, owing to ill health. He was 53 years of age and is survived by a wife and daughter.

N. S. Braden, formerly manager of the Westinghouse Electric and Manufacturing Company's district office at Cleveland, Ohio, has been appointed sales manager of the new Canadian Westinghouse Company. He assumed the duties of that office on January 1st. Mr. Braden succeeds the late Thomas C. Frenyear, who died on December 10th of last year. Mr. Frenyear's office was at Toronto, but Mr. Braden will make his headquarters at Hamilton, Ont. Mr. Braden was born at Indianapolis, Ind., 34 years ago. He finished his schooling in 1892, and went with the Jenney Electric Motor Company in his native city. He remained with that company until 1899, when he joined the Cleveland district sales office of the Westinghouse Electric and Manufacturing Company as a salesman, where he later became manager. Mr. Braden is known as one of the ablest and best-informed electrical salesmen in America.

The beginning of the new year brought many changes in the management of several important concerns in which Montreal capitalists are interested. The retirement of F. L. Wanklyn from the offices of general manager and vice-president of the Montreal Street Railway will affect that company and the Montreal Light, Heat and Power Company. Duncan McDonald will become general manager of the street-railway company, while W. D. Ross will occupy the new position of managing director, and in order to do so retires from the board of the Light, Heat and Power Company. P. G. Gossler, general manager of the latter company, has resigned, and most of his work will be undertaken by W. McLea Walbank, recently named chief engineer of that company. In the Canadian Pacific railway telegraphs the creation of the new office of electrical engineer for Mr. Camp results in a complete change of the entire staff of the Eastern division.

ELECTRIC LIGHTING.

The city of Higginsville, Mo., has voted $10,000 in bonds to improve its system of electric lights and waterworks.

The Washington Electric Light and Power Company will install a lighting system at Rockford, Wash., by February 1st.

The town of San Martin, Texmelucan, state of Puebla, Mexico, is about to inaugurate a system of electric lighting for streets and houses.

The city of Sturgeon Bay, Wis., has purchased the electric-light plant owned by Adolph Hamacek, in that city, for a consideration of $19,000.

Nicholas Codd and James A. Ralph of Colfax, Wash., have bought the electric-light plant at Dayton, Wash. Mr. Ralph will assume management.

A power plant of brick and stone construction, 50 by 100 feet, and to cost $20,000, is to be built at Bloomington, Ind., for the Indiana State University.

The plant of the Pittsfield Electric Light and Power Company at Pittsfield, Ill., has been sold to Kendall & Whiting of Lake Geneva, Wis., for $20,000.

Construction work has been begun on the new power station for the Ware Electric Light Company at Ware, Mass. Feehan & Manley have the contract.

An electric-light plant is to be installed at Searcy, Ark., by the Searcy Power Company, which was recently incorporated with a capital of $150,000. P. F. Miller, L. M. Burns and T. N. Powers are among those interested.

Fire recently destroyed the power house of the McGregor Water and Light Company at McGregor, Texas. The damage amounted to $10,000, and no service can be given consumers until extensive repairs are made.

It is reported that plans have been prepared and are in the hands of City Engineer Caldwell for a new municipal electric-light plant at Beloit, Wis. Bonds, in the amount of $40,000, it is asserted, will be voted for this purpose.

The stockholders' meeting of the Tampa (Fla.) Electric Company resulted in the election of the following-named directors: George J. Baldwin, P. O. Knight, Russell Robb, Henry B. Sawyer, Harry H. Hunt, Henry G. Bradlee and John W. Holloway. The directors were highly pleased with the manner in which the affairs of the company had been conducted.

At a special election held in Hannibal, Mo., to vote on the proposition to issue bonds to the amount of $100,000 for the purpose of constructing an electric-light and power plant, the proposition carried by a large majority.

At the civic elections held on January 4th the taxpayers of Ottawa, Ont., voted by a large majority to adopt a by-law providing $50,000 for the establishment and operation by the municipality of an electric-lighting plant for street-lighting purposes.

ELECTRIC RAILWAYS.

The Dixon, Rock Falls and Southwestern Electric Railway Company will build a power house and car barns at Rock Falls, Ill.

The Joplin, Neosho and Pierce City (Mo.) Interurban Railway Company has been incorporated with a capital stock of $50,000 by Charles Cunlipp and William S. Brawner of St. Louis.

The city of Alexandria has brought suit against the Indiana Union Traction Company to compel the payment of damages alleged to have been caused to the city water mains by electrolysis.

The Metropolitan Street Railway Company of Kansas City has given a contract to a St. Louis firm for 35 electric cars, which are to be delivered not later than May, at a cost of $7,500 each.

Construction work on the Alviso electric railroad has been commenced at a point about five miles from San Jose, Cal., under the direction of Lockwood & Mehling, promoters of the projected road.

The street cars in Jamestown, N. Y., have been equipped with new signs at each end designating their respective routes. The signs are lettered in black on white backgrounds and are very conspicuous.

Manager L. E. Fisher of the Danville-Champaign (Ill.) electric line announces that the Homer-Ogden branch of the interurban road will be in operation by May 1st. The new line will be operated independently.

It is asserted that the application for a receiver for the Sandusky (Ohio) Southwestern electric railway will be dismissed and the general offices of the company removed from Wapakoneta to Lima, Ohio, February 1st.

The Southern Pacific Railroad Company is planning to lay a third-rail line between Sacramento and Truckee, Cal., the power to be derived from the Truckee River. Especially powerful motors will be used on the heavier grades.

The Holton Power Company of Holton, Cal., proposes to construct 12½ miles of electric railway and will erect an electric generating station on Adams River, near Imperial, Cal. Electricity will be used for light, power and railway purposes. Samuel Storrow of Los Angeles is the consulting engineer.

Work on the Chautauqua Traction Company's electric line from Jamestown, N. Y., to Chautauqua, Mayville and subsequently through to Westfield, has been discontinued until more favorable weather conditions prevail. General Manager Maltby states that the track and wire have been finished as far as Stowe. The company is now making an effort to complete the power house at Stowe and install the machinery at an early date.

The Empresa Electrica de Santa Rosa has just built a power station at Chosica, Peru, to develop 1,700 horsepower, with provision for increase. This is in addition to the 1,800-horsepower plant established near Lima three years ago. The company will supply current to the nearly completed electric line between Lima and Miraflores, as well as to a line under construction from Lima to Callao. The equipment of the power houses and railways is in the hands of American firms.

A deal has been consummated whereby all the interests of the Mineral Cities Electric Railroad Company within the city of Joplin, Mo., were transferred to the Southwest Missouri Electric Railway Company for a consideration of $25,000. The latter company also owns the Joplin and Galena electric railway and the Jasper County electric railway. A. H. Rogers of Joplin is president of the Southwest company and F. M. Moore, also of Joplin, is president of the Mineral Cities company.

A number of Nova Scotia capitalists recently visited the Island of Trinidad and the opportunity there proved so tempting that it was decided to take over the tramways in the town of Port of Spain and operate them upon modern lines. The tramway in question is 12½ miles in length and is in the town of Port of Spain, serving a district populated by over 80,000 people. The company, which has been formed under the name of the Trinidad Electric Company, secured the plant at the figure of $1,200,000. The company has already instituted a new plant and has put a Canadian at the head in the person of F. W. Teale.

The Great Falls and Old Dominion Railroad Company, which proposes to build 14 miles of double-

track trolley line from Georgetown, D. C., crossing to Potomac River on the Aqueduct Bridge, and then to the Great Falls on the Virginia side of the river. The company also expects to construct a cross-town line in Washington, using the underground electric system from Georgetown to the new Union Station and beyond to the northeast portion of the city, besides another cross-town line to the navy yard. A large power house and probably a number of sub-stations will be constructed to provide the power for operating the lines. W. B. Upton of Washington, D. C., has been appointed construction engineer.

President J. H. Warner of the Chattanooga (Tenn.) electric railway announces that, of the $2,000,000 bond issue, which will be made by that company, $1,000,000 will be used to pay off the old bonded indebtedness, and the other $1,000,000 will be used for the improvements which are to be made on the system the coming year. By the issue of the new bonds the proposed line to Chickamauga Park is assured, and after this work is done it will leave a large reserve fund in the treasury of the company for such other improvements as the board of directors may decide up. An important feature of the Chickamauga Park line will be the erection of a transformer station on the top of Missionary Ridge, which will be used to furnish additional current for the cars on this line.

AUTOMOBILES.

President C. G. Rannier of the Vehicle Equipment Company of New York was in Chicago last week en route to New York, after a successful business trip through the West, in which he placed some good orders for heavy electrical drays. The demand for electrical trucks is increasing rapidly in the West and the vehicles are proving satisfactory in the case of a number of Chicago firms which have had several types in use for some time. Alexander H. Revell & Co., Chicago, have recently secured a fine five-horsepower machine. Mr. Rannier placed orders in Dubuque, St. Paul, Minneapolis, Milwaukee and St. Louis. His firm will exhibit 10 cars at the automobile show in Chicago February 6th.

SOCIETIES AND SCHOOLS.

Washington, D. C., has been chosen as the next meeting place of the American Electrochemical Society. The meeting will be held April 7th to 9th.

The Indianapolis Engineering Society has been organized to include in its membership civil, mechanical and electrical engineers and architects. The society starts with 50 members. There will be two meetings a month. C. C. Brown is president and W. E. Buehler secretary.

One of the most interesting and valuable portions of the volume of Transactions which the National Electric Light Association is about to issue is the report, with illustrations in colors, on "Decorative and Sign Lighting." Arthur Williams of New York, the reporter on the subject, has been appointed to take up the matter again this year in a second report, and proposes to handle the subject in a somewhat different manner, adding to illustrations the ideas and opinions of central-station men concerning advertising signs, and selecting instances in which decorative lighting of that character has been productive of increased trade and revenue to the users. He is now collecting such data, and those interested in the subject should communicate with him at the offices of the New York Edison Company. The book of proceedings has been delayed in its appearance for various reasons, but it is hoped that its unusual scope will compensate for the delay in getting it into the hands of the members.

PUBLICATIONS.

A brightly colored wall calendar with a picture representing two pretty girls is distributed by J. S. Boggs, Albany, Ga., manufacturer of yellow-pine cross-arms. The calendar will be appreciated by recipients.

The General Electric Company is sending out from its lamp-factory sales department at Harrison, N. J., a hanger 20 by 40 inches for the convenience of its patrons in ordering lamps. The sheet contains pictures of the various sizes of Edison lamps, together with their respective voltages, candlepower and watts per candlepower. The hanger will be found useful by those ordering lamps in considerable quantities, as at a glance the sizes desired can be picked out without taking the trouble to look the matter up in a catalogue.

The Guarantee Electric Company of 133-139 South Clinton Street, Chicago, has issued a new edition of its "Handy Electrical Directory" of Chicago. This little book is of vest-pocket size, neatly bound in leather and is as handy and useful as its name implies. It gives the names, addresses and telephone numbers of Chicago electrical men, business houses and societies, alphabetically arranged and is a real convenience. There are about 950 entries in the book, and several blank pages for additional addresses are also provided.

The report of the first annual convention of the American Railway Mechanical and Electrical Association, just out, contains much valuable material. A front page picture of Thomas Farmer, president for 1903, is given, after which is a list of officers elected at the organization meeting, held in Cleveland, February 16, 1903, together with their pictures and those of the executive committee. The officers for 1903-1904 are: President, E. W. Olds, Milwaukee, Wis.; first vice-president, Alfred Green, Rochester, N. Y.; second vice-president, C. F. Baker, Boston, Mass.; third vice-president, W. O. Mundy, St. Louis, Mo.; secretary and treasurer, Walter Mower, Detroit, Mich. All the papers of the meeting are given in full, with the illustrations and the discussions. A list of members, associate, honorary and active, also appears.

TELEGRAPH.

A recent court opinion holds the Western Union Telegraph Company liable for loss sustained by its failure to forward promptly an important business message. The opinion reverses the decision of the lower court and orders judgment in favor of Dr. Charles J. Swan for $1,050 with interest from January 2, 1901. The suit grew out of a delayed message which resulted in a disastrous stock deal.

Negotiations for a settlement of the pole-chopping controversy between the Pennsylvania Railroad and the Western Union Telegraph Company have been resumed, it is said. There has been no compact signed nor has peace yet been declared, but it can be stated that a common basis has been found and that this ground is sufficiently firm to satisfy men prominent in the financial world that there is at least a probability of an end to hostilities.

Less than 40 years ago the first Atlantic cable was laid. Now there are, besides the English lines, three that directly connect America with the Continent of Europe. A fourth line, beginning on the little German island of Borkum, has already stretched westward as far as the Azores and will be ready for operation by January 1, 1905. A contract between the German Atlantic Telegraph Company and the German Postoffice Department calls for the payment by the German government of 750,000 marks ($178,500) upon the completion of the first section of this cable, between Borkum and the Azores, before January 1, 1904, and a further agreement becomes operative if the cable is completed to New York within the year 1904. The first part of the agreement has been fulfilled, as the cable has been successfully completed between Borkum and the Azores, in spite of the generally unfavorable conditions of the weather on the Atlantic Ocean last year.

MISCELLANEOUS.

Meetings of the executive committee and of the committee on devices and materials of the National Fire Protection Association will be held at Chicago during the week of February 15th.

By a typographical error the line below the cut showing plan and elevation of the Westinghouse-Parsons steam turbine on page 39 of last week's Western Electrician was made to read "500-kilowatt" instead of "5,000-kilowatt."

On the evening of January 7th an informal dinner was held at the Grand Pacific Hotel, Chicago, for members of the supply sales department of the Western Electric Company, who gathered to the number of 45, and passed a few hours in social intercourse. This is an annual affair and is really the winding up of a meeting of representatives of the branch houses of the company, who come together once a year at headquarters in Chicago.

Among other new enterprises to be put in operation at Nantes, France, during the year 1904 will be a large plant for manufacturing patent fuel. This fuel is manufactured with coal dust and about eight per cent. of pitch. This latter article is becoming very scarce and the value has increased 25 to 30 per cent. American exporters of pitch, says Consul Ridgely, might well examine the question of finding a market at Nantes, also at St. Nazaire, which produces annually 100,000 tons of patent fuel. This fuel, consisting principally of briquettes, is used mainly by the railway companies.

In a recent issue of the London Globe a correspondent gave some information which he had collected regarding the chief steam-turbine plants, planned and now in use in Great Britain for electrical generating stations. The amount of power now developed in England by steam turbines, neglecting the smaller installations, is placed at 112,000 horsepower. Within the last few months, the writer says, there has been a great increase in the number of applications for patents for steam turbines, among the applicants being Mr. Parsons himself, the subject of whose original patent is at last coming to full fruition.

TRADE NEWS.

Robert Albertsen is to open an electrical supply store in North Fourth Street, Peoria, Ill., soon.

The annual meeting of the salesmen of the Bullock Electric Manufacturing Company will take place on January 25th at the Cincinnati offices.

The D. M. Stewart Company of Chattanooga, Tenn., manufacturer of electric insulators, lava gas tips, etc., has been incorporated with a capital of $30,000.

The Indiana Electrical Company, a new concern, began business in Anderson, Ind., on January 4th. The firm is composed of Frank Straton, for a number of years connected with the city light plant, and A. D. Smith.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until February 10th, for furnishing and placing the lighting fixtures for the United States Mint (new) at Denver, Colo.

Since Dr. Goldschmidt's lecture on "Thermit" before the American Society of Mechanical Engineers it is said that a great demand has arisen in this country for the new substance and for appliances, such as crucibles, etc. Until facilities are provided here for its manufacture, E. Stütz of 54 Front Street, New York, will carry an imported stock of the materials. Printed instructions may be had upon application to him.

The Tibbe Electric Company of Washington, Mo., of which A. A. Tibbe is president, has established a day circuit for supplying power. It has already equipped the Dittmann boot and shoe factory with Wagner single-phase motors of 35-horsepower capacity. The Washington Water and Light Company is figuring on electric pumping machinery to replace its large steam pumps and is open for propositions for the installation. H. D. Hibbeler is the general manager of this company.

Sales Manager Martin L. Bowbeer of the Chicago Die and Electric Company left Chicago on Saturday last to make a trip through the East in the interest of his company. Mr. Bowbeer will visit New York, Philadelphia, Pittsburg and in fact practically all the more prominent eastern cities. This trip is especially in the interest of the Maxstadt wire joints or connectors, which have been so extensively manufactured by this company. Mr. Bowbeer will be away from Chicago about 10 days.

Marshall H. Coolidge, the well-known cedar man of Minneapolis, announces that he has sold an interest in his business to H. B. Waite of the Waite Lumber Company and A. R. Rogers of the Rogers Lumber Company, both of Minneapolis. The Marshall H. Coolidge Company has been incorporated with a capital stock of $100,000, and, in addition to the gentlemen mentioned, C. B. Brooks is a member of the firm. The new organization will enable the Coolidge company to handle its constantly increasing business more satisfactorily than ever before.

Sales Manager H. B. Kirkland of the American Circular Loom Company, accompanied by President John H. Dale of the Dale Company of New York and A. N. Palmer of the Phillips Insulated Wire Company, was a recent visitor in Chicago, remaining throughout last week. Mr. Dale was in Chicago investigating a location for a new store, which the Dale Company will make its western branch. At this western store the company will carry a full line and large stock of the well-known Dale specialties. It is expected that the new Dale store will be in full blast within 60 days, as before he left for the East Mr. Dale made the selection of the new store location.

The friends of W. H. Hornsberger, who has been so long identified with the transformer trade in the United States, will be interested to know that he is now with the Crawfordsville Electric Company of Crawfordsville, Ind., and has been appointed to the position of manager of that company. The Crawfordsville Electric Company is a manufacturer and jobber of arc lamps, transformers, current and voltage regulators and switchboards. The company has just published a new catalogue, which will describe its entire line, and this catalogue will shortly be distributed to the trade. Mr. Hornberger brings to the company a long experience in the electrical-manufacturing business, and it is safe to say that the company will find in him a most valuable addition to its executive staff.

BUSINESS.

The Electric Appliance Company is prepared to fill orders on the McBride enclosed fuse in capacities from three to 30 amperes and from 125 to 500 volts. This fuse can be used with assurance that it will blow without an arc.

A new push button is manufactured by the Chicago Glass Novelty Company of Marion, Ind. It consists of a glass cover gilded on the under side, the gold being fixed into the glass. It will never tarnish and is very bright and can be easily seen in the night, as it reflects any light, no matter how slight, in street or hallway. It has a beautiful appearance.

The Electric Appliance Company, Chicago, is advertising "points" in connection with Adams-Bagnall arc lamps. Among the "points," in a bulletin just issued are: One hundred and twenty-five thousand lamps in successful operation; no change of model in past five years; 75 per cent. of the parts of these lamps are interchangeable; no delay in getting parts 10 years hence; positive value in non-changing model.

The Central Electric Company of Chicago reports an exceedingly good business on Columbia incandescent lamps, for which it is sales agent. Up to

this time the Columbia has been manufactured in only the ordinary incandescent and series burning types. The Central Electric Company is authority for the statement that it will now be able to supply miniature lamps of the Columbia brand, which will doubtless meet a large demand.

Among the many successful installations of the fan system for heating and ventilating woodworking factories is that in the recent addition to the Ivers & Pond Piano Company's factory at Cambridge, Mass. With this system the same apparatus that heats the building ventilates it without extra cost, increasing the efficiency of the workmen, especially in the warm weather. The apparatus was installed by the B. F. Sturtevant Company of Boston, Mass.

Recently an injunction was issued against the American Electric Fuse Company preventing it from manufacturing certain improved wire joints specified in patent No. 655,905, owned and controlled by the Chicago Die and Electric Company and called the "Improved American Joint." A notice has just been issued, however, by the latter company to the effect that satisfactory settlements and arrangements have been made by which the American Electric Fuse Company may now continue to manufacture and sell the joint, it being the only concern to which such license has been given.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) January 5, 1904.

748,571. Electric Soldering Iron. James I. Ayer, Cambridgeport, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Application filed November 13, 1902.

At the outer end of the holder of the heating mechanism is a socket with closed bottom. A tip having a sliding fit in the socket is adapted to contact with the entire length of the socket. Clamping means operate over the length of the socket for holding the walls of the socket under pressure against the tip throughout contacting area.

748,572. Apparatus for Controlling Current Supply to Electrically Heated Tools. James I. Ayer, Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Application filed June 1, 1903.

Electric circuits supply full current directly to a translating device, or reduced current through a resistance. Means operating in connection with the translating device introduce the resistance into circuit with the translating device when the latter is not in use, and cut the resistance out of circuit when the translating device is in use.

748,591. Third-rail Cover. Henry F. Duffy, Seattle, Wash. Application filed June 20, 1903.

The essential features are a stationary cover, a slotted plate, a bracket secured to the cover, a counterweighted lever, pivoted to the bracket, and a link connecting the lever and plate. One end of the lever is received and retained in the slot in the plate.

748,592. Third-rail Protector. Henry F. Duffy, Seattle, Wash. Application filed June 20, 1903.

Sectional covers are fastened to curved rods, which extend through a housing. The covers are connected to a rope or chain, which in turn is connected to a pulley and a weight for returning the covers to their normal position. (See cut.)

748,597. Wireless Signaling Device. Lee De Forest, New York, N. Y. Application filed December 24, 1902.

A reflector for the ether waves is connected with a wave-radiating conductor, the connections containing lag-producing devices adapted to cause the reflected waves to coincide in phase with the waves directly radiated from the radiating conductor and traveling in the same direction.

748,599. Incandescent Electric-lamp Socket. Henry A. Framburg, Chicago, Ill. Application filed April 9, 1903.

An insulator-plug is formed to provide terminal chambers on opposite sides, intermediate it and an insulator sleeve, and having a transfer slot across the top connecting the chambers and adapted to admit the terminal leads. A lamp contact and means rigidly engaging the lamp contact to the plug form part of the current source.

748,609. Production of Hydroxides and Oxides of Metals by Electrolysis. Frederick F. Hunt, New Brighton, N. Y., assignor of two-thirds to Maas & Waldstein, New York, N. Y. Application filed January 22, 1903.

The process consists in passing a current of electricity through a suitable electrolyte having both the electrodes formed of the metal whose hydroxide or oxide is desired, and making each electrode the anode and the cathode, alternately, at suitable intervals, and collecting the hydroxides and oxides as separate bodies apart from the electrodes. (See cut.)

748,619. Electric Railway. Charles J. Kintner, New York, N. Y. Application filed September 22, 1899. Renewed May 19, 1902.

An insulated current feeder or main, a series of flexible sectional trolley conductors or cables and switching devices for operatively connecting the sectional conductors to the insulated current feeder or main co-operate with flexible or yielding means for normally maintaining the sectional conductors in a taut or strained condition and out of electrical connection with the current feeder.

748,620. Electric Railway. Charles J. Kintner, New York, N. Y. Application filed March 10, 1902. Renewed May 22, 1903.

A series of sectional third rails or conductors is normally disconnected from the feeder mains. Switching mechanism for connecting the sectional conductors to the current feeder and disconnecting them is provided also, duplex signals being located at the adjoining ends of the sectional third rails or conductors.

748,621. Safety System of Electric Railways. Charles J. Kintner, New York, N. Y. Application filed November 15, 1902.

A sectional third-rail conductor has its sections progressively energized by a feeder main through automatically operated switching devices. (See cut on next page.)

748,635. Automatic Brake for Controlling Switches of Electric Motors. Frederick A. Muschenheim and William F. Hendry, New York, N. Y., assignors to the Western Electric Company, Chicago, Ill. Application filed June 2, 1902.

An electric motor-controlling switch contains an electromagnetic brake for arresting the movement of the switch lever, and a circuit including the magnet of the brake with the armature of the motor.

748,638. Electric Circuit-closer and Breaker. Thomas H. McQuown, Biggsville, Ill. Original application filed September 26, 1902. Divided and this application filed January 5, 1903.

A clock-controlled movable part operates two other movable parts successively and connects electric contact points only in the interval between the movement of the last two movable parts.

748,639. Fuse for Electric Circuits. Theodore Nagel, Chicago, Ill., assignor of one-half to Lathrop H. Collins, Chicago, Ill. Application filed April 24, 1903.

An electric fuse comprises a fibrous body having a bore of uniform diameter extending throughout its length. Suitable caps are secured over the ends, binding plates are secured to the ends of the body and continuous-fuse wire extends through the bore and is connected to and joins the binding plates and caps at points beyond the ends of the body.

748,690. Telephone Transmitter. Charles F. Bennett, Waterloo, Iowa. Application filed November 29, 1901.

Finely divided conducting material is placed in a receptacle having a substantially horizontal or straight floor, provided with a series of inclined planes to agitate and cause the circulation of the conducting material.

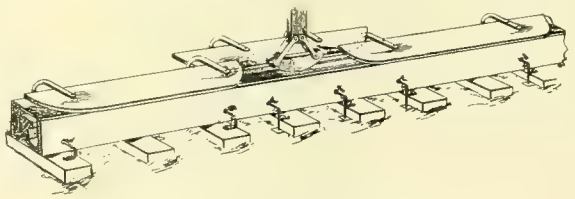
748,716. Wire Connector. James S. Ford, Chicago, Ill., assignor to the American Telephone and Telegraph Company. Application filed October 9, 1903.

A tubular member having an opening in one side and an elongated jaw at each side of the opening co-operates with a movable plate within the tubular member extending over the jaws, and clamping the wires in place.

748,718. Extension Lamp Hanger. Fernando H. Geisler, Dayton, Ohio, assignor of one-half to H. E. Snyder, Dayton, Ohio. Application filed October 5, 1903.

Inner and outer sectional globes, a perpendicular tube suspended from the upper section of the inner globe, a tubular hanger connected thereto, electrical conductors passing through the hanger and a sliding brush holder are the principal features. A coil spring normally controls the position of the brush holder, and ratchet devices are adapted to maintain the brush holder in various positions against the influence of the coil spring.

748,749. Electrical System of Heating. Edward H. Kitfield, Swampscott, Mass. Application filed October 26, 1903.



NO. 748,592.—THIRD-RAIL PROTECTOR.

In circuit with an electrical heater is included a thermostat controlling the circuit to cut out the heater when the temperature reaches a predetermined point and to include the heater in circuits when the temperature falls to a predetermined point.

748,771. Electrically Driven Centrifugal Machine. Henry G. Morris, Philadelphia, Pa. Application filed May 8, 1903.

An electrically driven centrifugal machine comprises a suspension hanger, a non-rotatable internal spindle, a rotatable external spindle and the fixed element of an alternating-current motor, suspended from the internal spindle. Flexible connections prevent rotation of the fixed element. The movable element of the motor is applied to the external spindle and is operatively arranged in respect to the fixed element.

748,810. Electric Car Plow. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thomas D. Taylor, Boston, Mass. Application filed March 30, 1903.

Pockets are secured to the plow, hollow contact arms provided with threaded inner ends project through the pockets and electrodes project from the arms. Wires within the arms are connected with the electrodes.

748,811. Switch. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thomas D. Taylor, Boston, Mass. Application filed March 30, 1903.

Electrically actuated means are arranged on each side of the switch tongue to move it in either direction. An approximately T-shaped lever is pivoted beneath the switch point and has one of its arms pivotally connected thereto. Rollers are journaled on the outer end of the lateral arm of the lever, means actuated by the first-named means for engaging the rollers to swing the lever and means for actuating the first-named means are other features.

748,812. Switch-throwing Mechanism. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thomas D. Taylor, Boston, Mass. Application filed March 30, 1903.

Electric motors are geared directly to shafts operating the switch tongue.

748,813. Contact Shoe. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thomas D. Taylor, Boston, Mass. Application filed March 30, 1903.

Contact shoes, trolley-wire-supporting brackets secured to and insulated from the supporting plates and supporting wires connecting the shoes and brackets are embodied in the invention.

748,814. Semaphore Mechanism. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thomas D. Taylor, Boston, Mass. Application filed March 30, 1903.

The semaphore-operating motor with its switching devices is inclosed in an iron casing. Circuits from the signal tower enter the casing and actuate solenoid switching mechanism, which throws the motor into and out of circuit.

748,815. Railway Block Signal and Switch. William F. Taylor, Jr., Providence, R. I., assignor of one-half to Thomas D. Taylor, Boston, Mass. Application filed March 30, 1903.

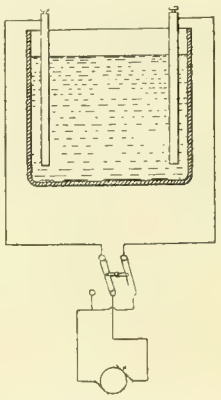
The block signals are electrically operated by circuits, which are closed by a shoe on the car.

748,824. Block-signal System. Joseph Weatherby, Jr., Wilmington, Del. Application filed July 24, 1902.

A conductor for the system is provided with turnouts and a signal station is placed at each turnout. Electro-mechanical devices at each station set the necessary signals.

748,831. Typewriter. Neal L. Anderson, Montgomery, Ala. Application filed August 24, 1903.

A unidirectional motor is operated by a step-by-step mechanism, and propels the carriage in its forward and reverse movements.



NO. 748,609.—HYDROXIDE AND OXIDE CELL.

748,872. Electric-railway System. William G. Lowrie, New York, N. Y. Application filed June 21, 1901.

An armature of magnetic material is provided with cores that correspond to the poles of the actuating magnet and are surrounded with coils. A number of plates have conducting contact pieces at their ends separated by insulating pieces, the contact pieces engaging a continuous conductor and the sections of a sectional conductor. Means for electrically connecting the contact pieces in multiple and for connecting the coils in series with the conductors through the contact pieces are also specified.

748,904. Electric Arc Lamp. Luis Wirtz and Thomas Hamilton-Adams, London, England. Application filed February 4, 1903.

A solenoid, having two separated half-bobbins, is mounted on a tube of non-magnetic material so as to leave an annular space between their adjacent ends. A coil surrounds the bobbins and is insulated therefrom. An iron jacket surrounds the coil and a core within the solenoid has a portion bored out to reduce the effect of the solenoid.

748,906. Transmitter. Ernest E. Yaxley, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed April 13, 1901.

A plate, a diaphragm, a felt ring between the plate and diaphragm, a cup-shaped back electrode, secured to the plate, a perforated disk secured at its edge upon the perimeter of the electrode, and a suitable quantity of granular carbon inclosed between the diaphragm and electrode at each side of the disk are the essential parts.

748,907. Electric Dynamo or Motor with Alternating Field. Rudolf Ziegenberg, Schöneberg, near Berlin, Germany. Application filed April 25, 1903.

The machine consists of field magnets, an armature comprising coils and a commutator having its segments connected to and common to successive coils. A double brush co-operates with the segments and has its two parts electrically connected with means interposed in the electric connection for producing an electromotive force equivalent to and differing in phase by 180 degrees from the electromotive force generated in the short-circuited coil by transformer action, so that the electromotive forces balance each other in the coil.

748,915. Electric Arc Lamp. Edward H. Belden, Dayton, Ohio, assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed April 28, 1902. Renewed May 11, 1903.

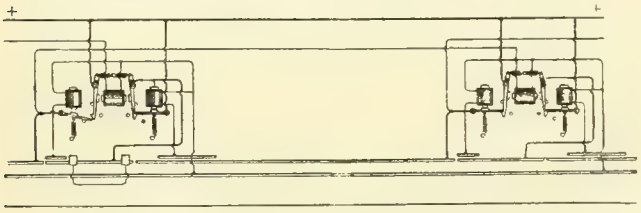
An upright carbon holder and a tubular armature fixed to the holder in concentric relation, coact with levers fulcrumed on the lamp frame and pivotally connected at their outer ends. One of the levers is pivotally connected at its inner end to the armature, and a solenoid is mounted upon one of the levers in co-operative relation to the armature.

748,940. Method of Producing Electrodes for Storage Batteries. Frederick A. Feldkamp, Newark, N. J., assignor to the Electra Manufacturing Company. Application filed April 17, 1903.

A process of producing an element or electrode for storage batteries by chemical reaction consists in incorporating in a porous material a reducing agent, and then subjecting the porous material to the action of a solution of a salt or salts of lead.

748,941. Electric Signal System. Howard A. Fessenden, Detroit, Mich., assignor to the Detroit Electric Signal Company, Detroit, Mich. Application filed December 16, 1901.

Transmitters at different stations for a number of corresponding signals co-operate with an alarm at one station adapted to operate continuously. An electromagnet controls the alarm circuit, extending to the transmitters at different stations. Means for respectively closing and opening the circuit whenever the transmitters are in or out of registration with each other are further specified.



NO 748,621.—SAFETY SYSTEM FOR ELECTRIC RAILWAYS.

748,961. Electric Coupling. George A. Le Fevre, New York, N. Y. Application filed January 28, 1903.

The invention comprises a series of parallel sockets, spring-pressed hooks forming the terminals of circuits arranged to slide longitudinally in the sockets, such hooks having engaging heads, and a series of plugs, also forming circuit terminals, the plugs having engaging heads to fit those of the hooks.

748,970. Automatic Signaling Apparatus. Ira A. Michael, Chicago, Ill., assignor of one-half to John H. Reynolds, Troy, N. Y. Application filed June 27, 1902.

A signal member is adapted to move in opposite directions. Means controlled by the duration of a current pulse in the line circuit initially determine in which direction the signal member shall move, and step-by-step mechanism controlled thereby is arranged to continue the movement of the signal member in such predetermined direction only upon each pulsation in the line circuit.

748,980. Telephone Exchange. Nils E. Norstrom, Chicago, Ill., assignor of two-thirds to John Anderson, Salina, Kan., and M. E. Richardson, Sterling, Kan. Application filed March 16, 1901.

A series of telephone stations are connected to one line; a switching mechanism is located at each station with magnets for operating and releasing the mechanism.

748,985. Apparatus for Electrolytic Decomposition of Alkali Chlorides. Johan J. Rine, Eisinore, Denmark. Application filed April 4, 1903.

Electrolytical decomposition of alkaline chlorides is accomplished by the combination with a horizontally moving mercury cathode of a series of combining cells without anodes, and a series of decomposition cells provided with anodes. The combining cells are of such dimensions that they expose about twice the area of surface to the solvent in the combining cell as the cathode surface exposed in the decomposition cells.

748,987. Trolley Harp. Edward D. Rockwell, Bristol, Conn. Application filed November 7, 1903.

Ways are formed in the trolley harp, trolley-wheel bearing blocks are slidably mounted in the ways and a yoke connects the levers, a spring-actuating knob being carried by the yoke.

749,016. Electric Arc Lamp. Edward H. Belden, Fort Wayne, Ind., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed April 17, 1901.

In an alternating-current lamp a clutch chamber incloses the clutch mechanism and has gas caps at its respective ends through which the gases of the arc pass in their escape, being also adapted to muffle the audible vibrations.

749,017. Electric Arc Lamp. Edward H. Belden, Fort Wayne, Ind., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed August 6, 1900. Renewed May 11, 1903.

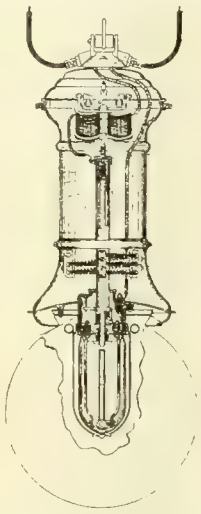
Series and shunt coils are mounted upon a stationary support and have pole pieces which project toward each other. An interposed rocking armature is pivotally mounted upon the support between the coils and is provided with lateral openings to admit the adjacent and respective ends of the pole pieces, whereby the sensitiveness of the controlling mechanism is augmented by the tendency of the shunt field to neutralize the influence of the series field by reversing the polarity of that portion of the armature which moves in the series field.

749,018. Electric Arc Lamp. Edward H. Belden, Fort Wayne, Ind., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed August 13, 1900. Renewed May 11, 1903.

Combined with carbon-feeding coils are two brackets between the inner ends of which the coils are clamped. A circular supporting frame, to which the outer ends of the brackets are detachably fastened, and a carbon-operating lever pivoted to one of the brackets and having an armature for the coils are the other features. (See cut.)

749,031. Telegraph Apparatus. Frederick G. Creed, Lenzie, Scotland, assignor to himself and William Arthur Coulson, Glasgow, Scotland. Application filed September 3, 1901.

A receiver for automatic telegraphy includes a tape-perforating punch, which is operated when a message is received.



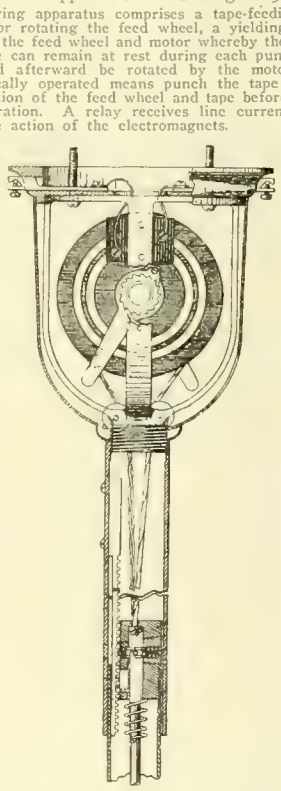
NO. 749,018. ARC LAMP

749,032. Perforating Telegraphy. Frederick G. Creed, Lenzie, Scotland, assignor to himself and William Arthur Coulson, Glasgow, Scotland. Application filed August 4, 1902.

Telegraphic-receiving apparatus for perforating a tape in accordance with the electrical impulse received comprises tape-feeding mechanism, tape-punching mechanism, a fluid-pressure motor for operating the tape-punching mechanism and an electromagnetic device for controlling the punch-operating motor in accordance with the electrical impulses received.

749,033. Telegraphic Receiving Apparatus. Frederick G. Creed, Lenzie, Scotland, assignor to himself and William Arthur Coulson, Glasgow, Scotland. Application filed August 9, 1902.

Receiving apparatus comprises a tape-feeding wheel, a motor for rotating the feed wheel, a yielding connection between the feed wheel and motor whereby the feed wheel and tape can remain at rest during each punching operation and afterward be rotated by the motor. Electromagnetically operated means punch the tape and correct the position of the feed wheel and tape before the punching operation. A relay receives line currents and controls the action of the electromagnets.



NO. 749,138.—ADJUSTABLE ELECTROLIER.

749,042. Electric-railway System. William M. Eader, Middletown, Md. Application filed July 27, 1903.

An electric railway has a third rail including a pair of aligned contact bars inclined toward each other and connected at the end of a rail section.

749,045. Motor Sparking Plug. James S. Foley, West Bromwich, England. Application filed May 29, 1903.

A sparking or igniting plug has a terminal composed of a number of fine wires arranged in tapered form.

749,085. Electrical Cut-out. Columbus B. McPherson, Birmingham, Ill. Application filed November 14, 1902.

A series of depending contact posts having instrument wires connected is combined with a series of vertically arranged conducting posts having main-line wires connected. A conductor is pivotally attached to each conducting post and all the conductors are connected for simultaneous operation to cause their free extremities to be thrown upwardly into engagement with the depending contact posts or be disengaged from the latter.

749,105. Electric Signal. Baptist H. Scott, Allegheny, Pa. Application filed January 20, 1903.

Electrically operated means light the signal when in its raised position, lock it in that position and automatically release it and return it to its normal position.

749,123. Magnetic Lock for Miners' Safety Lamps. August Wiedenfeld, Bochum, Germany. Application filed January 30, 1903.

In magnetic locks for miners' safety lamps are combined with the lamp vessel, a brass screw ring fitted therein, a bolt swinging about its center in a recess in the brass ring and provided with a tooth at one end, and an iron core fitted in the brass ring, the lamp casing being provided with a series of notches to receive the bolt tooth.

749,131. Wireless Signaling Apparatus. Lee De Forest, New York, N. Y., assignor to the Wireless Telegraph Company of America. Original application filed March 6, 1901. Divided and this application filed December 8, 1902.

A vertical radiating conductor and a horizontal linear conductor are placed in series between the vertical conductor and the earth and extend from the vertical conductor in the direction the signal is to be sent.

749,138. Adjustable Electrolier. George Andersen, Denver, Colo. Application filed March 27, 1902.

A spring-held drum is revolubly mounted on a support, the wires of the internal circuit being wound on the drum. A suitable electrical connection between the contacts and the wires of the internal circuit, hollow binding posts suitably mounted on the support and insulated from each other, electrodes movably mounted in the binding posts and engaging the respective contact rings and springs located in the posts and acting on the electrodes to hold the latter in operative relation with the contact rings are the main features. (See cut.)

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on January 11, 1903:

355,685. Telephone. Charles E. Egan, Columbus, Ohio, assignor of one-half to W. Y. Miles, Columbus, Ohio.
355,686. Telephone Transmitter. Charles E. Egan, Columbus, Ohio, assignor of one-half to W. Y. Miles, Columbus, Ohio.
355,687. Telephone. Charles E. Egan, Columbus, Ohio, assignor of one-half to W. Y. Miles, Columbus, Ohio.
355,729. Regulator for Electromagnet Motors. William L. Stevens, Dorchester, Mass.
355,734. Magneto Telephone. Henry E. Waite, New York, N. Y., assignor to Charles F. Livermore, trustee, New York, N. Y.
355,738. Current-collecting Device for Dynamo Electric Machines. David Williamson, New York, N. Y.
355,739. Electromagnetic Cut-out. Fred. H. Wilmarth, Peoria, Ill, assignor of one-half to Frank A. Miller, Peoria, Ill.
355,741. Telephone Cabinet. Charles Wittenberg, Indianapolis, Ind., assignor to Edward G. Cornelius, Indianapolis, Ind.
355,742. Alarm and Register Attachment for Telephones. Charles Wittenberg, Indianapolis, Ind., assignor to Edward G. Cornelius, Indianapolis, Ind.
355,743. Telephone Register. Charles Wittenberg, Indianapolis, Ind., assignor to Edward G. Cornelius, Indianapolis, Ind.
355,744. Telephone Toll Collector and Register. Charles Wittenberg, Indianapolis, Ind., assignor to Edward G. Cornelius, Indianapolis, Ind.
355,745. Register Attachment for Telephones. Charles Wittenberg, Indianapolis, Ind., assignor to Edward G. Cornelius, Indianapolis, Ind.
355,746. Telephone Toll Collector and Register. Charles Wittenberg, Indianapolis, Ind., assignor to Edward G. Cornelius, Indianapolis, Ind.
355,771. Electric Motor. Jacob H. Linville, Philadelphia, Pa., assignor to the International Printing Telegraph Company, Camden, N. J.
355,791. Electric Annunciator. Paul Seiler, San Francisco, Cal.
355,820. Circuit Breaker for Primary Electric Clocks. Vitalis Himmer, New York, N. Y.
355,855. Electric Push Button. Fred R. Brainard, Annapolis, Md.
355,860. Telegraphy. Robert G. Brown, Brooklyn, assignor to the Standard Multiplex Telegraph Company, New York, N. Y.
355,867. Electrical Subway. Russel A. Denison, Providence, R. I.
355,871. Electric Meter. James E. H. Gordon, 28 Collingham Place, Kensington, County of Middlesex, England.
355,892. Electromagnetic Regulator for Valves. George M. Sternberg, U. S. Army.
355,893. Electromagnetic Regulator for Dampers and Valves. George M. Sternberg, U. S. Army.
355,894. Electromagnetic Regulator for Dampers and Valves. George M. Sternberg, U. S. Army.
355,895. Electromagnetic Regulator for Valves and Dampers. George M. Sternberg, U. S. Army, and Anthony A. Lehman, Baltimore, Md.; said Lehman assignor to said Sternberg.
355,928. Telephone Switch System. Claude C. Gould, Buffalo, and Walton Smith, Batavia, assignors of one-fourth to Phillip W. Scribner, Tonawanda, N. Y.
355,929. Telephone Switch System. Claude C. Gould, and Walton Smith, Batavia, assignors of one-fourth to Phillip W. Scribner, Tonawanda, N. Y.
355,952. Telephone Transmitter. John C. H. Stut, San Francisco, Cal.
356,019. Incandescent Electric Lamp. William L. Voelker, Morton, Pa., assignor to John H. Irwin, trustee, Morton, Pa.
356,024. Controlling Valves by Electricity. Foree Bain, Chicago, Ill.
356,034. Telephone Transmitter. James P. Freeman, Chicago, Ill., assignor of one-half to Samuel M. Bryan, Washington, D. C.
356,038. Grounding Switch for Telephone Instrument. Claude C. Gould, Batavia, N. Y., assignor of five-eighths to Walton Smith, Batavia, and Phillip W. Scribner, and Lewis F. Watson, Warren, and Samuel A. Davenport, Erie, Pa.
356,040. Telephone Switch. Charles A. Hitchcock and William Burnley, North East, assignors to themselves, and Lewis F. Watson, Warren and Samuel A. Davenport, Erie, Pa.
356,041. Electric-current Indicator. John W. Howell, New Brunswick, N. J.
356,042. Electric-current Indicator. John W. Howell, New Brunswick, N. J.
356,069. Primary Electric Clock. Vitalis Himmer, New York, N. Y., assignor to the Standard Electric Clock Company, New York, N. Y.

WESTERN ELECTRICIAN

EVERY SATURDAY.

Vol. XXXIV. CHICAGO, JANUARY 23, 1904 No. 4

Recent Equipment for Power House of Shawinigan Falls Power Company.

By Frank C. Perkins.

The electric power-transmission plant at Shawinigan Falls, which is located on the St. Maurice River, has been in successful operation for some time, supplying electric current to a sub-station in Maisonneuve, which serves the city of Montreal, Canada. The power plant is continually being enlarged, and it is said the flow of water available at Shawinigan Falls is 20,000 cubic feet per second, or an equivalent of 200,000 horsepower.

The accompanying illustration (Fig. 2) shows a new turbine of Swiss manufacture, recently installed at the Shawinigan plant, having a capacity of 6,000 horsepower. This turbine operates under a net fall of from 125 to 135 feet and has a consumption of 558 cubic feet of water per second. It turns at a speed of 180 revolutions per minute and is of the horizontal-shaft type constructed by Escher, Wyss & Co. of Zurich. It is directly connected to a two-phase electrical generator of 3,750-kilowatt capacity. This polyphase alternator was constructed by Dick, Kerr & Co. of England. It is a revolving-field machine, with a cast-iron spider, the hub being arranged with a flange for bolting to the turbine. Laminated steel is used for the pole pieces, held together between two capped steel end plates. The machine has a frequency of 30 cycles per second and operates at a pressure of 2,000 volts.

The Shawinigan Falls power station receives its water from a canal 1,000 feet long, 20 feet deep and 100 feet wide. The water is carried by this canal to a forebay formed by a solid concrete wall 30 feet in thickness at the bottom and 40 feet high. From this forebay the water is conducted through a number of pipes, each supplying water sufficient to develop 5,000 horsepower at the turbine in the power houses 130 feet below. A number of industrial plants have already been established nearby to take advantage of this power, while a large amount of current is transmitted to a distance by a polyphase electric power-transmission line. The accompanying illustration (Fig. 1) shows the interior of the power house during the erection of the turbines and Westinghouse alternators of 3,750-kilowatt capacity. These machines are of the two-phase, alternating-current, revolving-field sort, supplying a current of 2,200 volts at a frequency of 30 cycles per second. The turbines are of the Francis type, with horizontal shaft, capable of developing 6,000 horsepower at a speed of 180 revolutions per minute. They were installed by the I. P. Morris Company of Philadelphia, while the alternators, to which they are direct-connected, were built at Pittsburg, Pa., by the Westinghouse Electric and Manufacturing Company.

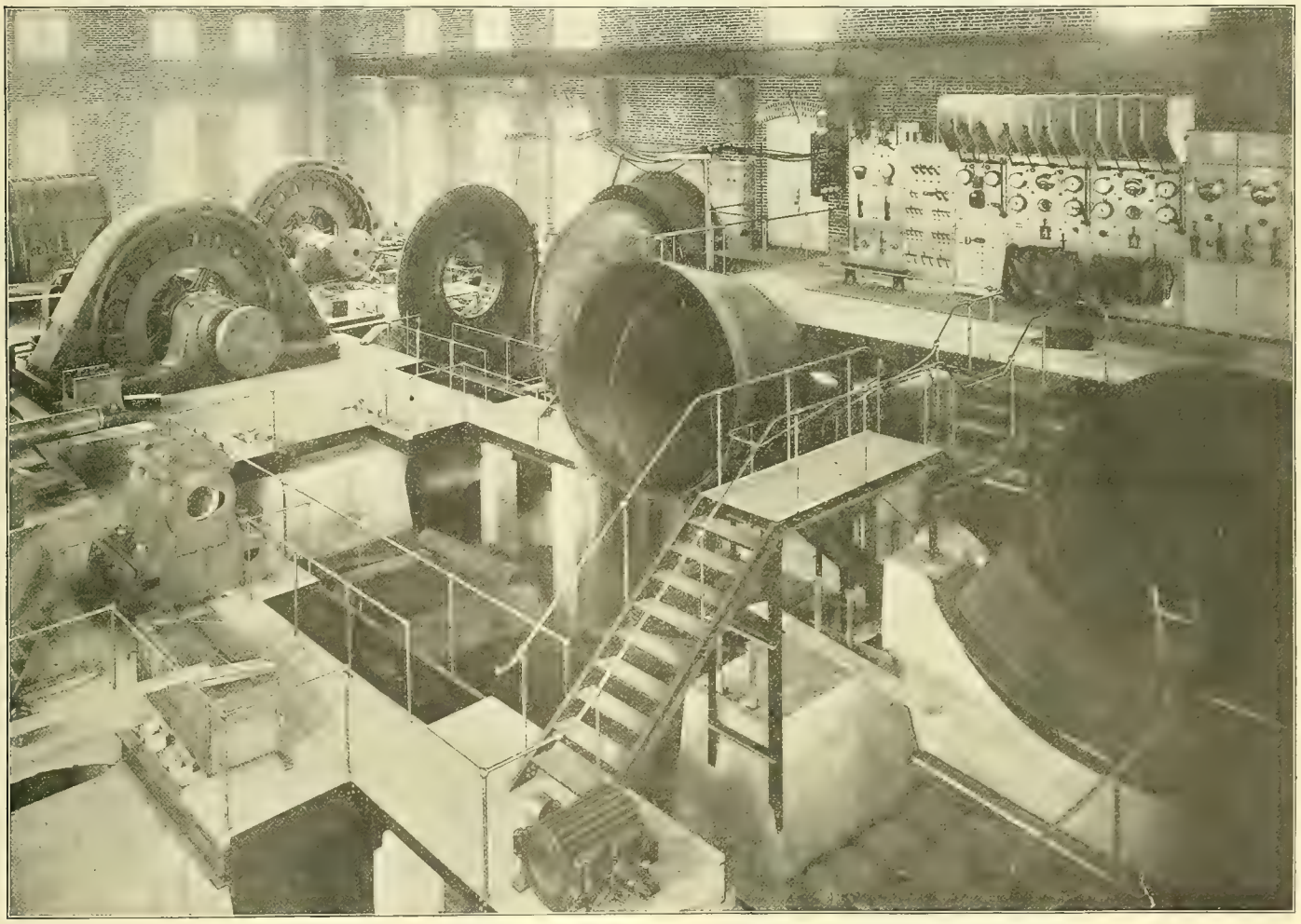


FIG. 1. INTERIOR OF SHAWINIGAN FALLS POWER HOUSE DURING ERECTION OF TURBINES AND GENERATORS.

The horizontal turbines are provided with draft chambers which connect with an eight-foot draft tube, which passes to the tail water, and has a mean low level of 25 feet below the center of the wheel shaft. The gates in the draft chamber control the turbines, butterfly valves closing toward the center between the shafts. Two air chambers are provided above the casing of the turbine, which is cylindrical in form and measuring 16 feet in diameter. The speed is regulated by a hydraulic governor controlling the gates in the draft tube, and the turbines may be started and stopped by a ring gate which is provided on the outside of the guide. This ring gate may be operated by an electric motor when desired, and is controlled from the switchboard gallery.

For the transmission of power from the Shawinigan Falls power plant to Montreal, a distance of 84.5 miles, an alternating current of a pressure of 50,000 volts is delivered to the transmission line. There is a loss of about 10 per cent. in the aluminum conductors connecting the power plant at Shawinigan Falls with the sub-station near Montreal. The aluminum conductors are connected at the sub-station with a series of over 40 lightning arresters, each having a half dozen air gaps, while two static interrupters are provided, each of the single-pole, 26-ampere type for a pressure of 50,000 volts.

The sub-station is equipped with five oil-cooled step-down transformers, each having a capacity of 1,000 kilowatts. These transformers reduce the pressure of the three-phase alternating current from 50,000 volts, less the loss in the line, to about 2,400 volts. The alternating current is then changed from a frequency of 30 cycles per second to 63 cycles per second by means of motor-generators, two of which supply a three-phase current from the generator sides of the sets, while the remaining three supply a two-phase current of a frequency of 63 cycles and a tension of 2,400 volts. The current from the motor-generators, after passing the switchboard, is conducted to the distributing circuits of the Montreal Light, Heat and Power Company. The sub-station at Maisonneuve, near Montreal, which receives the current on the transmission line from the Shawinigan power house, is a brick structure about 100 feet wide and 120 feet long, divided into two sections, one of which contains the motor-generators above mentioned and the other the step-down stationary transformers.

The Shawinigan Falls Power Company, in addition to transmitting several thousand horsepower to Montreal by the transmission line above mentioned, also supplies powers from its hydraulic installation to the power house of the Royal Aluminum Company, which is equipped with a number of turbines developing 3,000 horsepower each, the works when completed and fully equipped having a total capacity of 15,000 horsepower. The Belgo-Canadian Pulp

Company is also supplied with water for operating its turbines by the Shawinigan Falls Power Company, this concern having turbines in operation of several thousand horsepower capacity. There is every indication that a large industrial manufacturing center will ultimately grow up near Shawinigan Falls on account of the cheap power, which is particularly attractive to large electrochemical and electrolytic works.

As supplementing Mr. Perkins' article, the following from a Western Electrician correspondent in Canada, will be read with interest: "The Shawinigan Water and Power Company, which recently closed a contract with the Sorel Electric Company for the delivery of power at Sorel, Que., has completed the transmission line to deliver the current from Shawinigan Falls. To meet the requirements, a transformer station was built at Joliette, Que., where the 50,000-volt current from the main line is stepped down to a voltage of 12,500. A line was then built from Joliette to the banks of the St. Lawrence River, near Lanorale, following the right-of-way of the Canadian Pacific railway. Across the St. Lawrence the current is carried by a submarine copper cable, heavily insulated and armored with lead and steel wire. On the south side of the river the line follows the public road until it reaches Sorel. The river is crossed at a point not used for anchorage. Necessary steps have been taken to obviate danger from the current or pressure of ice in the spring. The line has been constructed on a three-phase system, and aluminum cable has been used throughout. The construction work was carried out by Johnson & Saunders, contractors of Buffalo, N. Y., the submarine cable having been supplied by the American Steel and Wire Company of Worcester, Mass. A second line to Montreal, with a capacity of 10,000 horsepower, will be built, and this Sorel line is only the beginning of a series of short lines which will tap the main lines and carry power to points between Shawinigan Falls and Montreal, the distance between these two places being more than 80 miles."

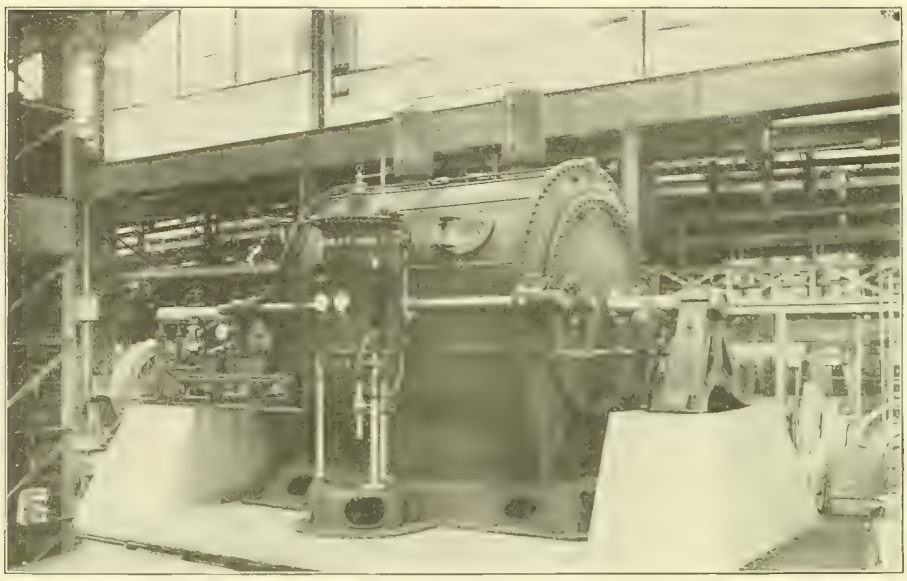


FIG. 2. SHAWINIGAN FALLS POWER HOUSE EQUIPMENT—NEW 6,000-HORSEPOWER SWISS TURBINE

Electrical Shortage in San Francisco.

The California correspondent of the Western Electrician says that the shortage of electric power for lighting and street-railway purposes in San Francisco continues. Although the local plants have considerably increased their capacity, a good deal of the new electric machinery installed during the last year has failed to work up to its full capacity because of unsatisfactory engine regulation. To make matters worse the United Railroads' electric-power plant at North Beach has been running at a disadvantage, due to an accident to a cylinder of one of the engines on Christmas. The Carl Street station was started up again to relieve the shortage, and the San Francisco Gas and Electric Company also supplied some power for the street-railway system after the accident, but the lighting company has had several short interruptions on some of its own circuits.

It was expected that the Mutual Electric Light Company, which has the only large opposition plant, would have its new plant in operation this winter, but the owners have been waiting to place some $400,000 in bonds on the local market. Their new 10,000-horsepower plant has not been commenced, although two of the large generators have arrived. The engines are on the way from the East and will be stored along with other machinery until the new building at Stewart and Folsom Streets is constructed. It would be impossible to have the plant in operation before next fall if construction were commenced at once.

Electrification of Steam Railroads in Great Britain.

[From the London correspondent of the Western Electrician.]

The announcement that another of the great steam-railway companies in Great Britain—the Great Western—has placed a contract with a British firm for 10,000 horsepower of electrical machinery as a contribution toward the electrical equipment of portions of its existing system, has occasioned a revival of interest in this important problem. In this particular instance, however, no outside influences would appear to have affected the decision to adopt electric traction, but with practically all the other steam-railway companies which have converted, or intend to convert, any portion of their lines to electrical working, the process of evolution has been brought about by the fierce competition of electric tramways in the particular districts. This very reason was the explanation tendered to the shareholders of the Mersey Railway Company, the Northeastern Railway Company and the Lancashire and Yorkshire Railway Company.

The circumstances were somewhat different in respect of the Metropolitan District Railway Company, now in the hands of Mr. Yerkes. The company had been in a parlous condition for many years, making but little profit, but the opening and subsequent success of the Central London electric tube railway (which took a transfer of several millions of the District company's passengers) at once, under the direction of Mr. Yerkes, settled the future method of traction on the "Underground," as it is familiarly known.

Suburban lines are alone being experimented with, so far, and perhaps the comparative timidity of railway directors and managers in this direction is justified in view of the variety of opinions existing among electrical engineers here as to what should constitute the standard electrical equipment of a converted steam railway. To what extent this fact has guided the steam-railway companies it is difficult, or indeed impossible, to say, but it is significant that very little is heard with regard to the adoption of electric traction on suburban railways worked by steam engines when no service of electric tramways taps the traffic. In every instance in which a move has been made, it has been as a direct consequence, as already pointed out, of the force of circumstances.

Leaving the economical side of the question out of discussion, it is interesting to notice that a very large degree of standardization is evident in connection with those comparatively short lengths of steam track, in various parts of the country, which have been changed over. This, perhaps, points to the view that the want of agreement in the opinions of the experts applies more to the long-distance main lines, the standardization of the equipment of which undoubtedly assumes serious proportions. Perhaps this is so. Of course, standardization of track construction is the main objective, as anything tending to prohibit the present facilities of intercommunication between one company and another would at once be ruled out of court. With the main lines capital expenditure is the stumbling block, but upon suburban lines the problem narrows itself considerably. The gauge of four feet 8½ inches will remain unaltered, and really the only matter to be finally settled is the method of collecting the current to the motors. Upon the "tube" railways in London a conductor rail is employed, the track rails being used as the return. But this method has not been accepted for the surface railways, and a completely insulated return has so far been favored. Some discussion has already taken place at the Railway Clearing House (a body which settles all details connected with railways) upon the question and also as to the most suitable positions of the positive and negative conductors, and I believe a certain amount of agreement has been arrived at.

The Lancashire and Yorkshire Railway Company is the latest undertaking of its kind to adopt electric traction, and a few miles of its lines are now nearing completion. The line in question runs between Liverpool and Southport, between which towns there is a continuous line of electric tramways which do the journey in less time and for lower fares than the steam trains used to. The equipment follows, more or less, that upon the Mersey railway and the Northeastern railway. Two conductor rails are provided, the positive being outside the running rails, three feet 11½ inches from the center of the track and three inches above the surface of the track rails. These dimensions have been agreed upon by all the railway companies, I believe. The conductor rails are of special steel, Vignoles section, 70 pounds to the yard, and supported every 10 feet by an insulator. On the opposite side of the running rails is placed an exactly similar rail supported on wooden blocks. Each conductor rail is bonded to the running rails, and, further, at busy crossings, etc., is protected by a wooden guard.

The power house is close to the railway and is equipped with 16 Lancashire boilers, eight feet six inches in diameter and 32 feet long, four horizontal cross-compound condensing engines of 1,500-kilowatt capacity and a subsidiary vertical compound condensing engine of 750-kilowatt capacity, all capable of taking a large overload for short periods. The electric generating machinery is three-phase, having a voltage of 7,500 and a periodicity of 25 cycles per second. This current is transmitted by means of three-core cables, paper-insulated and metallic-sheathed, to four sub-stations. There the current will be converted to 600 volts continuous, the working pressure.

Two first-class and two third-class cars will constitute a train, the third-class cars being on the front and rear, and equipped with four 150-horsepower motors. The cars, which will be the widest in this country, will be 60 feet long and 10 feet wide. The multiple-unit system of control has been adopted, the motorman's cab encroaching upon the seating capacity of the front and rear cars. These compartments are lined with "uralite," a non-combustible material.

The troughs in which the cables run from end to end of the train, are also lined with this material. Indeed, its use throughout the trains has not been spared, the possibility of fire having been strongly brought home to the management by the several incidents of this kind which have occurred both at home and abroad. The cars are also equipped with a vacuum brake, this being used for the first time upon an electric railway, in this country, at any rate.

It is but 12 months ago since the Lancashire-Yorkshire Railway Company decided to equip electrically this portion of its system, which is about 23 miles in length. The whole of the permanent way has been carried out by the company's own staff and the contractors for the generating and sub-station equipment hope to be ready in a few weeks.

These few notes will serve to indicate the tendencies in Great Britain with regard to heavy electric-traction work. Other companies will no doubt await the results of the experiments on the lines named with interest. So far as the Mersey line is concerned, although a complete year under the new régime has not been run, the working expenses have decreased, and the receipts increased. The Northeastern lines will be put into operation almost as soon as the Lancashire and Yorkshire, but the District lines in London are rather more backward than was originally anticipated. But here the undertaking is on a considerably larger scale, several tube railways also being operated from the one generating station.

G.

Electric Governing of Steam Turbines.

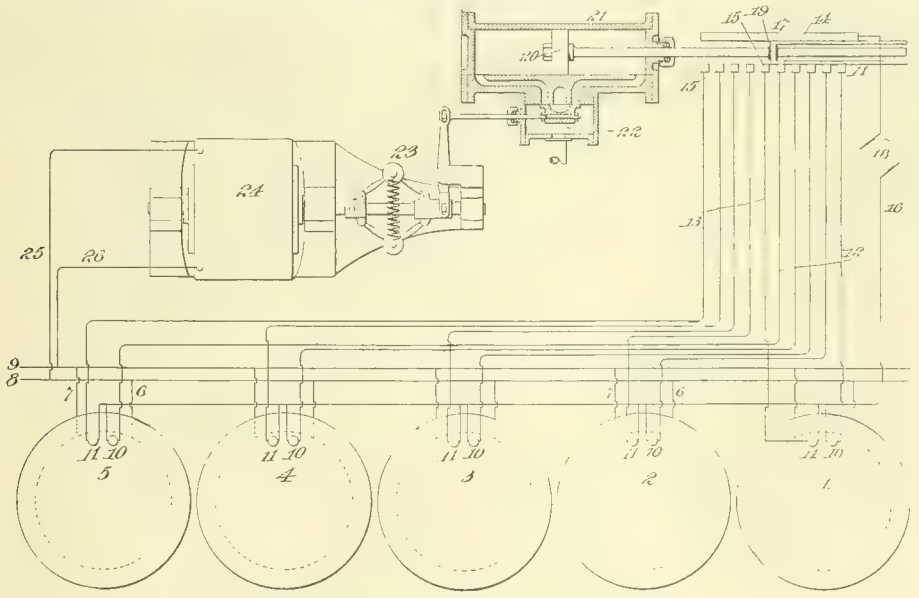
A simple means of governing a series of steam turbines has been devised by Charles G. Curtis of New York, which does away with the multiplicity of valves leading to the buckets of each turbine.

The controlling element of the apparatus is a centrifugal governor, which may be mounted upon or driven from the shaft of the first turbine of the battery, or in case the turbines are used to drive alternating-current generators, this centrifugal governor may be driven by a synchronous motor connected with the bus bars to which the dynamos are connected. This centrifugal governor serves to open and close a valve admitting water, oil, or other suitable liquid to opposite ends of the cylinder, in which moves a piston, and the piston by its movement opens and closes directly or indirectly and in proper order the valves controlling the supply of steam to the turbines. The general scheme of the apparatus is clearly shown in the accompanying diagram.

The controlling valves of the several turbines are operated by the governing apparatus, so as to govern the turbines progressively in the following manner: Enough of the valves of the first turbine are opened in succession as the load increases to produce the full-load condition of the dynamo driven by that turbine. As the load increases further the controlling valves of the second turbine are opened successively until the full-load condition of the dynamo driven by that turbine is reached, and so on, for the third, fourth, and any greater number of turbines which the battery may contain. After the full-load condition of all the dynamos of the battery has been reached the governing apparatus puts on part of the ovreload on the first turbine and then successively on the other turbines of the battery, until all the dynamos are carrying the same amount of the overload, when a further fraction of the overload is added, first to the first turbine and then to the second turbine, and so on, and this operation of adding the overload to the turbines in succession fractionally is repeated until the full overload condition is reached. Instead of having the control of each turbine divided between a number of valves, both for the full-load condition and for the overload condition, the number of valves for each turbine may be reduced, and the regulation for each turbine made dependent to a greater extent upon the throttling action of the valves. This may even be carried to the extent of providing only two valves for each turbine, one for the full-load and one for the overload, each of these valves controlling the admission of the steam to a large number of sections of the sectional nozzle. In this case the governing apparatus will act to first open the full-load valve of the first turbine, depending upon the throttling action of the valve at intermediate positions to control the turbine for less than full load. The governing apparatus will then in the same manner open the full-load valve of the second turbine, and so on, until the full-load valves of all the turbines of the battery are open. For the overload, the governing apparatus will apply the overload fractionally to the turbines by first partially opening the overload valves of the turbines in succession and then returning to the first turbine and opening the overload valves in succession still further, and so on, until the overload valves of all the turbines are entirely open. The loss in efficiency which will result from depending upon the throttling action of the valves will not be very great in the case of a battery containing a number of turbines, since the effect produced by throttling will be for most of the time confined to a small fraction of the whole effect.

Referring to the diagram, (1) (2) (3) (4) and (5) represent turbine units, together with alternating-current dynamos connected by wires to the bus bars (8) (9). Magnets (10) and (11) control the valves of the turbines. For simplicity of illustration, only two of such magnets are shown for each turbine, the magnets (10) controlling the full-load valves and the magnets (11) controlling the overload valves. The magnets are connected by separate wires (12) and (13) with the separately insulated contacts (14) (15), while a return wire (16), common to all the magnets, is connected with a plate (17) and includes a source of direct current (18). A contact plate (19), having a length equal to all of the contacts, slides over the contacts and the plate (17). The contact plate (19) is carried by the rod from the piston which moves in the cylinder. The piston is moved in one direction or the other by liquid under pressure admitted to opposite sides of the cylinder and exhausted through suitable entrance and exhaust ports controlled by a valve (22). The valve is moved by a centrifugal governor which is driven by a synchronous motor connected by wires with the bus bars (8) (9). As already suggested, the centrifugal governor may be mounted on the shaft of the turbine.

It will be understood that the usual switches are placed in the several circuits for opening and closing them and also that the steam-supply pipes leading to the turbines will be provided with the usual throttle valves for turning on and off the steam. When the turbines are not running, these throttle valves will be closed and the switches will be opened, the piston will stand at the left-hand end of the cylinder, and the plate (19) will cover all the contacts (14) to (15). To start up the plant, the circuit to the magnets (10) (11) will be closed, thus opening all the turbine valves controlled by the various branches of that circuit. Steam will then be turned on the first turbine by opening its throttle. When the dynamo operated by the turbine has acquired the proper speed, it will be connected with the bus bars and the circuit to the synchronous motor will also be closed. The motor will at once acquire the speed of the dynamo and will operate the centrifugal governor, which will move the valve (22) to the right and cause the piston to move to the right until the contact plate (19) covers the proper number of contacts.



CURTIS APPARATUS FOR GOVERNING STEAM TURBINES.

Assuming that the throttles of all the turbines are open and that all the dynamos are connected with the bus bars and are turning, the operation of the governing apparatus will be as follows: Starting with a light load on the first dynamo, it is assumed that contact plate (19) rests only on the contact (14) at the extreme right, thus opening the full-load valve of the first turbine. As the load is increased the first dynamo will reduce in speed, and this will cause the synchronous motor to reduce in speed, causing the governor to move the valve (22) to the left, opening the right-hand end of the cylinder to the liquid pressure and the left-hand end of that cylinder to the exhaust. The piston will be moved slowly to the left, drawing the contact plate (19) upon the second contact (14) and opening the full-load valve of the second turbine. This will cause the second turbine and the dynamo driven by it to take a part of the load, and the synchronous motor will regain its speed and will move the valve to a central position, covering both pressure ports to the cylinder. As the load further increases, a similar sequence of operations will take place, and the contact plate (19) will be drawn farther to the left, covering in succession the contacts (14), connected with the full-load valves of the third and subsequent turbines. A still further increase of load will cause a continued movement of the contact plate to the left, so that it will cover in succession the contacts (15) and will successively open the overload valves of the several turbines. The reverse operation takes place as the load decreases.

Cleveland Three-cent Fare Ordinance.

The McKenna ordinance passed by the City Council and providing a three-cent street-car fare for Cleveland is said to have been based on an understanding between Mayor Johnson and officials of the Cleveland Electric Railway Company. While it is reasonably certain that the ordinance will be ratified, the agreement privately adopted has not been sealed by the signatures of the city officials and the officials of the railway company.

PROPOSED ZONES OF THREE-CENT FARE IN CLEVELAND.

The new three-cent-fare proposition contains elements which will make many of the residents of Cleveland doubt its justice. It gives a three-cent fare to a part of the citizens while it requires others to pay two cents for a transfer, and still others an additional fare. A boundary is fixed, as shown by the heavy black line in the accompanying diagram, for the territory in which the three-cent fare shall be charged. All those residents of the city living outside this boundary will be forced to pay a higher fare. The new arrangement will abolish free transfers and creates an extra charge for them. Outside the limits specified in the boundaries of the McKenna ordinance a five-cent fare will be charged, and an additional charge of two cents will be made for a transfer.

It is estimated that 85 per cent. of the people will have the advantage of the low fare; 12 per cent. will pay five cents, and three per cent. will pay seven cents. The receipts, it is figured, will be increased with this arrangement over those of the last year. The Cleveland Electric Railway Company has begun negotiations with the Forest City Railway Company for the purchase of the three-cent fare roads, on some of which a little work has been done. In case the purchase is made the company will have control of most of the streets on which lines have not already been built.

President Andrews of the Cleveland Electric Railway Company maintains that the zone of the low-fare territory is too large and suggests reduced limits, as shown by the inner circle of the diagram. This zone includes but one park, and has brought out the statement from Mayor Johnson that he will enter into no agreement unless every park will be reached by a three-cent fare. President Andrews has also asked that the franchise be for 25 years instead of 20 years.

The matter at this writing rests until some counter proposition is made by the mayor; it is believed, however, that an agreement will be reached with but slight changes from the McKenna ordinance.

The British consul-general at Rio de Janeiro, Brazil, reports that the erection of small electric-power plants in the southwestern part of the state of Minas Geraes would perhaps be a profitable venture. In this agricultural district there are, in addition to the great fazendas, a great many small towns having from 5,000 to 10,000 inhabitants. The electric energy, for the production of which water-power exists in sufficient quantity, could be used for lighting purposes, for ice and butter making, for operating small machines, and for other purposes.

Dodd's Controller.

Samuel T. Dodd of Pittsfield, Mass., has obtained a patent upon a motor control system in which he has three objects in view: First, to produce an efficient controller which shall be as compact as possible; second, to provide an economical blowout which shall blow the arc in a direction tending to form an arc between two fixed parts of the controller, and, third, to give suitable means for supporting insulating septa to separate the contact fingers of the controller and also to protect the pole-pieces of the magnetic blowout in such a way that though readily fixed in position they can be with equal readiness removed independently in order that

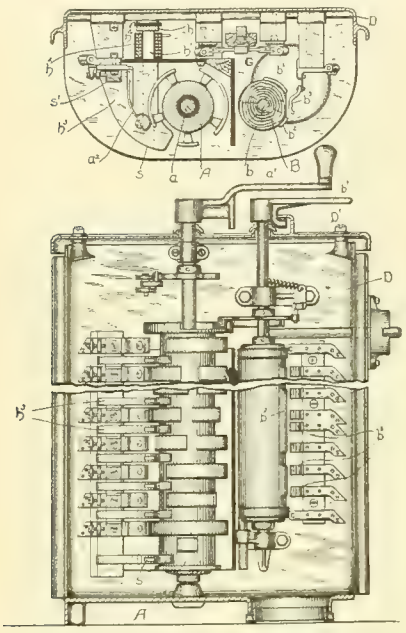


FIG. 1. DODD'S CONTROLLER.

the fingers or other parts may be inspected or repaired.

An elevation and section of the controller is shown in Fig. 1, while Fig. 2 is a diagram of connections.

Referring to Fig. 1, (a) and (b) are the shafts, respectively, of the controlling and reversing switches. The controller drum (A) is composed of a number of contact segments. The drum of the reversing switch (B) carries contacts (b^2), engaged by fingers (b^3). The fingers engaging the drum of the controller switch are lettered (a^2). In Fig. 2, where the connections of all these fingers are shown, each finger is given a separate reference letter. For cutting out either of the motors, as desired, in case one of the motors is disabled the switch (G) is provided.

Considering the controlling switch, cut-out, and reversing switch as closed and the former at the position shown, the contact (E) is out of engagement with any of the fixed contacts and contacts (E') and (E^2) engage the fixed contacts to connect them in pairs, while the reversing switch may be considered as closed with contacts (r) to (r^5) in engagement with the fixed contacts of the switch.

The general scheme of control is to maintain the motors in two sets, there being two motors in each set in parallel with each other and the two sets being started in series with each other, preferably with an ordinary rheostat, and the two sets being afterward changed to parallel relation without at any time opening the main circuit, by successive changes in which the connections to mid-points in the fields of the different motors are shifted to different parts of the circuit, so as to make different combinations of such half-fields and the remaining parts of the motors. Thus, the motors are started in series, then a higher speed is obtained by placing half of one field in parallel with half of the other field without disturbing the series connection of the remaining coils of the motors. Then a still further speed is obtained by short-circuiting half the field coil of each motor, and then a still further speed connection is obtained by placing the armatures and half of the fields of each of the motors in parallel while maintaining half of the field of each motor in series. Finally, the motors are placed in full parallel. This gives a gradual acceleration, and at the same time there are no positions at which the motors can deleteriously buck each other, because there is always a substantial resistance in the path of each armature and each armature is always in circuit with half, at least, of its own field. In order to effectively employ this method of control for four motors without increasing the controlling apparatus to too large an extent, the motors of each set are permanently coupled together at points midway their field windings. Also, the terminals of the two motors of each set being connected permanently, so far as regards the controlling switch, so as to lead to the controlling switch only three leads from each pair of motors, and thus have no more contacts than if only a pair of motors were to be controlled.

Another means employed to reduce the contacts that are necessary for controlling consists in so arranging the motor elements in the circuit and so shifting the connections that the circuit between the field and armature of each motor is never ruptured. To this end, one pair of elements—say, the armatures—are placed at the extreme ends of the motor circuit, and the other elements at intermediate points in the motor circuit. This groups the fields of both sets of motors together and enables the making of series multiple and other changes of the fields without disturbing the field connections between fields and armatures, which is an important feature.

Suppose the drum of the controller is in such a position that the controller at dotted line (1) (see Fig. 2) engages the contact fingers (f') to (f^{16}). Under these circumstances the current enters at (T), which represents the trolley connection, passes through blowout coil (F_5) to finger (f^{15}), thence through contacts (30) and (32) to finger (f^{14}), through contacts (e^5) and (e^4) of the cut-out switch to armatures (M') and (M^2). Thence through the contacts of the reversing switch (A') and (A^2) the current passes in multiple through the reversing switch and through the two field coils (K') and (K^2), leaving the reversing switch at finger (d) and again passing through the cut-out switch and reaching the controlling switch at finger (f^{10}), thence by contacts (23) and (22) and finger (f') through the cut-out switch to finger (d') of the reversing switch, where the current divides between field coils (K^3) and (K^4), and out of the reversing switch at fingers (A^3) and (A^4), through armatures (M^3) and (M^4), thence through the cut-out switch to finger (f^9), contacts (18) and (19), finger (f'), and through the resistance (R) to the ground (G), thus putting the two sets of motors in series with each other and in series with the whole of the external resistance. Having thus traced out one step, it will not be necessary to trace out each step in detail, as the results for the other positions of the controller are easily traceable on the diagram.

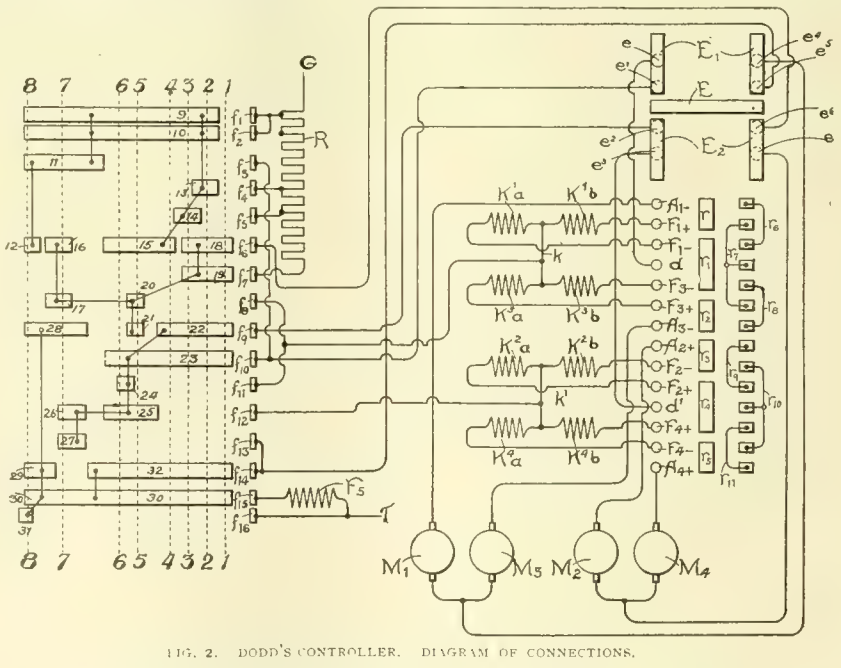


FIG. 2. DODD'S CONTROLLER. DIAGRAM OF CONNECTIONS.

It will be noted that while numerous speed stops have been made, and therefore uniformly graduated acceleration, and a number of changes are made in the circuit relations, yet at no step is any considerable change made, and there is no complexity of circuits. It will also be noted that at no step, whether transitory or running, is found a condition in which an armature has not a local closed circuit containing a resistance less than that of the two half fields in series, so that the condition of the circuit is always a comparatively stable one, there being no tendency to what is known as "bucking" when the motor acts temporarily as a generator to produce current in a local circuit. Moreover, and what is perhaps more important, in none of the positions is any armature in a local circuit when it has not a substantial strength of field, so that if there be any tendency to generation of local current there will be no substantial sparking. Also, when the motors are in series, the trolley makes connection to the first group of motors at their armature terminals, while the connection between the ground and the second group of motors is also at the armature terminals. In this way the fields of all the motors are together in the central portion of the circuit, so that the series parallel changes of the half fields are made without at any time disconnecting the field of a motor from its armature. Moreover, by coupling the half-fields, no matter what the circuit position, half of the field remains in the active circuit in series with its own armature receiving the full current.

The blowout is arranged as illustrated in Fig. 1 and comprises a vertical bar (h), from which projects a series of horizontal bars (h') energized by coils (h^2). The pole ends of the bars (h') extend between the contact fingers (a^2) and carry the insulating septa (h^3). The result of this arrangement is that almost all of the magnetic flux produced is effective for the disrupting action, instead of practically threading all parts of the controller and merely somewhat concentrated at the paths across the arcs. Moreover, this arrangement of blowout is especially effective in that it passes vertically. As the fingers are arranged in a vertical row, the passage of the magnetic flux vertically is extremely advantageous, since it will thus tend to blow the arc laterally and not have a tendency to blow the arc from one finger to another. In order to protect the pole-pieces from the arcs, and therefore to insure a more perfect disruption, insulating septa (h^3) are employed to cover the poles. These septa are shaped to conform at their ends to the conformation of the drum, and thereby separate the contact segments of the drum at the points of arcing, and are slotted to embrace the poles of the arms (h^1), so that each of the poles supports one of the insulating septa. In order to further support the septa in position, each septum when in position is engaged by spring clips. By this means the ordinary insulating septa are provided and the pole-pieces are protected in the ordinary manner; but each septum is individually removable, so as to allow free inspection and repair of the contact fingers and other parts, and by this arrangement is dispensed the necessity of any mechanism to carry all the septa and allow their removal.

Mr. Dodd has assigned his patent to the Stanley Electric Manufacturing Company.

Engines, Motors and Waterwheels in Indiana.

State Factory Inspector McAbee, in his annual report to the governor of Indiana, touches on the increase of manufacturing plants last year, many of them due to electric railways, he says. He reports that the horsepower of stationary steam engines used in the state last year was 288,511; that of gas engines, 14,006; that of electric motors, 10,161, and that of waterwheels, 7,354. The percentage of increase of electric power was greater than that of the other powers named.

New York Automobile Show.

The New York automobile show was held at Madison Square Garden this week. The exhibit was not for machines alone, but for all the accessories from charging generators to spark plugs, not omitting wearing apparel and novelties calculated to make automobiling as comfortable and pleasurable as possible. The exhibits embraced both American and foreign apparatus, and in all there were 185 firms represented.

One of the features of the show was the keen competition among the different booths to present as gay and handsome appearance as possible. Over 50,000 electric lights were used in the decoration.

A particularly interesting exhibit was that of the General Electric Company, some features of which are shown in the accompanying pictures. This exhibit occupied a space at the right-hand corner of the south aisle at the Fourth Avenue end of the garden and was handsomely decorated.

It was obvious that where the power to run the motor is derived from batteries carried in the vehicle and not from practically an unlimited source of power, such as is supplied by the overhead trolley, the electrical qualities of such a motor should receive careful attention. Low cost and light weight are, of course, desirable qualities, but not at the expense of high-torque efficiency and proper-speed characteristics at all loads. If the motor be too light, it lacks proper structural strength, and its life is consequently short. If a motor is to have the proper electrical efficiency a certain amount of iron and copper must be provided in order to obtain increase of torque for the given current input and decreased heating effected.

The new six-pole General Electric automobile motor, now exhibited for the first time, is said to approach very nearly to theoretical possibilities in its speed, torque and efficiency characteristics and the relationship between them. The torque for a given current is relatively high and increases in correct proportion as the current increases. It also keeps up its efficiency when a large torque is required, such as starting, hill-climbing, or running on bad or muddy roads. Experience is expected to prove that this type of motor will result in a very considerable saving in battery maintenance.

The field rings of this new class of motors are made of cast steel. The pole pieces are of laminated iron and the coils are machine-wound and thoroughly waterproof. The commutator segments of the armatures are deep and wide, giving a high conductivity and good radiation of heat at overloads as well as insuring long life and freedom from sparking.

In order to decrease the cost of repairs the armatures of these motors have been built on quills so as to facilitate removal. The oil-ring bearings have been standardized in a form similar to those employed in street-railway service. The shafts have been made of a specially high grade of steel and the journals are large, insuring minimum attention, and are protected from dirt and grit by a perfected form of dustproof packing.

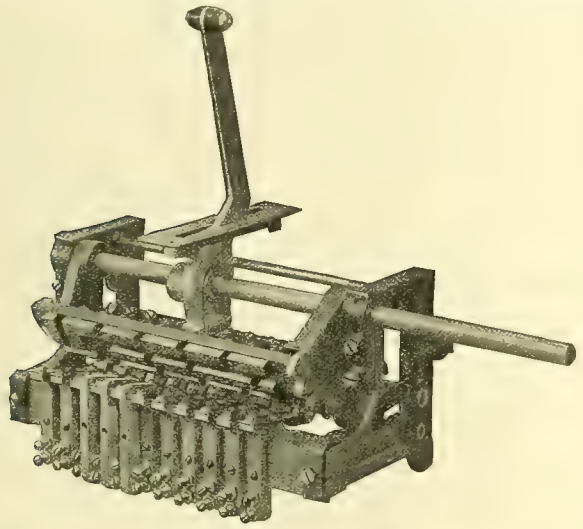
A charging panel shown in the exhibit was fitted for one two-horsepower three-phase 60-cycle induction motor connected to a one-kilowatt 110-volt generator. The equipment of this panel consisted of a four-pole circuit breaker; two lamps with bases to be used as polarity indicators; one pocket volt ammeter, 10 amperes capacity; one pocket voltmeter with 120 volts capacity; one starting rheostat; two fuses, one plug switch, and one resistance for the low-voltage coil.

To supply the demand for a small charging set for automobiles that can be operated by any standard single-phase circuit the General Electric Company has placed on the market a single-phase self-starting rotary transformer that can be operated successfully on both 60 and 133-cycle circuits. This type of single-phase rotary is self-starting, with less than full-load current, and the starting mechanism is automatically changed from the starting to the synchronous running position. The single-phase rotary converter has several advantages over a motor-generator set, comprising an induction motor coupled to a direct-current generator. First, unity power factor; second, small starting current; third, only two bearings and no coupling; fourth, higher efficiency; fifth, by the use of a compensator the electromotive force can be halved without excessive drop losses; sixth, by use of a compensator the electromotive force can be raised or lowered step by step to take care of battery either empty or nearly full.

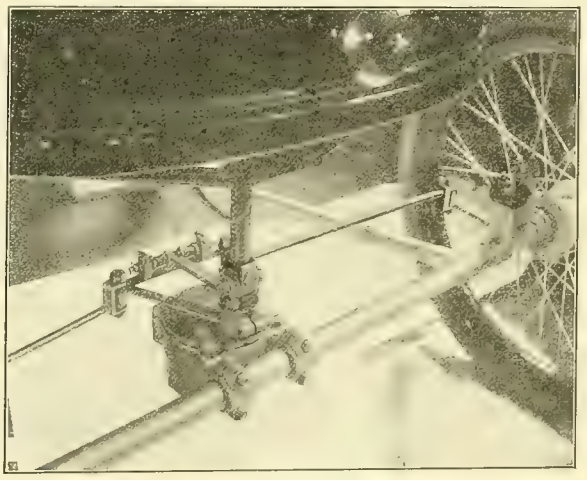
Up to the present time it has not been possible to build an efficient and satisfactory single-phase rotary transformer without the use of some dampening or anti-hunting device. The Churchward anti-hunting device has been in successful operation for a number of years, both 60 and 133-cycle rotaries operating on single, two and three-phase currents. All these new single-phase rotaries are equipped with the latest improvements on this device.

The present standard outfit will give a range of electromotive force without the use of resistance of 90-120 volts and 45-60 volts at full-load current. To operate the machine, first close the line switch. The machine will run up to speed and automatically change switch to synchronous running, then adjust the compensator for the electromotive force desired and close switch to battery circuit. If the current fails momentarily or the fuse blows, the machine will be automatically shut down and connections changed for starting.

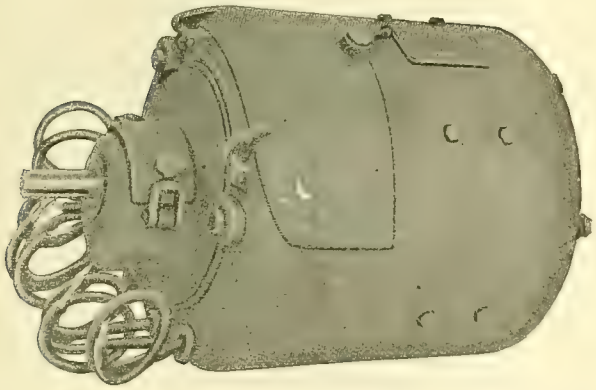
For localities where the owner of a small electric automobile has great difficulty in arranging charging facilities, or the expense and care of a gas engine or motor-generator are too great to be considered, the General Electric Company has developed a type of mercury rectifier suitable for charging the common runabout of 20 or 30 cells under all ordinary conditions of usage. The two principal features of the rectifier outfit are: First, a vacuum tube in which the conversion takes place, and, second, a reactance, the function of which is to secure stability of operation and to give a ready means of varying the load. The operation of the rectifier is most simple. Insert the battery plug and close the line switch. The vacuum tube automatically lights, and as soon as lighted the battery begins to receive its charge, the amount of current being regulated by the dial switch on the face of the compensating reactance mounted on the top of the panel. The capacity of this rectifier is 10 amperes, this being the rate at which an automobile, in case it is fully run down, may be safely left charging all night.



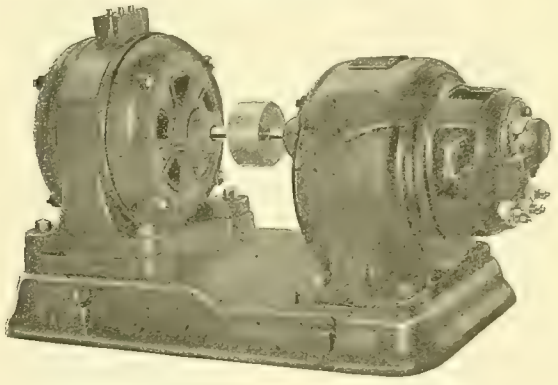
Controller for Single-motor Vehicle.



Lemp Steering Check.



Late Type of Enclosed Motor.



Alternating-current Motor Driving Direct-current Charging Generator.

NEW YORK AUTOMOBILE SHOW. -SOME OF THE ELECTRICAL EXHIBITS.

Canadian Lighting Statistics.

The use of the electric light has increased in Canada during the last year. According to the report of the officers carrying out the electric-light inspection act, there were last year 324 plants in the Dominion, with 14,780 arc lights and 1,212,861 incandescent lights. Taking the arc light as equal to 10 incandescent lights, the country had on the 30th of June last, 1,360,661 lights in use. This is an increase of 236,865 lights in the year 1903, or over 21 per cent. The increase since 1898 in arc lights has been 42 per cent. and 161 per cent. in the number of incandescents. Of the several provinces, Ontario is the chief employer of the electric light. This province has 203 of the 324 plants in use in Canada. It has considerably more than one-half the total number of arc lights and 47 per cent. of the incandescents. The province of Quebec, although possessed of enormous waterpower, has not adopted electric light to the same extent as Ontario. It has 53 plants, 3,853 arc lights and 409,503 incandescents. The plants in Quebec, however, are much larger than those of Ontario, the average of Quebec's 53 plants being 15,000 arcs and incandescents, and that of Ontario's 203 plants being 3,215 arcs and incandescents. The largest single plant in the Dominion is that of Toronto, with its 170,000 lamps, arcs being reckoned at 10 incandescents. The next largest is that of the Lachine Rapids Company, Montreal, with 158,503, and the third in size is that of the Ottawa Electric Company, Ottawa, with 111,927 lights. All the other provinces have made considerable progress, but British Columbia shows the largest proportional increase of any of the divisions of Canada. The figures go to show that increased use of electric lights is general throughout the Dominion.

Among recent electrical companies to incorporate is the Portable Electric Safety Light Company of Jersey City, N. J., with a capital of $250,000. The incorporators are Duncan L. McLaren, Henry H. Graff and Joseph Du Vivier.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome: and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company**, and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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WHILE the article by Mr. Coar on the "Theory and Operation of the Storage Battery," which appears on another page of this issue, is of an elementary nature, and will seem to many like the retelling of an old story, it must be remembered that there are thousands of students and practical men entering the electrical field every year, and an article of this nature presents just the material to enable them to obtain an intelligent grasp of the subject. The field covered is a broad one, but the writer has succeeded in a limited space in presenting in a logical manner not only the theory of the accumulator cell but also information of a practical nature relative to its operation which will be found useful by those having a limited knowledge of the subject.

IF the terrible Iroquois Theater fire, with the loss of 572 lives, was due in large measure to the lax administration of the laws by the city government of Chicago, one cannot help asking whether there would be any diminution of street-railway accidents in this city if the surface lines were municipally operated.

SINGLE-PHASE railway motors are to be discussed at next week's meeting of the Institute in New York, and the discussion should be exceptionally interesting and profitable. Mr. Steinmetz is to present a mathematical paper on "The Alternating-current Railway Motor," and Walter I. Slichter, who is an electrical engineer with the General Electric Company, is to treat in a general way "Speed-torque Characteristics of the Single-phase Repulsion Motor." These are very up-to-date and important subjects, or, rather, divisions of one subject, in which the most progressive electrical engineers are deeply interested, as they have a vital relation to the future development of the electric railway. It is to be hoped that the subject will be fully discussed in all its bearings by the inventors and engineers engaged in developing the several single-phase systems under way. The meeting will be held next Friday evning at the Chemists' Club 108 West Fifty-fifth Street.

RADIUM was instructively discussed by Sir Oliver Lodge before a large public gathering held in Birmingham, England, earlier in the month. The great demand for admission to the lecture from among the ranks of all classes shows the universal desire to learn more about this remarkable element. During the course of his address Sir Oliver remarked that sometimes a fact was born into the world before its clothes were ready, and sometimes a "layette" was provided before the fact was born. Radium, he said, was in the latter predicament; its properties as now known went beyond the anticipation of theory, but they were all in line with theory, and there was no difficulty in understanding them and fitting each into its niche. The speaker declared that the behavior of radium revolutionized some of the doctrines of science, but the revolution had been prepared for beforehand, far away from practical chemistry, in the study of the mathematician, in the laboratory of the pure physicist; a few of the leaders on physical science were on the lookout for evidence of some kind of atomic radiation, and, after the discovery of spontaneous radioactivity, were on the further lookout for some kind of instability, or some rearrangement of parts in the atom of matter. Some thought that X radiation might be found in conjunction with the phenomenon of fluorescence, and it was owing to a vague and indeterminate suggestion of this kind by the French Mathematician, Poincairé, that the discovery of radio-activity was actually made by Becquerel in Paris in the year 1896, one year after the empirical, and, at first, puzzling discovery of the X-rays themselves by Roentgen in Germany had been achieved.

Early in his lecture Sir Oliver announced that he intended to say nothing about the price of radium—a point which arouses considerable attention nor would he speak of its hoped-for medical uses, for the development of these features lay in the future. For our present views of the nature of the atom of matter, he asserted, we are indebted to the labors of many, but especially to two Englishmen—Larmor and Thompson now professors at Cambridge, of mathematics and physics, respectively. A picture of an atom of matter, as near as it could be conceived at present, was thrown on the screen. The atom is held to consist of positive and negative electricity and nothing else—the negative electrons in a state of violent movement, with occasional possibility of escape. An electric charge in motion constituted all the electric currents and magnetism, and it possessed momentum; further, the speaker said, when accelerated it should, by Poynting's theorem, generate radiation.

The lecturer reviewed at length early experiments and mentioned Stokes as being the first to understand the phenomenon of fluorescence; and after the discovery of Roentgen rays the phosphorescent substance, uranium, was studied by Henri Becquerel in 1896 to see if it emitted rays which could affect a photographic plate after penetrating black paper or other opaque material. The valuable discoveries of Becquerel were mentioned and Sir Oliver gave due credit to Professor and Mrs. Curie, the German chemist Giesel, Professor Suess and others for the developments resulting from their untiring researches. Speaking of the analysis of radiation by a magnet, he said the rays from any of the substances were found to be of three kinds—gamma rays, which were very penetrating, could be detected after passing through a foot of iron, and were possibly a variety of X-rays; beta rays, which consisted of flying or escaped electrons; and alpha rays, the nature of which were investigated by Rutherford, late of New Zealand, then an 1891 student at Cambridge, now of Montreal. These last were found to consist of atoms of matter, each one per cent. of the weight of a radium atom, projected from it with a velocity of 100,000 miles a second. These were the projectiles which made the luminous splashes on a target in Crookes' spinthariscope. The material which remained behind was called the "emanation;" it was much more active and unstable than radium itself, and was the part which could be blown away like a gas.

In conclusion, the speaker stated that the spontaneous breaking up of an atom constituted a novel source of energy larger than any previously known. The amount of energy of any weighable collection of atoms was enormous if it could be got at, but in practice only a very few atoms were unstable from instant to instant. Most behaved as if they were permanent; but they were probably none of them really and eternally permanent. The discovery of this new or intra-atomic energy affected the estimate of the possible life of the sun, and, to some extent, of the probable geologic age of the earth. But the most important consequence was the discovery of the mutability of matter, the transmutation of elements, and the liability of material atoms to break up or explode. In old days Heraclitus promulgated the doctrine that the universe was not a "being," but a "becoming;" that everything was in a state of flux—that nothing was stationary, or fixed, or permanent, and this assumption was now shown to be true.

FRIENDS of the metric system are encountering a vigilant and active opposition, particularly in relation to its official adoption by the United States government. There is, it appears, a bill now before Congress, providing for the immediate adoption by the government of the metric system of weights and measures, and its adoption as the legal system in the United States in 1907. It is asserted that the use of the system will at once become obligatory, in the event of the passage of the bill, on all importers and on all those engaged in furnishing supplies to the government. The National Association of Manufacturers is opposing this bill, on the ground that the business interests of the country do not desire it. It is taking a ballot to ascertain the attitude of commercial and manufacturing organizations in relation to the bill. Already, it is declared, the National Association of Machine Tool Builders, Railway Master Mechanics' Association, Master Car Builders' Association, Engine Builders' Association, Society of Naval Architects and Marine Engineers, and the Society of Heating and Ventilating Engineers have ranged themselves against the measure. On the other hand, many scientific bodies have declared themselves in favor of the metric system in the strongest terms. In the electrical industry sentiment is divided. On abstract principles there are many who favor the logical decimal system who are not prepared to do away with patterns and designs dimensioned in feet and inches at one fell swoop, or by any process that is not gradual and carefully prepared for. Generally, these liberal conservatives rather rely on training the rising generation to think in meters and centimeters and the like rather than a more drastic policy. But it is obvious that sometime there must come a point of radical departure if the metric system is ever to be adopted in the United States. Probably 1907 is too early for a sweeping change.

Iroquois Fire Investigation.

The developments at the coroner's inquest continue to bring to light new evidences of neglect and violation of law at the Iroquois Theater.

According to the evidence of Archibald Bernard, the house electrician, who had charge of the switchboard on the stage, the auditorium lights were controlled from the stage and not from the front of the house, as the ordinance required. He disclosed another violation of the ordinance when he said that the stage ventilators were not operated from the switchboard. It further developed that although the exit lights (two incandescent lamps) were always kept lighted during the performance they were so obscured by the door draperies as not to be visible from the house. The witness also stated that a pail of water on the platform on which the spot and reflector lights were situated would have been sufficient to have extinguished the flames when they were first started.

The operator of the reflector or flood light, William McMullen, was another important witness. He testified that the light was the property of the theatrical company and that he was under the orders of its electrician. The witness said: "I was leaning over attending to one of my lamps; when I looked up I saw the drapery hanging close to the reflector was on fire. The fire was eight or 10 inches away from the lamp then." The witness explained the operation of the lamp, which has been in the inquest room since the first day of the inquiry, and later produced a picture showing him in the act of operating the light, and the drapery hanging in dangerous proximity. This picture was the one taken for the Western Electrician's illustrated article in the issue of December 12th.

Stage Carpenter James G. Cummings, when questioned aobut the fatal flood light, stated that he had examined it every day and that if its position on the platform had been considered dangerous it would have been his duty to see that it was removed. He testified that the borders were at least 15 inches away from the lamp when he had inspected it on various occasions. Upon being shown the Western Electrician of December 12th he declared the picture to be a good representation of the switchboard, but that the position of the lamp was probably not the same in the daytime when the picture was taken as at night, though he asserted that the position of the drapery was unaltered. This brought out the fact that the lamps are adjustable vertically and are moved up or down as the conditions of the scene required.

The witness also testified in regard to the proscenium lights, saying that when he had inspected the trough reflector it extended out about four inches from the arch, when swung open, and at that time did not hinder the falling of the asbestos curtain. He finally asserted that in his belief the curtain did not catch on the proscenium-light reflector, but that the powerful draught created by opening the rear doors sucked the curtain outward so strongly that it refused to operate. He said that this could be demonstrated in any theater in Chicago by opening the front doors alone, when the curtain would be drawn outward with great force.

W. H. Merrill, Jr., secretary of the National Fire Protection Association, has sent out a report on the Iroquois Theater fire, prepared with the help of F. J. T. Stewart, superintendent of inspections of the Chicago Underwriters' Association. From this interesting report the following on the origin and spread of the fire is quoted: "The fire started on the stage, in all probability by a spark from an electric arc light coming in contact with an inflammable curtain, which was moved by a strong current of air. The lamp was partially inclosed by a sheet metal casing. It was technically known as a 'spot' or 'flood' light, being used to concentrate the light on the performer. This device has largely replaced the calcium light, which is seldom found now in modern theaters.

"Hand regulation was used, as is customary with these lamps, instead of the automatic regulator common to ordinary arc lamps. Several futile attempts are said to have been made to extinguish the blaze in its incipiency, and some 'kilfyre' dry powder extinguisher is claimed to have been used. Vain efforts were made to drop the asbestos curtain. It was obstructed apparently by a proscenium-light board which was hinged to the wall and had been swung out under the north end of the curtain. After a few seconds the fire spread very rapidly to all of the highly combustible scenery used in the spectacular production of 'Mr. Blue Beard.' The exit from the stage at the extreme west was immediately opened by those escaping; this caused a strong current of air from this point to the open ventilator over the main ceiling of the auditorium and just above the gallery. The highest alley exit at the rear of the gallery was also opened, increasing the draft in that direction. The vents over the stage were closed. As a result the full volume of flame, smoke and gases swept through the stage opening and bore directly on the gallery and to a less extent on the balcony. The auditorium was exceptionally wide and shallow, which brought the balcony and gallery nearer than usual to the stage. The stage equipment was so highly inflammable that the fire reached its greatest degree of intensity very rapidly, and within 15 minutes had spent its force, having consumed most of the combustible material on the stage side of the proscenium wall."

OBITUARY.

F. von Hefner-Alteneck.

The London Electrician of January 8th has the following: "It is with deep regret that we record the death yesterday, by apoplectic stroke, of Dr. Friedrich von Hefner-Alteneck, one of Germany's most distinguished electrical engineers. Dr. von Hefner-Alteneck was born in 1845, and was, therefore, 58 years of age. At the age of 22 he entered the firm of Siemens & Halske, having previously received scientific training at the Zurich and Munich polytechnics, and worked his way up into the position of manager of the electrical-engineering department, remaining with that firm until 1889. In 1872 he invented the drum armature, one of the most important developments in the design of dynamo-electric machinery. He also invented one of the first, if not the first, differential arc lamps, the transmission dynamometer which bears his name, and (in 1883) the famous Hefner amyl-acetate standard of light." Dr. von Hefner-Alteneck's name stood high in the long list of scientific technicians that Germany has given to the world. His reputation extended to all parts of the globe where electrical engineers are working out the problems of their profession, and in the United States his death will be lamented no less than in Europe.

William O. Garrison.

William Oliver Garrison, president of the Columbia Incandescent Lamp Company, died on January 17th at his home, 5544 Cates Avenue, St. Louis. He was the eldest son of Daniel E. Garrison and a grandson of the late Commodore Oliver Garrison of military fame, and who was largely instrumental in the building of the Missouri Pacific railroad. Mr. Garrison's illness dated from October last.

The decedent was 42 years old, a native of St. Louis, and had been in business there for many years. About 13 years ago he married Miss Edith Hendel, a granddaughter of the late Jesse Arnott, who survives him. Mr. Garrison's mother died last June. A brother, Daniel E. Garrison, Jr., has been in California with his familiy for some time, but arrived in St. Louis in time to attend the funeral. The other surviving brother is Arthur C. Garrison of St. Louis. Mr. Garrison was a charter member of the Country Club, a member of the Mercantile Club and of other social and commercial organizations. He had a wide acquaintance among electrical men and was highly esteemed.

Asa S. Bushnell.

Ex-Governor Asa S. Bushnell of Ohio, who died at Columbus on January 15th, was largely interested in the Springfield, Troy and Piqua Traction line, which has been almost completed, and the Springfield-Xenia Traction Company. Governor Bushnell had planned a number of other lines radiating from Springfield, which would have been built at an early date, but fear is expressed now that the plans will not be consummated. Since his retirement from the governor's office he had become greatly interested in traction work, notwithstanding the fact of his advanced age. Governor Bushnell was extremely fortunate in business affairs and accumulated wealth as one of the members of the firm Warder, Bushnell & Glessner, manufacturers of mowers and reapers. His fortune is reputed to be about $8,000,000, nearly $1,000,000 having been distributed among his children only a short time ago. His private charities were many. He was 70 years of age.

Gen. C. H. Barney.

General C. Henry Barney died at his home in Hackensack, N. J., on January 10th, after a month's illness, on his sixtieth birthday. General Barney was born in Providence, R. I., and when 17 enlisted with the Fourteenth Rhode Island Heavy Artillery, and served through the Civil War. He retired with the rank of captain. He was adjutant-general of Rhode Island for five years, and under Governor Van Zandt did much in reorganizing the state militia. He constructed the first long-distance telephone line from Providence to Boston, as superintendent of the Interstate company, and later was superintendent of the New York and New Jersey Telephone Company. In 1885 he was one of the commissioners from New Jersey to the New Orleans Exposition.

General Barney was very well known to electrical men all over the United States, being connected with several electrical enterprises, in addition to the telephone companies mentioned. About 1890 he was a member of the firm of Alexander, Barney & Chapin in New York city, which for a time did a flourishing electrical supply business. During the Chicago World's Fair of 1893 he was superintendent of the Electric Launch and Navigation Company, which operated a fleet of 50 electric launches on the lagoons at Jackson Park, carrying from 6,000 to 10,000 passengers a day. These electric boats were one of the most popular and successful features of the exposition, and the credit for the idea and for the hard work necessary to carry the idea into effect was given mainly to General Barney, whom some of his friends renamed "Admiral" Barney. Mr. Barney was at one time connected with the Sawyer-Man Electric Company, and for the last four years had been in charge of the electrical department of the Monarch Fire Appliance Company of New York He was prominent in the Masonic Order, Loyal Legion and Grand Army of the Republic, and leaves a wife and three adult children.

Indiana Engineering Society.

The twenty-fourth annual meeting of the Indiana Engineering Society was held in the Commercial Club rooms, Indianapolis, on January 14th, 15th and 16th. Ninety-four of the 111 members were present, and the interest was good throughout the convention. The secretary's report showed the society to be in a most prosperous condition.

R. L. Sackett, of Earlham College, Richmond, presided. In his annual address President Sackett dwelt upon the evolution of the engineer. The essential feature of the address was that while the engineer formerly designed, he now does more—he designs and directs the construction and often is promoted to the administrative branch of an enterprise. The speaker deplored the existence of "graft" and warned the engineers to beware of tempting offers. He said that the engineering profession in Indiana had been greatly advanced and stimulated by the Indiana society; that the association of scientific men and teachers and their coming together annually for social and scientific intercourse had proved highly beneficial to the members and the public as well.

There were many interesting papers read during the convention, several of which were illustrated by stereopticon slides.

The Committee on Electrical Engineering made a report through its chairman, H. B. Marsh, to the effect that great progress had been made during the year—so great, said the chairman, that it was difficult to keep up with it. There were several papers presented which were partially concerned with electrical subjects. "Central Steam Heating Plants" were discussed by Fred B. Hofft, manager of the Indianapolis Home Heating Company. Mr. Hofft set forth the value of a central plant on account of the convenience and economy it affords its patrons, and because, in part, it solves the smoke-nuisance problem. "A Description of the New Centralized Power and Heating Plant of Purdue University" was read and illustrated by Professor J. D. Hoffman. Other papers were "A New Automatic Stationary Engine" (illustrated), by F. F. Chandler, Indianapolis; "Power Chains and Their Use," by Charles H. Hills, Indianapolis; "Plans for Testing Locomotives at the St. Louis Exposition," by Professor W. F. M. Goss, Purdue University; "The Railway Profile Considered with Reference to the Propelling Power of Locomotive or Electric Railway Motor," by Professor W. D. Pence, Purdue University; "The De Laval Steam Turbine" (illustrated), by G. A. Young, Purdue University; "Interurban Railways in Small Cities," John W. Fulwider, Lebanon, and "Some Special Street-railway Work Now in Progress in Indianapolis," by Thomas B. McMath.

The reading of these papers by the members was listened to with marked attention and the papers were discussed thoroughly. It was asserted that a level track was not essentially necessary for the operation of electric interurban cars; that an undulating track was in no sense a detriment if the grade percentage was not too great. Several good papers dealt with building material, wood, concrete and iron. Stream pollution and its remedies were also discussed. Upon the whole, the convention was the most interesting and successful in the history of the society.

The next meeting will be held January 12, 13 and 14, 1905. Professor Sackett was re-elected president. J. B. Nelson of Indianapolis vice-president, and C. C. Brown of Indianapolis retained as secretary.

F.

Northwestern Electrical Association.

[Special dispatch to the Western Electrician.]

Milwaukee, January 20.—President F. W. Bowen called the opening session of the annual convention of the Northwestern Electrical Association to order to-day at noon. There was not a large attendance, but the prospects for a successful meeting are good nevertheless. The president's address was postponed until the afternoon session, when a much larger gathering is assured. Secretary and Treasurer Thomas R. Mercein read his report, which was accepted. The association then adjourned for luncheon.

A number of manufacturers and supply dealers have exhibits on the second floor of the Pfister, where the convention is in session. About 35 electrical men arrived on the morning train from Chicago.

[A full report of the convention, which is in session as the Western Electrician goes to press, will be given next week.]

Joplin, Mo., May Supply Electric Light To Private Consumers.

Recently the United States Supreme Court handed down a decision of especial interest to electric-light companies. It relates to the principle whether a city may engage in the business of supplying electric light to private consumers when by doing so it enters into competition with a private company to which it had itself given a specific franchise for the purpose of performing similar service. The private-company view is that such action on the part of the municipality is in violation of the obligation of a contract, and thus unconstitutional. But the Supreme Court holds otherwise, declaring that, in the case of the Southwest Missouri Light Company against the city of Joplin, Mo., the ordinance does not restrain the city from engaging in the electric-light business. The text of the opinion accompanying this important decision is as follows:

The city of Joplin, appellant, vs. the Southwest Missouri Light Company.

Bill in equity to restrain the appellant from supplying its inhabitants with incandescent lights or other electric lighting in competition with the appellee.

The city of Joplin is a municipality of the state of Missouri; the appellee is a corporation of said state, and the jurisdiction of the Circuit Court was invoked on the ground that the action of the city impaired the obligation of the contract existing between it and the appellee, in violation of the constitution of the United States, and hence the appeal directly to this court.

A preliminary injunction was granted. (101 Fed. Rep. 23.) It was made perpetual upon final hearing and a decree was entered enjoining the city "from supplying or furnishing to the inhabitants, residents or any other person, firm or corporation within said city, or any addition thereto or extension thereof, electric lights, either incandescent or arc, or in any other form or manner, for commercial or private lighting, for and during the full term" of the grant to the predecessors and assignors of appellee, to wit, the term of 20 years from and after October 7, 1891. (113 Fed. Rep. 817.)

A statute of Missouri (laws 1891, p. 60) authorizes cities to erect, maintain and operate electric-light works, to light the streets and supply the inhabitants with light for their own use, and to establish rates therefor. Or they may, the statute provides, "grant the right to any person or persons or corporation to erect such works. . . . upon such terms as may be prescribed by ordinance, provided that such right . . . shall not extend for a longer period than 20 years." Subsequently to and in pursuance of this statute the city by ordinance, October 7, 1891, granted the right to erect and maintain an electric-light plant to certain persons, naming them, their successors and assigns, for a period of 20 years. The plant was erected at considerable expense and has ever since been maintained and operated. The appellee is the successor of the original grantees.

The ordinance conferred rights and exacted obligations, and fixed, besides, the rates to be charged. It also provided for its written acceptance within 10 days after its passage and the commencement of the work within 60 days. It was accepted.

Subsequently (March, 1899), the city, acting in pursuance of and in the manner provided in certain ordinances, issued bonds to the amount of $30,000, "for the purpose of erecting an electrical-light plant to be owned, controlled and operated by the city," and by the means obtained thereby constructed electrical works, erected poles and wires, established a schedule of rates, and entered into the business of commercial electrical lighting in competition with appellee. The bill alleged that the appellee was the owner of real and personal property within the city, which is assessed by the city for municipal taxation, and that appellee is compelled by reason of such taxation "to aid and assist in operating and maintaining defendant's (the city's) electric plant and business as a rival and competing one" with appellee's electrical plant and business.

Mr. Justice McKenna, after stating the case, delivered the opinion of the court.

The foundation of the suit is that the ordinances of March, 1899, and the acts and conduct of the city in entering into competition with the complainant (appellee) impairs the obligation of the contract impliedly arising from the ordinance of October 7, 1891, and the acceptance thereof by appellee. In other words, it is contended that under the statute of the state, which we have quoted, the city was given the power to construct an electrical plant and erect poles, etc., to "supply private lights for the use of the inhabitants of the city," or it could grant that right "to any person or persons or corporation" upon such terms as might be prescribed by ordinance. It chose the latter and granted to the assignors of appellee the right given by the statute and expressed it to be "in consideration of the benefits to be derived therefrom." And it is hence contended that thereby the city contracted not to build works of its own, and that by doing so it violated section 10 of the constitution of the United States, which provides that no state shall "pass any law impairing the obligation of a contract," and also violated that clause of the fourteenth amendment of that instrument, which provides that no state "shall deprive any persons of property without due process of law."

It is by implication from the statute and the ordinance passed under it, not from the explicit expression of either, that the conclusion is deduced that the city is precluded from erecting its own lighting plant, and yet it is conceded that the grant to the appellee is not exclusive. That is, it is conceded the city has not exhausted its power under the statute by the grant held by appellee, but may make another to some other person than the appellee. In other words, that the city may make a competitor to appellee, but cannot itself become such competitor. The strength of the argument urged to support the distinction is in the consideration that competition by the city would be more effective than competition by private persons or corporations—indeed, might be destructive. The city, it is further urged, could be indifferent to profits and could tax its competitor to compensate losses. But this is speculation and it may be opposed by speculation, and there are besides countervailing considerations. The limitation contended for is upon a governmental agency, and restraints upon that must not be readily implied. The appellee concedes, as we have seen, that it has no exclusive right, and yet contends for a limitation upon the city which might give it (the appellee) a practical monopoly. Others may not seek to compete with it, and if the city cannot, the city is left with a useless potentiality while the appellee exercises and enjoys a practically exclusive right. There are presumptions, we repeat, against the granting of exclusive rights and against limitations upon the powers of government.

Many cases illustrate this principle, and some of them were decided in response to contentions similar to those made in the case at bar. In Skaneatales Water Company vs. Skaneatales (184 U. S. 354), the village of Skaneatales, under statutes of the state of New York, granted to the water company the right to construct waterworks and contracted with it to supply water to the village and its inhabitants for the period of five years. At the expiration of the term of the contract some difference arose about the terms of its continuance, and the village constructed an independent system of waterworks. A suit was brought by the water company to restrain the further construction of the works and their operation, and the company contended that under the statute of the State, by which the village granted to the company its franchise, the village had the election to construct works, or confer such power upon a private company like the water company, and having elected the latter, it impliedly contracted not to construct works of its own. In reply to this contention this court said, by Mr. Justice Peckham:

"There is no implied contract in an ordinary grant of a franchise, such as this, that the grantor will never do any act by which the value of the franchise granted may in the future be reduced. Such a contract would be altogether too far-reaching and important in its possible consequences in the way of limitation of the powers of a municipality, even in matters not immediately connected with water, to be left to implication. We think none such arises from the facts detailed."

It is true there was an element in that case which is not in the case at bar. The village of Skaneatales had entered into a contract with the water company to take water from the company. This contract had expired before the city constructed its works. It was not that contract, however, which was alleged to have been impaired, but that which the water company claimed to have been implied by reason of its organization and incorporation and in pursuance of the application made to and with the consent of the village authorities. The ultimate reliance, therefore, of the water company was that from the grant to it the village impliedly contracted not to construct works of its own. The similarity of the contention with that in the case at bar is apparent.

In Bienville Water Supply Company vs. Mobile (175 U. S. 109; 186 U. S. 212) it was again decided that the granting of franchises to private persons to construct waterworks in a city does not preclude the city from afterward erecting such works and supplying its inhabitants with water.

Walla Walla vs. Walla Walla Water Company (172 U. S. 1) is not in opposition to these views. The city of Walla Walla was, by the statute incorporating it, empowered to erect waterworks or to authorize the erection of the same. In pursuance of this power it granted a franchise to the Walla Walla company and contracted to take water from the company, reserving the right to avoid the contract under certain contingencies. But it was provided that: "Until such contract shall have been so avoided, the city of Walla Walla shall not erect, maintain or become interested in any waterworks except the ones herein referred to, save as hereinafter specified." The contract was in force at the time the suit was brought and the water company had substantially complied with all of its terms and conditions. The contract passed upon, therefore, was expressed and explicit. The power to make it was sustained. In the case at bar restraint upon the power of the appellant city is claimed to be implied by the grant to the appellee. We think, for the reasons stated and upon the authorities cited, such restraint cannot be implied.

Decree reversed and case remanded with directions to dismiss the bill.

BOOK TABLE.

MODERN WIRING DIAGRAMS AND DESCRIPTIONS. By Henry C. Horstman and Victor H. Tousley. Chicago: Frederick J. Drake & Co. 1904. Pp. (4¼ by six inches), 157, with 177 illustrations. Price, $1.50.

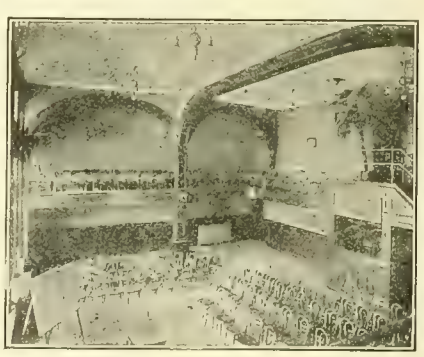
This little book is written by practical men who know just what information the working electrician most desires. It is intended as help to the electrical worker in his everyday problems in wiring, and does not supplant any other book, but is rather of a supplementary nature, to enable the electrician to turn to good account the matter he may obtain from more elaborate works. The book contains useful diagrams of all descriptions of circuits, such as alarm circuits, telephone circuits, switchboard wiring, gas-lighting circuits, telegraph systems, all kinds of lighting circuits, including transformer, storage-battery and equalizer connections, etc. Each diagram is accompanied by a short description of methods. There is also some little space devoted to testing. In short, the book is written expressly for the practical electrician, and will be found convenient, as it is easily carried around in the pocket ready for reference when some particularly knotty problem arises.

AMERICAN METER PRACTICE. By Lyman C. Reed. New York: McGraw Publishing Company. 1903. Pp. (5¾ by 8¼ inches), 196, with 76 illustrations. Price, $2.

Metering the output of central stations is a broad subject, and if properly gone into, a book devoted entirely to it is necessary to cover the field properly. "American Meter Practice" covers even more ground than its title would indicate. To begin with, it gives, in two chapters, a condensed but at the same time a clear treatment of the subject of the measurement of power, not only for direct-current circuits, but also for single-phase and polyphase circuits. By the aid of diagrams, together with brief but concise explanations the reader may obtain at the outset a conception of what takes place in an alternating-current circuit and how to go about measuring the power. Then arises the question of the selection of the meter. A chapter devoted to this gives 14 different requisites of a good meter which it would be well for the prospective purchaser to bear in mind. Seven types of well-known meters in use at the present time are next discussed in as many chapters. These types were selected because they each represent some particular feature in meter construction or operation which it is desired to illustrate. Records and testing are treated at some length, as is also the general policy of central stations bearing on the measurement of current and the care of the instruments. Two or three pages are given to the reading of meters. Though this seems so simple, yet it is surprising to find how many persons "fall down" when asked to read a wattmeter. "Elements of Photometry" is the title of the last chapter of the book and presents such phases of the subject as will be found useful to the central-station man.

Electric Club of Pittsburg.

As a means of self-education the Electric Club, composed of young men of the different departments of the Westinghouse Electric and Manufacturing Company of Pittsburg, presents a good example of concerted action on the part of young technical men to enable them to receive the most good from the practical work which they are undertaking. The club has spacious rooms for lectures, for study and



ASSEMBLY HALL OF THE ELECTRIC CLUB OF PITTSBURG.

for library purposes, and here the members congregate during the evenings to listen to talks by the older and more experienced engineers of the company and to work out solutions of the practical everyday problems which arise in their work. The accompanying picture is a view of the Assembly Hall of the club, where the lectures are held. As was noted in the Western Electrician of recent date, the Electric Club publishes a journal of its own, called the Electric Club Journal, which contains the principal papers read before the club.

Theory and Operation of the Storage Battery.

By Chas. H. Coar.

A storage battery or accumulator is a cell which will accumulate electricity through the chemical changes its material undergoes when subjected to an electrical current. The current during charging causes the elements to decompose, and during the discharge these decomposed elements return to their original state or form. In the strict sense of the word, therefore, a cell cannot be said to store electricity.

That the accumulator of to-day owes its origin to Garton Planté is generally conceded. Planté's cell consisted of two lead strips insulated from each other and a jar containing dilute sulphuric acid, in which the lead strips were immersed. Planté found that this cell was capable of delivering 2.25 volts after it had been subjected to a charging current, and also that it was possible for him to increase the surface of the lead strips by charging and discharging the cell, then repeating this operation with the charging current reversed. Several days of this charging and discharging caused the strips to become spongy in character; therefore, by reason of the elements having more surface in contact with the electrolyte the cell would be capable of delivering more current.

The charging and discharging is quite tedious and expensive, and Faure, another inventor, conceived the idea of coating the plates with oxide of lead, but some difficulty was found in making this paste adhere. Scratching and indenting the plates was tried with more or less success until other means which ultimately ended in the perforated plates of to-day were adopted. The paste is pressed into the perforations in the plates, and cells with plates of this description can be operated with success after they have been discharged two or three times.

The accumulator jar is made of any substantial non-conducting and acid-proof material, such as glass, hard rubber or lead-lined boxes. The positive and negative plates are arranged alternately, and there is always one more negative plate than positive in each cell. All of the positive plates are connected together and all the negative plates are connected together. The positive plates are separated from the negative plates by non-conducting acid-proof rods. These rods are usually made of glass or hard rubber, although in recent years a separator, which is of the same dimensions as the plates themselves, of chemically treated basswood, is used with success. These basswood separators are about three sixty-fourths of an inch in thickness, and the cell solution can easily penetrate them.

The positive plate, which is the one where the charging current enters, is usually made of pure lead with perforations, which are filled with peroxide of lead or lead oxide, sometimes called litharge, while the negative plate is of spongy formation.

In most accumulators the electrolyte is sulphuric acid diluted with water to a specific gravity of approximately 1,200° on the scale of a hydrometer. The acid must be free from such impurities as arsenic, nitric or hydrochloric acids, and acid made from pyrites should never be used. The acid should be diluted with pure distilled water and this solution should be thoroughly cooled before it is poured into the cells. The acid should always be poured into the water slowly.

The chemistry of the accumulator is somewhat complicated, and although there is as yet a little doubt as to what actually takes place the following chemical changes are generally accepted:

When a cell is thoroughly charged the postive plate is covered with lead peroxide (PbO_2), while the negative plate is covered with a spongy lead. During the discharge the lead at the negative plate unites with the sulphuric acid (H_2SO_4), forming lead sulphate ($PbSO_4$), and setting hydrogen free. At the positive plate the lead peroxide (PbO_2) unites with the hydrogen set free from the negative plates and forms a lower oxide (Pb O) and water. The PbO unites with the sulphuric acid and forms lead sulphate ($PbSO_4$) and water. As the cell becomes discharged the acid then unites with the plates and water is formed. When a cell is fully charged the further application of a current breaks up the water of the solution, liberating hydrogen gas at the negative and oxygen gas at the positive. These gases reduce the amount of the solution in the cell both by decomposition of the water and by the acid which is carried off in spray. This spray is also carried off if the charging current is too strong, so that the active material on the electrodes is affected at the surface much faster than it is nearer the center of the plates. If the charging current be too small, insoluble sulphate is apt to form and so injure the plates. A cell which is charged or discharged too fast is apt to have its plates bent, owing to the fact that the active material of the plates expands during a discharge. This is called buckling of the plates.

The capacity of an accumulator depends on the amount of surface that plates have exposed to the action of the electrolyte, and it is usual to have a number of plates connected together where large capacity is desired rather than to have one large plate, on account of the inconvenience a large plate would cause in handling. The capacity of a cell is measured in ampere-hours. A cell which delivers a current of 100 amperes for one hour, or one ampere for 100 hours, is spoken of as a cell having a capacity of 100 ampere-hours.

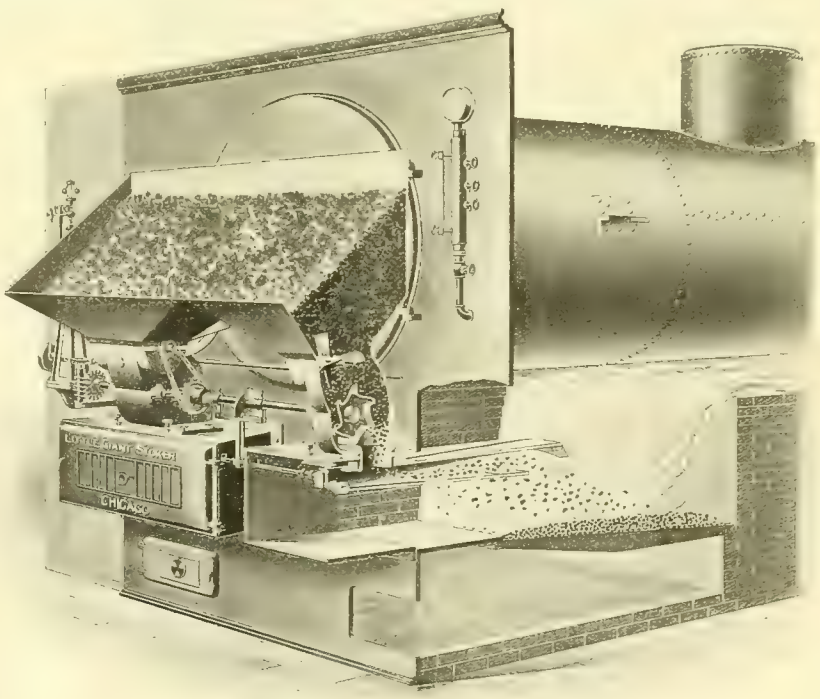
Charging is, of course, done with direct-current, which should not exceed four amperes per square foot of plate surface. The plates in cells are usually marked so that their polarity may be known, but in case there are no marks the positive plate assumes a brown velvety appearance, while the negative is smooth and of a lead or slate color. Great care should be exercised that the positive pole of the charging current is attached to the positive plate.

During charging if a cell is found to "gas" too freely it should be disconnected and examined to see if some of the plates are not short-circuited by falling particles of oxide. Adding caustic soda in the proportion of one to five with the water of the cell will help to prevent the insoluble sulphate forming on the plates. An estimate for charging current can be made on the basis of allowing eight amperes per square foot of positive plate.

A cell in which the solution is open should be kept in a cool and thoroughly ventilated room. Cells should never be discharged below 1.8 volts unless they are to be taken out of service. In that case they should be thoroughly charged, after which the solution is drawn off by means of a siphon and water substituted in its place. Then the cell can be discharged completely, after which the elements can be taken out and allowed to dry.

"Little Giant" Mechanical Stoker.

From time to time new inventions make their appearance, are investigated thoroughly in most cases, adopted by a few if they prove feasible, and unanimously accepted if they demonstrate clearly that a saving of time and money—essential assets of a successful invention—can be effected by their use.



"LITTLE GIANT" MECHANICAL STOKER

It has long been conceded that mechanical firing of coal is the correct principle and absolutely essential to procuring the most economical combustion. It is generally admitted, however, that there is room for considerable improvement in nearly all the devices on the market designed to take the place of the human stoker.

Fully appreciating the numerous advantages and disadvantages possessed by the various devices designed to mechanically feed a fire, the Chicago Pneumatic Tool Company has entered on the construction of a mechanical stoker which is said to have many advantages. The stoker is clearly shown in the accompanying illustration. The aim has been to construct a stoker acceptable to the small plant as well as the large one, and the cost of which shall place it within reach of all. The result of these endeavors is embodied in the "Little Giant" Mechanical Stoker.

The operation is exceedingly simple. The fuel is dumped into large hoppers either by hand in a small plant, or by means of an overhead travel, where there is a battery of boilers. Passing from the hoppers it travels over a revolving coggedwheel, which regulates the flow as desired. From this point it passes into a slowly oscillating spreader or chute and is forced through this by means of a steam jet, thus falling in a thin stream over the grate. The movement of the spreader as it swings slowly backward and forward distributes the coal in such a manner as to cover the most remote portions of the grate with as intense a fire as is in the center, therefore creating a luminous flame of intense heat, which is evenly distributed over the entire grate surface.

In attaching the stoker it is not even necessary to draw the fire and no alteration or damage to boiler front is necessitated. It has been demonstrated that this stoker can be attached to the boiler front in eight hours and taken off in one, thereby eliminating the necessity of shutting down the plant for an indefinite period.

The cheapest grade of fuel may be utilized with good results, and any size of coal can be used, from that which will pass through a 1¼-inch size of screen to the smallest size of slack. The advantages of this feature and the consequent reduction of fuel bills will be readily apparent.

Telephone Perils in Kentucky.

A Southern Ohio correspondent of the Western Electrician tells the following story:

A lineman employed by the American Telephone and Telegraph Company is suffering from a gunshot wound because some people on the other side of the Ohio River have never seen a telephone and know nothing of its mysteries. A few days ago this lineman went down into the hills of Kentucky to locate a break in the wires of the company. The line he was looking after runs in a direct line from Georgetown, Ky., to Huntington, W. Va. On account of the topography of the country the line crosses some of the wildest parts of the "Dark and Bloody Ground."

The lineman climbed a pole near Mt. Olive, Ky. He had a test set with him and wanted to talk to the superintendent of the company at Cincinnati. When he reached the top one of the natives came running out with a gun in his hands and wanted to know what he was doing up the pole with such a queer-looking instrument. The lineman told him that he was a workman and that he was talking to Cincinnati.

"Come down out of that!" was the command of the Kentuckian. "No honeycooler can come around here and tell we 'uns such trash as that. Come down, I say."

The lineman paid no attention to the order and was shot in the leg, which caused him to fall about 20 feet. The mountaineer took him into his house and dressed the wound, and then sent him away with the explanation that a man had paid him $5

for the privilege of putting the pole in his front [illegible] to let anybody climb it but the man who paid the money.

Indiana Telephone Items.

The West Fork and Sulphur Home Telephone Company, just incorporated with a capital stock of $5,000, will build and operate telephone lines in Crawford, Harrison and Perry Counties. The principal office and exchange will be in West Fork. George F. Dewitt is president.

The Centerpoint Telephone Company, incorporated with a capital stock of $5,000, proposes to build a system of telephone lines and exchanges in Clay, Putnam, Parke, Sullivan, Vigo and Owen Counties. The directors are H. F. Webber, P. L. Lansitt, M. H. Campbell and R. M. Bryant.

A new telephone company has been organized at Daleville with a capital of $10,000. The company will elect officers and incorporate in a few days. The construction of 20 miles of pole line will be begun immediately.

A meeting to further the plans of the municipal-telephone idea in Evansville was held on the 12th. Mayor Covert, General Manager Eversole, W. C. Pricket and others were present. The question of going ahead and installing a new plant was thoroughly discussed. It was the belief of all present that the investment would undoubtedly prove profitable to the stockholders. Eighty thousand dollars was reported in the treasury, but $120,000 is necessary before actual work of installing a plant can be commenced. In the meantime the Cumberland company has asked for the renewal of the restraining order against the city to prevent the removal of its poles and wires pending an appeal to the higher courts. This will doubtless be granted. It is difficult for the municipal advocates to raise any more money until the courts are done with the question of rights.

Winfield Scott, president of the Farmers' Telephone Company of Madison County, has devised a signal to all patrons of his system for use when someone on the line is in distress or in need of help. Following the general alarm signal, the operator at the central station will give the number of rings, indicating the person at whose home there is need of assistance by neighbors.

The Remington Telephone Company is building a new line to Wolcott and Monticello.

The Luce and Ohio Township Telephone Company of Rockport has issued a new up-to-date directory containing about 1,000 subscribers in Spencer County. This company opened its central office on August 1, 1902. It has seven exchanges and its lines ramify every portion of the county. Its telephones are all long-distance instruments and quick and efficient service is given. It was this company that first introduced free service in the county, and it is receiving a very liberal support from the people.

Ed. V. Fitzpatrick of Portland has secured a controlling interest in the Citizens' Telephone Company of Dunkirk and brought about the election of a board of directors of his choice.

The strike of the Electrical Workers' Union of the Delaware and Madison Counties Telephone Company, which began last April, has been declared off, a compromise having been effected. Hereafter none but union electrical workers will be employed by the company.

The Board of Public Safety of Indianapolis has contracted with the New Telephone Company and the Central Union Telephone Company for telephone service for the police department. The New company will furnish 74 telephones and a new switchboard at the headquarters for $1,250, and the Central Union 84 telephones for $1,248 for the year.

T.

Ohio Telephone Notes.

President F. S. Dickson of the Cuyahoga Telephone Company, Cleveland, and president also of several other Independent interests, has written a letter to President Roosevelt protesting against a recent order of Postmaster-general Payne to the effect that but one telephone should be used in the postoffices over the country, and that to be the one which has long-distance connections with Washington. He asserts that the Independent companies should have an equal chance with the Bell people for the postoffice service, notwithstanding connection may not yet have been established with Washington over the long-distance lines.

Four different telephone companies have applications for franchises pending before the City Council of Cincinnati, and that body will soon be called upon to act in some way. They are the Queen City Telephone Company, promoted by Harry B. Gates; the Cincinnati Telephone Company, of which Powel Crosley is at the head; the Fitzsimmons Telephone Manufacturing Company, under the control of Philip Fitzsimmons, and the Interstate Telephone Company, backed by Judge C. B. Wing and others. It is reported that the Queen City Telephone Company stands the best show of winning out.

The Farmers' and Merchants' Telephone Company of Warsaw has been reorganized with the following officers: President, J. P. Darling; vice-president, Joseph Finley; secretary and manager, S. C. Kissner; treasurer, James L. Black; auditor, M. D. Kissner.

The Lake Shore and Michigan Southern Railway Company has arranged to test the telephone as a means of transacting railroad business. A line will be equipped between Mishawaka, Ind., and Chicago, and if this is satisfactory the remainder of the road will be operated under the system. A telegraph wire will be used and at the same time telegraph messages will be sent over it. Train orders will be sent by telegraph.

The annual meeting of the Ohio and Indiana Telephone Association will be held at the Grand Hotel in Cincinnati on February 17th, 18th and 19th, and it is said about 200 delegates will be present. It is expected that several interesting addresses will be made.

C.

Telephone News from the Northwest.

The Columbia Telephone Company, a farmers' line, is soon to build into Hokah, Minn.

A telephone line is projected from Halstead, Minn., [illegible].

Business men of Oriska, N. D., want a local telephone exchange, with rural connections, but have been unable to reach terms with the lines situated on each side of the town.

The Wisconsin Telephone Company of Chippewa Falls, Wis., has cut over a new switchboard.

The Businessmen's Association will petition the Cedar Falls (Iowa) council for a telephone franchise.

An Independent telephone company has been formed at Estherville, Iowa, and the council will be asked for a franchise. It is intended to extend the line into the rural districts adjacent to the city.

The Crawford County Telephone Company at [illegible] Iowa, has increased its capital stock from $50,000 to $80,000.

A farmers' telephone line will be built in the vicinity of Ellendale, Minn. R. J. Dobell is one of the promoters.

The Reinbeck (Iowa) Mutual Telephone Company will install an exchange at that place.

B. F. Simpson of Sunnyside, Iowa, will enlarge and improve the Audubon County telephone line.

The various rural telephone companies of Hamilton County, Iowa, are talking of consolidating.

The Automatic Electric Company of Chicago will furnish the equipment for the new telephone exchange at Sioux City, Iowa. The new exchange building will cost $25,000 and will be large enough to accommodate 10,000 telephones.

The Frederic (Iowa) Mutual Telephone Company has been formed by Henry Chapman and others.

The Michigan Bell Telephone Company has installed an exchange at Newberry, Mich.

The Fort Dodge (Iowa) Telephone Company will rush work in the spring on the extension of its underground system. About 6,500 feet still remain to be put in.

William Knottes will install the Clark automatic exchange on his telephone system at Long Pine, Neb.

R.

Southeastern Telephone Developments.

It is definitely stated that the measure introduced in the Legislature of the state of Virginia requiring all telephone companies in the state to connect with one another will not pass at this term of that body.

D. H. Nixon, manager of the East Tennessee Telephone Company at Knoxville, Tenn., has been transferred to Chattanooga, W. K. Bordman of Lexington, Ky., succeeding Mr. Nixon. Mr. Nixon takes the position of manager at Chattanooga formerly held by T. N. Derrickson, who goes with the Cumberland Telephone Company at Memphis, Tenn. Mr. Bordman will be superintendent of the Knoxville division of the Cumberland Telephone Company.

The Virgilina Telephone Company of Virgilina, Va., has re-elected all but two of the former officers. An annual dividend of six per cent. was declared. The company operates long-distance lines, besides a local exchange and connections with the numerous copper mines.

A new line has just been completed between Florence and Waterloo, Ala., and is operated by the Stantonville Telephone Company. A connection with the Bell is also secured.

L.

Michigan Telephone Matters.

The American Car Telephone Company, with a capital of $2,500,000, has been organized in Grand Rapids, but incorporated under the laws of Arizona. It is asserted that this company has solved the problem of telephoning to or from electric or steam cars while either are at full speed. The general offices of the company will be in Grand Rapids. The officers are: President and general manager, Theodore Morgan of Muskegon; vice-president, F. W. Lyle of Dowagiac; secretary and assistant general manager, E. L. Silver of Grand Rapids.

At the annual meeting of the Co-operative Telephone Company of Detroit, C. M. Burton, Max J. L. Towler, J. C. Danziger, J. W. Howland and A. A. Cowles were elected directors.

Among other extensive improvements the Bell Telephone Company is contemplating in its Mt. Clemens system is the laying in conduits of all the wires in the central portion of the city. This will be done if permission is obtained from the city offi[illegible].

W.

TELEPHONE MEN.

The Farmers' Telephone Company of Haulontown, Iowa, has elected M. Blackmore president and J. W. Osborn secretary and manager.

Harry Sommers, superintendent of the Bell Telephone Company's Montana district, has been promoted to be superintendent of construction, with headquarters at Salt Lake City.

George H. Edwards of Boston has been made auditor of the Northwestern Telephone Exchange Company of Minneapolis and W. R. Obermire of Minneapolis is assistant auditor.

The International Telephone Manufacturing Company of Chicago recently increased its traveling force by securing the services of George H. Pierce. Mr. Pierce will represent the International company in the state of Iowa, with headquarters at Des Moines.

The Des Moines (Iowa) Mutual Telephone Company has elected J. S. Bellamy of Knoxville president, and J. C. Hume of Des Moines secretary. The company is considering the advisability of floating $100,000 worth of bonds to pay for rebuilding the exchange.

NEW COMPANIES.

The Laplata and Western Telephone Company of Laplata, Mo., has been incorporated, with a capital stock of $15,000.

S. Bryant, T. E. Marshall, Jr., and H. O. Barker of Randleman, N. C., are interested in the Randleman Telephone Company, recently incorporated with a capital of $5,000.

The Cumberland Gap (Tenn.) Telephone Company, organized recently by G. W. Fortune, J. H. Quillen and others, has been incorporated with a capital of $10,000.

A telephone company is about to be organized at Kirksville, Mo., with a capital of $100,000 for the construction of a telephone system. J. M. Kennedy is at the head of the movement.

The Farmers' Telephone Company of Union Hill, Ill., has been incorporated. The capital is $2,500 and the company will build a telephone system. Albert Stehr, Fred Stehr and J. C. Ruder are interested.

The Sharp County Telephone Company of Evening Shade, Ark., has been chartered and will construct a telephone system. The officers are: President, J. C. Wilson; vice-president, J. S. Medley; secretary, C. L. Coger; treasurer, W. B. Ham.

EXTENSIONS AND IMPROVEMENTS.

The Southern Massachusetts Telephone Company has put into commission its newly installed common-battery system, to supplant the old magneto system formerly in use in the city of Fall River.

The Home Telephone Company of Fullerton, Cal., is constructing a line into Orange County and across the country to Santa Ana. The company is preparing to apply for new franchises in order to cover the surrounding country.

Workmen from each end of the line of the American Telephone and Telegraph Company met at Bryantsville, Ky., recently, thereby completing the metallic circuit between Cincinnati and Louisville. The line passes between Danville and Lancaster and loops may be built to connect each with the through line.

The stockholders of the Kansas City Home Telephone Compny have taken preliminary steps to build long-distance lines which will connect the Home company's exchange with other cities. A construction company has been organized with a capital of $100,000. J. J. Heim, Hugh Ward and others are interested. Incorporation papers have been filed.

A record of upward of 10,000,000 calls answered during the year 1903 was made by the Springfield (Mass.) central telephone exchange, and some 600 new subscribers were added during the same period. An exchange at Ludlow and another at North Wilbraham, near Springfield, are to be opened this month.

The directors of the Southern New England Telephone Company announce an increase of $500,000 in the capital stock, bringing the total up to $4,000,000. The new stock will be issued February 15th to stockholders of record January 15th, one new share at par being allotted to each seven shares held. The company operates chiefly in Connecticut, and its purpose in making the issue is to take up loans recently made for the purpose of improving and extending the service. The authorized capital is $5,000,000, under a recent charter amendment secured by the company.

MANUFACTURERS AND DEALERS.

The Menominee (Mich.) Electrical Company will build an addition to its plant for the purpose of manufacturing telephones.

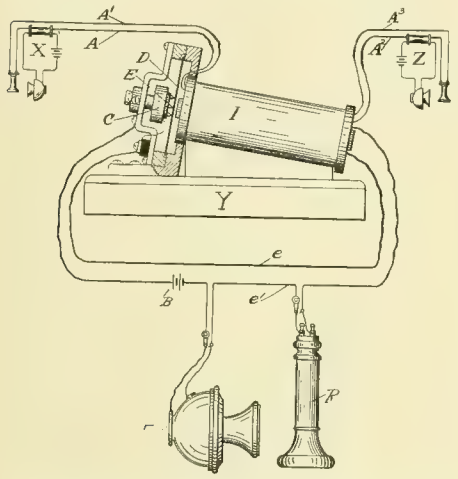
President W. E. Doolittle reports that the Sterling Electric Company of Lafayette, Ind., after shutting down for inventory, is again in operation, with a bright business outlook.

Another Telephone Repeater.

Telephone repeaters form an unfailing subject for the ingenuity of inventors, and indeed they may well do so, for a practicable automatic telephone repeater would be an extremely serviceable device, and ought to make the fortune of its inventor. A recent patent, issued to Merritt Gally of Brooklyn, N. Y., is for the telephone repeater shown by the accompanying schematic drawing.

On March 18, 1903, Mr. Gally filed an application for patent for a telephonic repeater, in which the receiving part of the repeater was described as having a doubly wound magnet coil, one of the wires of the coil connecting with one main line and the other wire of the coil connecting with another main line. In a primary circuit connected with the transmitting part of the repeater were shown a battery and two induction coils, one of the induction coils having its secondary wire in one of the main lines and the other induction coil having its secondary wire in the other main line. It was also stated that the two induction coils might be in one by winding the secondary double and connecting one of the wires with the one main line and the other wire with the other main line.

In the present invention, a combination of the re-



GALLY'S TELEPHONE REPEATER.

ceiving-magnet coils and the secondary wires of the doubly-wound induction coil is made. In the drawing, (I) is the induction coil for the repeating transmitting circuit. The coil has one winding in the primary, which is in the battery circuit (ee') with battery (B). The circuit is connected with the transmitting part of the repeater. It has the ordinary core of soft-iron wires; but as it is in an electric circuit, it is constantly magnetic and can serve the purpose of a permanent magnet for the receiving part of the repeater. The double winding of the secondary wires of the induction coil can also serve as the coils for the receiving part of the repeater. It is therefore proposed to combine the receiving magnet of the repeater and the repeater transmitting induction coils in one, as shown at (I).

As to the receiving part of the repeater, the compound coil (I) acts as a receiving magnet operating the receiving diaphragm. The compound coil (I) also acts as a compound induction coil for transmitting from the primary circuit of the repeater to the main lines. The two wires of the secondary of the induction coil connect one with one of the main lines and the other with the other main line.

The core of the induction coil being continually magnetic, operates on the diaphragm (D) in the same manner as the ordinary permanent receiving magnet. The vibrations of the receiving diaphragm (D) operate the transmitter connected therewith, transmitting into the other main line.

From the diagram it will be seen that the transmitting part of the repeater is an ordinary carbon granular microphone, having the cup (C) for the granules and the button electrode (E), which button is provided with three small projections touching the diaphragm (D). If the repeating transmitting device is omitted, except the diaphragm, and the battery circuit is closed, then the magnet (I), with its combination coils and diaphragm (D) and electric circuit (ee'), will act as a magneto transmitter, transmitting from one main line to the other. The core of the combined receiving magnet and transmitting induction coil is preferably made of a bundle of soft-iron wires.

A local transmitter (T) may be placed in circuit (ee') to transmit to either or both main lines. The receiver (R) may also be placed in the same circuit or placed in a loop to connect to either of the main lines at will. In case the repeater is used with magneto transmitting device, if a permanent magnet is used in connection with or forming a part of the receiving-magnet core, the battery may be used or not, as desired.

The coil (I) of the drawing is shown placed on an incline. This is only to make it in line at right angles to the line of the plane of the diaphragm. The diaphragm is inclined from a vertical line to cause the button-electrode (E) to rest against the diaphragm by its own gravity. Besides, this position of the transmitting part of the repeater is the best for the proper operation of the carbon granules in cup.

Wisconsin Independent Telephone Convention.

The annual convention of the Independent telephone companies of Wisconsin will be held at Milwaukee on February 10th and 11th. The Wisconsin association is one of the strongest of the state organizations, and its meetings have always been successful. The question of an Independent exchange in Milwaukee will be taken up and plans formed for carrying out this undertaking. Other matters of importance to Wisconsin companies will be discussed, and an effort made to secure the co-operation of all the companies in dealing with these problems. Some of the prominent telephone men of neighboring states will take part in the programme. The more important telephone manufacture and supply houses have arranged to make displays of their apparatus. The convention headquarters will be at the Pfister Hotel, and the sessions will be held in the hotel convention hall.

Strong Telephone-patent Litigation.

Henry C. Strong, an aged inventor, "one of the original inventors of the telephone," has again attracted attention by reason of the progress of his infringement suit against the American Telephone and Telegraph Company and several Bell licensee companies. The Strong patent appears to have been issued in 1885, and has now expired, but it forms the basis of the suit in which the Atlantic and Western Telephone Company appears as the plaintiff. The report of H. L. Strohm, who was appointed in 1901 by Judge Kohlsaat to take evidence in the case, was filed last week in the United States Circuit Court. The amount of damages asked is no less than $50,000,000.

GENERAL TELEPHONE NEWS.

The Sunset Telephone Company will build a line between Elma, Wash., and Centralia. Cost, $12,500.

The Gainsboro Telephone Company of Carrollton, Ga., has purchased the system of the Commercial Telephone Company at Atlanta, Ga., and will improve and operate the lines.

W. F. Snider and associates of Salisbury, N. C., have sold the Salisbury and Spencer telephone system to the Southern Bell Telephone Company. The lines will be extended and improved.

A telephone system will be constructed and operated in Oblong, Ill., by a company recently incorporated as the Oblong Telephone Company. E. T. Shire, F. P. Willard and Zach Wirt are interested.

The construction of a telephone system in Warren County, Va., and adjacent counties will soon be commenced by the Royal Telephone Company of Fort Royal, Va. This company has recently been incorporated by O. Harrell, J. L. Borden and G. W. Forsyth.

A telephone and telegraph system is to be constructed by the recently incorporated Nacogdoches and Southeastern Railroad Company of Nacogdoches, Texas. The telephone lines will extend about 30 miles along the company's right-of-way. E. B. Hayward is president of the company.

All the linemen employed by the Missouri and Kansas Telephone Company at Sedalia, Mo., have struck for an increase of wages. The scale demanded is as follows: City foreman, $3 a day; city lineman, $2.50 a day; an increase of $10 a month for all men on monthly salaries; time and one-half for all overtime; double time for Sundays and all legal holidays; nine hours to constitute a day's labor.

The Home Telephone Company of Louisville has paid the city $178 as a special franchise fee, representing $1 for each telephone in use above 6,000, as provided in the franchise. This company is making rapid progress and will, no doubt, be the leading one of the state. The Independent movement is popular in Kentucky and many small lines are being planned at various points. These will ultimately be connected up and receive the long-distance service.

A recent consular report states that the Belgian iron works, at least a number of them—including the Société Cockerill—are going to equip their plants with electric-motor power. The Cockerill Company, which it is believed will furnish the steel rails for the Antwerp-Brussels high-speed electric railroad, has been negotiating with Siemens & Halske, the German electric firm, for the equipment of its plant with electric power.

Electrical Notes from Mexico.

A new electric-light plant will be installed at San Martin Texmelucan, Mexico.

Machinery for the new electric-light plant to be installed at Tampico, Mexico, has arrived from the United States.

The Amparo Mining Company will install a large electric-light and power plant at its mines, situated at Etzlatan, Mexico.

An electric-light plant is to be installed at the Dolores Trompeta mine, situated in the Catoree district, state of San Luis Potosi.

The Mexicaltzingo Street Railway Company will build a new line over important streets of Guadalajara, Mexico. Other improvements will be made.

General Lorenzo Torres has been granted a concession by the Mexican government to establish large hydraulic works on the Yaqui River, situated in the Guaymas district.

The Mexican government is extending its system of telegraph wires to all parts of the state of Sonora. A large amount of material is required for this work of improvement.

An electric-light and power plant to cost $20,000 will be installed at Jiminez, Mexico. The Legislature of that state has exempted it from all state taxation for a term of 10 years.

All kinds of railroad cars, including cars for street railways, are to be constructed at the plant of the Mexican Car and Foundry Company, which is to be established at the City of Mexico.

It is announced that the electric street-railway system at Torreon, Mexico, is to be extended to the plant of the Torreon Smelter Company, a distance of more than a mile. Dr. D. Rios Zertuche is at the head of the enterprise.

The electric-light and power plant which has just been installed at Hacienda Almancena, Mexico, for furnishing light and power for the famous Palmillo mine, owned by Pedro Alvarado, cost $40,000. The current is carried three miles up the mountain side to the mouth of the mine.

Theodore V. Peerebom, Francisco Louvrier and Renato Jonat have secured government concessions for the utilization of the waters of the Jamapa River at a point near Cordoba, Vera Cruz, for operating a power plant. An electric-power plant and transmission lines will be constructed.

The Mexican government has granted a concession to Idilon Villanueva of Guadalajara to utilize the waters of the Rio Grande de Tuxpam or the Coahuayana River, in the state of Jalisco, for the purpose of irrigation and for motive power. Mr. Villanueva will establish a large electric-power plant. Under the terms of the concession the government grants an exemption of duties and taxation on all telegraph and telephone wires, transmission cables, electrical machinery, etc., necessary for the proposed electrical-power and transmission plant. The enterprise must be completed and placed in operation within seven years.

Chicago Street-railway Situation.

The last week has been marked by controversy due to the differences of opinion between the Union Traction Company and its underlying companies—the North and West Side companies. The differences relate to the construction of the new leases made under the recent reorganization and the questions in dispute are what charges for maintenance, interest and equipment the underlying companies must bear and what are to be paid by the Union Traction Company. The question involves the payment of dividends and Judge Grosscup may finally be called to settle the dispute. The new leases provided that the agreed dividends should be paid if the property earned them, and most of the stockholders supposed this meant if the receipts of the Union Traction Company were sufficient to meet the rent charges. Now, however, comes the proposition that these charges must be made against the separate earnings of each underlying company and be subtracted before the amount of the dividend is fixed.

Another incident which created a stir in traction circles was the resignation of Henry G. Foreman from the presidency of the board of directors of the Union Traction Company. Mr. Foreman's resignation is said to be due largely to his failure in carrying out plans involving J. Pierpont Morgan and other eastern capitalists some months ago for the speedy solution of the traction situation.

The local transportation committee has nearly completed its labors on the Chicago City Railway Company's franchise ordinance and in its report to the City Council, it is believed the plea of the advocates of municipal ownership will be entirely ignored. Mayor Harrison adheres to his original determination to have a referendum on the ordinance, whatever its provisions, before it is passed. The City company's proposition to pay the city five per cent. of its gross receipts up to $197,000,000 for the 20-year franchise and 20 per cent. on all in excess of that amount was not received with approval by the committee, and will not change the committee's attitude favoring a higher compensation.

The Treatment of Malignant Diseases by Electrical Methods.

A discussion on the subject of treatment of disease by electricity took place at a recent meeting of the British Medical Association, and was opened by Dr. H. Lewis Jones, who said that although electricity was a powerful factor in the cure of malignant disease, yet medical men should be careful to avoid anything like overstatement of the case. According to the Lancet he proceeded as follows:

"First let us examine the observed facts upon which there is now a general agreement of opinion among X-ray workers—namely (1) that in rodent ulcer a satisfactory result may be often observed; (2) that healing of an ulcerated cancerous surface has been observed in a certain portion of cases (3) that relief of pain in cancer is a fairly common experience; and (4) that superficial nodules, undoubtedly cancerous in nature, will sometimes decrease notably in size under X-ray treatment. This is the groundwork on which we hope to be able to build, but the edifice is not yet built, nor do we even know whether we shall ever advance much further. Having reached our present position we are searching, I might say groping, in the dark for a fresh clue to enable us to progress another stage. What direction shall we take? Shall we use hard tubes, soft tubes, or medium tubes? Shall we operate our tubes with the anti-cathode red-hot or cool? Shall we have the tube close to the part or remote from it? Do we desire a reaction of dermatitis or do we need to avoid it carefully? No one knows, though some of us have opinions. Only a sifting of cases and a comparison of results will in time teach us whether these points matter or not. If we have no successes to relate, let us tell of our failures and try to learn from them.

"The successful treatment of rodent ulcers by the X-rays is now sufficiently established for us to leave it on one side at present. I do not mean that there is no more to learn about this particular disease, but that the points not yet worked out are such as may be left for the present to individual investigators. I would suggest, therefore, that to-day we should limit our remarks to cases of undoubted sarcoma or carcinoma. If it were possible to do so we would choose to begin in the case of carcinoma with simple superficial epithelioma, as, for example, epithelioma of the lip in its earliest stages. If in such cases it could be satisfactorily established that a complete disappearance of the growth followed the treatment, it would be reasonable to advance to the more difficult problems of deeper growths. Unfortunately, these are just the cases which we cannot as yet obtain. Naturally, the surgeon who feels that an immediate cure can be secured by a prompt operation is reluctant to run the risk of sacrificing his patient's chances by any procedure which involves delay. His attitude is not likely to change until it can be shown that the results of treatment by the X-rays are as good as those now obtained by excision. That is the position of affairs to-day, and the only material which is available for the study of the effect of the X-rays upon malignant disease is among cases which are too extensive or too deeply seated for the surgeon to be able to touch them. Naturally, this complicates matters a good deal and adds very greatly to the difficulties of the position.

In spite of these difficulties cases have been recorded which show that the progress of epithelioma can be profoundly influenced by the application of the X-rays. Even if we pass over partial successes and consider only such as are complete we find some satisfactory evidence to support us. Macintyre of Glasgow has recorded a case of epithelioma which filled the nasal cavity; eight months later the whole neoplasm had disappeared under X-ray treatment. The diagnosis of the case was confirmed by microscopical examination. In looking through the published records of the use of the X-rays in cancer one cannot help feeling surprised to find how few of the alleged successful cases have been so recorded as to carry to those who read a reasonable conviction of success, and this, too, in spite of the fact that numbers of people are working at this subject, and scores, if not hundreds of cases have been treated. Half a dozen cases of unmistakable cure of undoubted cancer, if minutely reported, would be worth more just now than any number of vague statements about partial improvement, favorable effects and the like. The more one examines the published cases the more suspicious one becomes. In most of them there is some flaw in the evidence. Either the diagnosis is uncertain or the patient is not more than partially relieved at the time of writing or he has been so unfortunate as to die from some intercurrent disease. It is greatly to be wished that all medical men who have recorded favorable cases will periodically supply further notes of the later progress of their patients.

"In short, while there is a quantity of evidence to support the contention that the X-rays act beneficially in malignant disease the amount of evidence to show that cures have resulted is lamentably meager. What can be the explanation of this? Here is an agent which very commonly gives relief to some of the symptoms produced by a malignant growth and yet fails to give as much relief as is really required. Is it because of some defect in our technique, or is it because the cases subjected to X-ray treatment are ill-chosen, or, finally, is it from some inherent defect of the method of a fundamental kind? This is the crux of the situation. First as to technique. Have we yet to discover that some tubes only emit the right kind of X-ray? Have we to use our tubes differently, or do we fail from insufficient perseverance? The nature of the tube, the degree of penetration of the rays which it gives off, the proximity of the tube to the affected part, the production of a reaction or not, are all points on which further knowledge is wanted. Already there is a divergence of opinion as to the need for a dermatitis or not, for while some observers think that the good effect is in proportion to the amount of dermatitis, others hold a quite opposite view. Secondly as to the selection of cases. Most of us will agree that the cases hitherto submitted for X-ray treatment have been of the most unpromising character. Most, if not all of them, have been of a kind which were already too advanced to be other than practically hopeless from the first. And whereas the failure has usually been from the re-appearance of the disease in a vital organ remote from its original seat, the application of the X-rays has so far justified their employment by improvements at the place to which they were applied. Thirdly, as to inherent defects in the X-ray method. It may be that all our efforts will be in vain because of this; but until the method has been tried for simple cases at an early stage we cannot abandon our attempts.

"In my opinion, the proper course to adopt would be to start the X-ray treatment as soon as possible after the removal of the primary growth by the surgeon and not to wait until recurrences have seriously spoiled the chances of success. I would avoid all masking of the surrounding parts by impervious screens for fear lest the screens should shield some foci of disease. It is probable that the use of lead screens have contributed a good deal to the failures of the past. I would use a medium tube and would prefer to operate with a hot anti-cathode. I would avoid dermatitis by arranging the exposures suitably, and I would continue the treatment with occasional breaks 10r three, four or five months.

"In conclusion, it is necessary to speak of other proposed electrical methods—namely, the high-frequency method and the use of the static machine. Both of them have been tried and both have had some slight success to show. In both methods there is a common factor—namely, the presence of cathode rays—and it seems to me possible that these may require further examination. Curiously enough, radium has lately been tried for the relief of cancer and cases of its favorable action have been mentioned. The rays emitted by radium are of two kinds, one apparently identical with the X-rays and one with the cathode rays, and it may be that the combination of the cathode rays with the X-rays has some special advantage."

J. F. Hall-Edwards (Birmingham) continuing the discussion, said that the failures so far noted were largely due to the extremely unfavorable character of the cases submitted to the treatment. He had no doubt at all that cases of early epithelioma of the surfaces of the body could be cured by the X-rays in a satisfactory manner. As to internal cases, he had treated a case of cancer of the rectum by applications to the sacral region, and his patient was alive still after three years had elapsed, and the growth had diminished in size. He had often noticed that with the appearance of dermatitis the patient began to feel better. He would like to know whether the use of the X-rays did harm in some cases by leading to the liberation of toxins during the process of regression of the tumors under treatment. He agreed in preferring a medium tube with a hot anti-cathode. He insisted less now than he had formerly done on the necessity for producing a sharp dermatitis.

Chisholm Williams (London) had obtained good results from the use of the high-frequency machine. His method was, he believed, very important if successful results were to be obtained by that apparatus. He used an electrode of glass tube so exhausted as to emit X-rays. Its vacuum could be judged by seeing whether the wall of the tube emitted a green phosphorescence. If it did this X-rays were being produced. There were present, therefore, X-rays, cathode rays, ultra-violet light, and general electrification. The tube could be put in contact with the patient and X-ray burns were not at all likely to result. He had obtained marked relief in many cases, but had no complete cure to record as yet.

Dr. C. H. Allfrey (St. Leonard's) suggested that drugs might be employed together with the electrical treatment; possibly iodide of potassium might be useful to remove the products of the breaking down of the growths.

Dr. Horace Manders (London) had tried experiments with the high-frequency current, using vacuum electrodes of blue glass, particularly of cobalt glass. He advised the study of the pulse tracings during and after treatment, also a careful examination of the urine.

Dr. Lovell Drage (Hatfield) had found benefit in many cases of malignant disease from the use of cinnamate of sodium as a hypodermic injection; he thought that this method might give improved results if combined with the electrical treatment. The effect of cinnamate of sodium had been surprisingly good in some of his cases.

Among other matters touched on was radium and its possible therapeutic uses. It was pointed out that radium had one valuable quality which would help in proportioning the times of exposure—namely, that its radiations were uniform in strength.

The president (Dr. H. Lewis Jones), in closing the discussion, said that several valuable points had been elicited by the debate. He believed that the vacuum electrode used with a high-frequency coil might develop into a useful instrument. The diffused X-rays offered some advantages, particularly in the diminished risk of X-ray burns, and it was highly probable that the co-existence of cathode rays around such a tube might be useful. He had treated a patient after an operation for the removal of a recurrent carcinoma in the glands of the neck with the object of preventing a further recurrence. After three months of mild X-ray treatment the scar of the operation wound began to feel hard and it was again excised. A microscopical examination showed the presence of a few cancer cells, much fibrous tissue, and some extravasated blood corpuscles, and the pathologist who reported on the specimen was doubtful as to its exact character. The specimen removed at the preceding operation was of typical carcinoma, rich in cells. The X-rays seemed, therefore, to have influenced the growth and to have altered its character in a favorable direction. He thought that a more vigorous application of the rays might have been successful in preventing the reappearance. He hoped that the subject of X-ray treatment for malignant disease would again come before the sub-section of electrotherapeutics in 1904, and that further advances might by that time have been achieved.

Before the same association, Chisholm Williams opened a discussion on "The Treatment of Tuberculous Diseases by Electrical Methods," in the course of which he said that he had used high-frequency methods on 43 cases of pulmonary tuberculosis, and after two years 40 of these were living, although one was very ill with tubercle of the urinary tract. It appeared that there was an increase, followed by a decrease, of bacilli in the sputa, and for a few days there was a distinct rise of temperature. After this, however, the patients exhibited great improvement. The high-frequency treatment of lupus, by the high-vacuum glass tube, was very satisfactory.

A Method of Electrolytic Drilling.

Drilling by means of the electric arc has been used to some extent, notably in drilling armor plate. In this process the plate to be drilled is one electrode, connected to one terminal of a generator, and a carbon electrode connected to the other terminal of the generator is held against the plate. Another process is to soften the plate locally by an electric current, making the place to be drilled the resistance in the electric circuit, and then drilling out in the ordinary manner.

Sherard Cowper-Coles has undertaken some experiments, described in the Electrochemist and Metallurgist of London, with the object of ascertaining whether it is possible to drill and slot holes electrolytically at a sufficiently rapid rate to be of commercial value. Such a process would have many advantages, as holes of any shape could be drilled in hardened armor plates and could be pierced without drawing the temper.

In the first experiments the electrolyte was projected on to the iron to be drilled, a current of electricity being caused to flow from the metal to be drilled through the jet of liquid, and thus back to the generator. This method was found to be fairly satisfactory, but the holes were not sufficiently true. A different nozzle was then constructed, the electrolyte being rapidly circulated through the nozzle, and round a baffle plate placed down the center, so as to get rapid circulation. A pointed rod, fitted in a gland, was so arranged as to be near the end of the baffle plate. In this apparatus the rod forms the negative electrode, on which the iron is deposited as a powder, due to the high current density, and is washed away by the rapidly circulating electrolyte. The end of the nozzle is fitted with a removable rubber washer, the shape and size of the hole to be drilled are determined by the shape and size of the rubber washer. Some of the best results when drilling iron have been obtained with a solution of sulphuric acid. Good results have also been obtained with ordinary salt water.

As in the case of the arc drilling device, the plate is made one electrode and the pointed rod the other. The parts can be so arranged as to work from both sides of the plate to be drilled, the plate being made one electrode and current flowing from it to the two nozzles. The electrodes may also be mounted concentrically in a revolving head similar to that of a lathe. This gives to the electrode points a circular motion which is adaptable to cutting out large holes, as, for instance, manholes in boiler plates. Of course, for drilling a small hole the electrodes are forced straight through without circular motion.

Merchants and mining men of Okanogan County and in the town of Chelan, Wash., are organizing a transportation company to operate boats on the Columbia River from Wenatchee to the mouth of the Okanogan River and then up to McLaughlin Canyon, a distance of 100 miles. At the canyon a short electric railway will transport the freight to up-river boats, which will run to Fairview, B. C. In addition to this, a 20-mile electric railway is to be constructed from the river to the town of Nighthawk. The railway will be used to transport ore from the mines to the boats. J. M. Hagerty of Nighthawk and Captain Depew of Chelan are interested in the new enterprise.

CORRESPONDENCE.

Great Britain.

London, January 9.—The official report of the fire which occurred at the Bristol electricity works, gives no particulars as to the cause of the outbreak. The makers of the switchboard at which the fault occurred have made every investigation with a view to discovering what defect in the design led to the disaster. The system upon which the failure occurred was single-phase, alternating current at 2,000 volts, and the fire resulted in the total destruction of the high-tension switchboard and great damage to the buildings and machinery. There was a load of about 3,000 kilowatts on at the time, which was taken up by two 400-kilowatt machines in one power station, and four 750-kilowatt machines in the other, both power houses being connected up through one switchboard. The general assumption as to the cause of the fire is that one or both of the machine fuses blew, apparently followed by a severe arc in the fire panel, which burned through the slate above it and melted the fuse contacts and metallic connections between the fuses and the switches. The makers say that the cellular switch gear, although apparently at fault, was of an obsolete type, yet the arc caused by the failure was confined to the switch and fuse panels of three or four machines. As a matter of fact, the damage was not so serious as was at first imagined and reported.

Great attention is now paid to turbo-generators in Great Britain, and they have been installed on a moderate scale in many electricity generating stations. Mention has already been made of their employment on a large scale in connection with two of the power companies, and the Glasgow corporation is now seeking tenders for two 3,000-kilowatt, 6,500-volt, three-phase turbo-alternators.

The gas journals have made a little capital out of the fact that during the year one or two towns in Great Britain have discarded electric for gas lighting on the streets. It is true that such has been the case in two instances where the amount of public lighting, electrically, has not been excessive. In some localities the comparison between gas and electric lighting for street purposes is apt to be regarded more from the point of view of cost than the increased illumination given by the latter. As a matter of fact, since the introduction of electric lighting into the larger towns, the amount of public lighting has increased by leaps and bounds.

The competition of electric tramways continues to have a most serious effect upon the suburban traffic of the steam-railway companies. This has once more to be reported by reason of the fact that in one district served by the Great Northern Railway Company it has been decided to close one station, owing to the decreased traffic due to the increased patronage of the electric tramways. The district in question is served by the Leeds municipal lines. It will be remembered, too, that a short time ago the local railway serving Glasgow restricted its service for the same reason and now is seeking powers to work its lines by electric traction.

The constitution of Mr. Joseph Chamberlain's commission, which will inquire into the possibilities of general advantage should England revert to a protective-tariff policy, has almost been completed. The chairman of the commission has been selected and is Sir Robert Herbert, G. C. B., chairman of the Telegraph Construction and Maintenance Company, and a director of the Eastern and South African Telegraph Company. Several members are interested in the various branches of engineering.

A large extension of the London County Council's conduit system of tramways in the south of London will shortly be put into operation. In the north slower progress is being made. In fact, within the county of London itself no roadwork has yet been started. The great difficulty has been in securing the acquiescence of the borough councils to the conduit system, but one by one they are gradually agreeing. In the mean time, the lines running from the county boundary are being converted to the overhead system by the company which leases them.

Following an amalgamation of the German houses, the business of the British Schuckert Electric Company has now been amalgamated with Siemens Bros. & Co.

A considerable increase in the use of Nernst lamps for public lighting is taking place. The engineer to the Maidstone corporation has made numerous tests upon the one-ampere, half-ampere and quarter-ampere sizes in comparison with gas lamps, and these have been greatly in favor of the former. The makers, too, have effected several improvements in the details, and now give a substantial guarantee.

G.

New York.

New York, January 16.—The uses to which electricity will be put in the New York Times Building when completed will combine a greater number and greater variety than any other structure in this city. The January 10th issue of the Times describes at some length the electrical equipment of the building, from which it is seen that electricity will operate over 100 different appliances. It will run the presses, light the building and furnish various conveniences in the interest of tenants. Steam will be almost an unknown quantity, as it will be used only for heating purposes, and then only at a pressure of five pounds. The electrical supply will be furnished by the New York Edison Company and will furnish power for 109 motors, rated at 900 horsepower, light for 4,000 incandescent lamps, 15 arc lights, one searchlight, signs, bulletins, Cooper Hewitt lamps, and for many novelties, aggregating the use of current amounting to more than 400,000 kilowatt-hours per annum. There will be independent connections with three supply stations of the Edison company.

The committee having in charge the arrangements for the annual dinner of the American Institute of Electrical Engineers on February 11th has arranged for the features of the event. The dinner will be held in the ballroom of the Waldorf-Astoria at 7 o'clock p. m. Thomas A. Edison, in commemoration of whose birthday the dinner will be given, will be the guest of honor. The following appointments on preliminary arrangement have been made: Committee on menu, T. C. Martin; committee on tickets and admission, C. F. Bates, Calvert Townley; committee on decorations, Arthur Williams; committee on invitations, Charles W. Price (chairman), E. H. Mullen, Bancroft Gherardi, Jr., and William J. Hammer.

A bill to create a railroad commission for this city will be reported to a conference of organizations of Greater New York to-day in the Board of Trade and Transportation. The bill is the work of a committee appointed in October last and the call for the meeting is signed by William H. Gibson as chairman and Frank S. Gardner as secretary.

At a meeting of the Board of Rapid Transit Commissioners on Friday, Controller Grout, who is ex-officio member of the commission, commented favorably on the bill introduced to the Legislature allowing the city to issue bonds to the extent of $50,000,000 to be used for new subway tunnels on both the East and West Sides. The controller said he believed the city should be permitted to go ahead with this work and that the new tunnels should be so arranged in the plans that an entirely independent company might come in, and, if their bids should be the lowest, be able to build and operate them without any reference to the subway system now in the course of construction. Requisitions for $750,000 for work on the various branches of the subway system during December were approved by the commission.

It is thought probable that the Pennsylvania Railroad Company will reject the bids submitted on December 15th last by various contractors for the construction of the tunnels under East and North Rivers in connection with its great terminal and advertise for new bids. Such action was foreshadowed a few days after the bids had been opened, and now that sufficient time has elapsed to examine these bids it has developed that as a rule they are not satisfactory to President Cassatt or to the engineering commission which supervised the preparations of the plans and specifications and which will supervise the work of construction. It has been learned that some of the bids submitted were considerably higher than the estimate of the commission. Others were not in accordance with the specifications, the bids in some instances being based upon specifications or ideas of the bidders.

Electricity instead of steam power was used Monday for the first time on the Ridgewood branch of the Brooklyn elevated road, an electric train of five cars being substituted for the old four-car steam train. The Brooklyn Rapid Transit Company expects to abandon the locomotive service entirely on April 1st.

O.

New England.

Boston, January 16.—The thirty-fifth annual report of the Massachusetts railroad commissioners gives some interesting statistics regarding the capital invested in street railways of this state, from which it appears that the investment, capital stock and net debt included, increased during the last year by nearly $9,600,000, rising from $113,071,113 to $122,666,365. The total income of all the street-railway companies for the year ended September 30, 1903, to which time the report is made up, was $27,027,651, against expenditures aggregating $27,010,982, leaving a net balance of $16,669 to be added to the surplus account. The accident record furnishes food for considerable reflection. The whole number of injuries reported was 3,974; and while most of these were trivial, of course, there were 84 on the fatal list.

The Massachusetts Electric Companies will soon have in operation a complete new high-tension system for supplying power to the lines included in the properties of the combination, three new steam turbine alternating-current stations being planned to supersede upward of a dozen engine-driven direct-current stations scattered over the territory covered by the lines. South of Boston the big stations will be at Fall River and Quincy Point, with substations so placed that each will serve an area of five miles in each direction. The Fall River station will be of 12,000 horsepower, the Quincy station of 15,000 horsepower. North of Boston five of the present stations will be superseded by a big 9,000-horsepower station at Danvers.

When the Western Massachusetts Street Railway Company builds its proposed line from Lee to Westfield, in Massachusetts, connecting at the latter place with the Woronoco Street railway, and the line from Stockbridge to State Line, now being surveyed, is also constructed, there will be a chain of electric roads closely paralleling the Boston and Albany steam railroad between the two cities which give the latter its name. The mileage is as follows: Boston to Worcester, 44; Worcester to Spencer, 18; Spencer to Westfield, 48; Westfield to Stockbridge, 28; Stockbridge to State Line, 14, total in Massachusetts, 152 miles; State Line to Chatham, 15; Chatham to Claverack, 10; Claverack to Mellenville, 14; Mellenville to Hudson, 16; Hudson to Albany, 28; total in New York, 83 miles.

Considerable stir has been created in Pittsfield, Mass., by the action of the new city government, inaugurated at the beginning of the present year. At the last meeting of 1903 the majority granted four important franchises to the Pittsfield Street Railway Company, the minority protesting thereat. At the first meeting of 1904, held this week, these franchises were summarily revoked as a result of a change in the political complexion of the Board of Aldermen. An appeal to the board of railroad commissioners is said to be contemplated.

The town of Cohasset, which has many wealthy summer residents, who are opposed to the invasion of the trolley cars, is confronted with a merry war over the question of granting a franchise for a street railway within the town limits. Irving M. Garfield, son of the late President James A. Garfield, has been retained as opposing counsel by one faction, and other eminent attorneys are also engaged in behalf of the remonstrants. The petitioners desire a location for the Norwell and Scituate Street Railway Company's proposed line.

The Metropolitan Park Commission, which has supervision over the parks of Boston and the suburban districts adjacent to the larger city, has ordered an electric motor from the General Electric Company for the operating of the Wellington drawbridge, on the park roadway between Somerville and Medford, over the Mystic River. This is the first instance in New England of the use of an induction motor for the operating of a drawbridge, it is stated, and the fact will be noted by engineers having the planning of similar structures in future.

A suit of the Thomson-Houston company against the Ohio Brass Company, the Pettingell-Andrews Company and C. B. Price, president of the latter, for injunctions to restrain the defendants from alleged violations of patents 393,278 and 396,313, issued to Charles J. Van Depoele for a crossing or crossover for use with an overhead wire in underrunning-trolley systems of electric railways, was heard by Judge Hale in the United States Circuit Court last Monday. The decision was reserved.

The Edison Electric Illuminating Company, which has been gradually buying up a number of electric-light plants in the municipalities around Boston, has just acquired the Somerville Electric Light Company, the consideration named being $577,000.

B.

Dominion of Canada.

Ottawa, Ont., January 16.—According to a recent cable from London, it is understood, upon reliable authority, that a company of prominent English capitalists is sending experts to Canada to prospect the country's waterpowers, with the object of utilizing them for electrical purposes.

G. A. Overstrom, a prominent Swedish mining engineer and the inventor of the Overstrom concentrating table, has been in Renfrew County, Ont., supervising the erection of the large new mill of the Canada Corundum Company. He states that this mill, which will be in operation in about two weeks, is larger than any ore-concentrating mill in Canada. Its daily output of grain corundum will be worth between $2,000 and $3,000.

An influential deputation, representing the large electrical interests at Niagara Falls, has interviewed the Ontario government with a view of obtaining permission to export electrical energy from Canada to the United States. The International Railway Company, which includes the Gorge line to Buffalo and the Niagara Falls Park and River line, has not sufficient power, and its representatives desire that the Canadian power companies shall have the right to export power. It was, however, thought doubtful whether the government, under the constitution, could allow the exportation of power, and the matter has been taken under advisement.

An electric railway between Frederickton and Woodstock, in the province of New Brunswick, is projected by Messrs. Shaw of Pokiok and Gilman & Burden, mill owners. American capitalists will also be interested in the enterprise. The new line will be used for carrying freight and passengers.

The Ontario government has obtained information from provincial cities, towns and villages regarding municipal undertakings covering a period from 1898 to 1902. The electrical statistics compiled from the returns sent in show that electric lighting was a losing business in cities, but successful in towns and villages. The following figures, in regard to electric undertakings, are for the average of the years 1898 to 1902: There were three cities, 23 towns and eight villages owning and operating electric-light plants in the province. The capital provided for electric lighting by cities amounted to $81,573, by towns $537,355 and by villages $121,565. The average annual income from electric-lighting plants in cities was $7,613, with working expenses at $18,418; the average income for towns was $134,803 and working expenses $107,581, and in villages the average income was $11,247 and working expenses $7,893.

W.

Indiana.

Indianapolis, January 18.—The Indianapolis, Danville and Rockville Traction Company has increased its capital stock from $100,000 to $700,000. The increase of $600,000 is in consideration of the construction and equipment of the company's new road from Indianapolis to Danville. A large increase in the capital stock of the Ft. Wayne and Southwestern Traction Company was also recorded by the secretary of state. The capital stock of $1,875,000 was increased to $2,000,000.

The Winona, Warsaw and Goshen Electric Railway Company filed articles of incorporation on the 6th instant. The company intends to build an electric line from Winona through Milford Junction and Milford, in Kosciusko County, and Nappanee, in Elkhart County, terminating in Goshen. The company is capitalized at $10,000. The incorporators are James B. Hanna, F. C. McMillen, Samuel G. Morris and L. A. Collins. The headquarters of the company will be in Goshen.

The Sandusky Portland Cement Company will build an electric railway from Syracuse to New Paris, a distance of six miles, to connect with the Big Four and Wabash railways for freight traffic only. The line will be on a private right-of-way and the contract for the steel has already been made.

A suit of long standing relating to the title of the old Wabash and Erie Canal bed in Tippecanoe County was compromised at Lafayette on the 5th instant. The suit was brought by E. W. Shirk, trustee, against the abutting property owners. By the compromise it is agreed that each defendant or property owner is owner in fee simple of the real estate (canal bed), and by like agreement the defendants grant to the plaintiff the right-of-way for a traction railroad along the old canal towpath, provided the traction line is built inside of 10 years. This step, it is said, insures the building of a traction line next year connecting Lafayette, Delphi and Logansport, and will form an important link in the chain of interurban lines reaching from Lafayette to Lima, Ohio.

The men interested in the proposed Columbus, Hope and Shelbyville interurban road have arranged for a preliminary survey of the route. Although this is unusual prior to effecting an organization, the men say the company will be organized in a short time.

The Indianapolis Board of Health has made a demand upon the local traction company and the interurban companies to fumigate and clean their cars regularly and that greater sanitary precautions be taken at this time of year.

A trust deed has been filed with the recorder of Miami County at Peru by the Wabash-Rochester Electric Railway Company in favor of the Cincinnati Trust Company for $900,000. The building of the road is now assured. Charles Caine is president and S. E. Pratt secretary.

The Indiana Central Traction Company, which is projecting two lines in Indiana, has opened offices in Auburn.

The poor service of the electric company operating street cars and providing light, power and steam heat at Terre Haute has brought out a statement from Manager Wells to the effect that the plant is unequal to the demands and that a new plant is needed. He says he has assurances from the owners that steps toward the erection and installation of an adequate plant will be taken in the spring.

The Indiana Supreme Court has decided that a street-railway company operating within a city under a franchise providing for the issuing of transfers to passengers on lines within the city limits is bound to issue transfers to passengers and carry them within the limits of the city as they might afterward be established.

The City Council of Columbus has let the contract for a new electric-lighting plant for the city to the General Electric Company of Schenectady, N. Y., for $7,833. An engine to run the plant will be bought on the open market, bids on engines not being satisfactory.

Henry Warum, city attorney for Indianapolis, has sent an opinion to the Board of Public Works holding that interurban cars are common carriers, and are therefore compelled to carry freight; that the interurbans entering Indianapolis must build freight depots in a reasonable time after accepting a franchise, and that the city's right is limited to demanding that the companies haul freight for a reasonable compensation; such reasonable time and reasonable compensation may be determined by a court of law.

J. N. Crabb of Indianapolis has invented a continuous non-breakable rail, and a company has been organized for its manufacture. J. F. Messick is president and W. A. Zumpfe secretary, with offices in the Stevenson Building. It is the intention of the company to erect a large mill for the manufacture of the rail. The company has incorporated with a capital stock of $2,000,000. Mr. Crabb says the continuous feature will absolutely do away with the hammering of the drivers and trucks so noticeable when wheels strike the joints of an ordinary rail. It will also prevent accidents due to broken rails.

The Vincennes Citizens' Street Railway Company has increased its capital stock from $15,000 to $100,000, in order to make extensions and improvements in the equipment, made necessary by increased patronage.

The Columbus, Greensburg and Richmond Traction Company has decided to increase its capital stock from $1,000,000 to $2,500,000. The general manager, C. N. Wilson, announces that franchises and rights-of-way have all been secured and as soon as the survey is completed and the weather suitable work will be begun.

The Union Traction Company is arranging to abandon its offices in this city and the headquarters for all the departments will be in Anderson.

The stockholders of the Indianapolis, Danville and Rockville Traction Company have elected directors for the year. Work of constructing the line between Indianapolis and Danville is progressing rapidly, being concentrated at the cuts and fills, where freezing interferes very little.

Another step has been taken in the development of interurban through traffic between Indiana and Ohio by placing on sale through tickets between Dayton, Ohio, and Indianapolis. A mileage book will also be on sale in a few days.

The directors of the Wabash and Rochester Railway Company, building a line between the two cities named, have elected Charles Crane president, P. E. Wilcox vice-president, E. S. Pratt secretary, and C. E. Barnum treasurer.

The Indianapolis Board of Public Works has ordered the two interurban roads now entering the city which do not carry freight to begin doing so at once. The company managers say they are quite willing and anxious to haul freight, but complain of insufficient terminal facilities. This answer occasioned the board to order the Indianapolis Terminal Company to provide freight stations and depots at once. This demand is in accordance with the franchises granted to the companies interested.

There are indications that there will be a number of bidders for the new 10-year electric-lighting contract for this city. The specifications are now ready and in great demand. The Indianapolis Light and Power Company, which now has the contract, paid the city $22,490 last year, being five per cent. of the company's gross receipts for power and current during 1903.

Mayor E. T. Runyon of Charlestown, Ind., has awarded the contract for building an electric-light plant in that city to C. R. Hay & Co. and also a 10-year contract to light the city.

The Town Council of Ft. Branch, Gibson County, has granted a franchise to Polk & Genung for an electric-lighting plant in the town.

The Indiana Correspondence College of Indianapolis has filed articles of incorporation. The work of educating students in the various branches of technical knowledge will be conducted by mail. George F. Bass is secretary.

The Williams Air Compressor Company of Indianapolis has incorporated to manufacture and sell automatic air compressors, engines, automobiles, motors, automatic air brakes and other machinery of like character. The capital stock is $40,000. John W. Williams, A. G. Schonaker and J. M. Pietzuch are the officials.

The Indiana Appellate Court has rendered several important decisions affirming judgments against the interurban companies. In the case of Landercook vs. the Union Traction Company, the court held that a street or interurban car has no superior right over a traveler in a buggy at a street crossing in a city. In the case of Eads vs. the Hammond, Whiting and East Chicago Electric Railway Company, the court held that a motorman who sees that a horse is running away with a wagon, and the driver is helpless and that a collision between the wagon and his car will probably result unless he stops the car, is negligent if he fails to stop. F.

Ohio.

Cleveland, January 16.—Cars operated for the use of girl students of two select schools in this city have been discontinued. People did not take kindly to the innovation, and said that the girls were no better than other people and could ride in the same cars.

The following-named officers have been chosen by the Cincinnati and Hamilton Traction Company: President, H. H. Hoffman; vice-president, Bayard L. Kilgour; secretary and treasurer, Albert J. Becht. The latter replaces Henry Burkhold and his place is taken in the board of directors by Briggs S. Cunningham.

James A. Bope of Findlay, S. C. Schenck and George E. Pomeroy of Toledo, Charles D. Kinney, John Kilgour, Charles H. Kilgour and George P. Kerper of Cincinnati have been chosen directors of the Toledo, Bowling Green and Southern Traction Company. Messrs. Kerper and Bope being the only ones in the old board. Because of the absence of Mr. Kerper from the meeting, officers were not chosen, but Mr. Kerner will doubtless be re-elected to the presidency. Henry Burkhold resigned as treasurer of the company, giving as a reason, ill health. A. J. Becht will likely be chosen to succeed him. The statement shows net earnings for the year of $38,482.47, with a surplus of $51,465.84. It is stated that arrangements have been made now so that the line will secure an entrance to Toledo. The present northern terminus is at Perrysburg. Owing to this fact, it is probable that southern extensions will also be made at once.

The Traction Building Company of Cincinnati has been incorporated with a capital stock of $1,000,000 by Dana Stevens, J. B. Foraker, Jr., George H. Warrington, S. C. Cooper and W. H. McAllister. All these gentlemen are connected with the Cincinnati Traction Company, and it is said to be their purpose to take over the new traction building in Cincinnati. It is probable, however, that no further building operations will be planned at present.

The Toledo and Fort Wayne Electric Railroad Company of Toledo has been incorporated by James M. Brown, Elmer E. Davis, Holland C. Webster, John F. Kumler, Jr., and Walter F. Brown. The capital stock is $100,000.

The directors of the Dayton and Kenton Electric Railway Company have decided to adopt the third-rail system. The feed rail will not be exposed, but an underrunning system will be used that will prevent danger. Safety stops will make collisions almost impossible. The Farnham Construction Company has been awarded the contract for building the line, which will be one of the longest in the state when completed. Carlisle, Springfield, Bellefontaine and a number of other large towns will be connected with Dayton and Kenton by the line.

The Fort Wayne, Van Wert and Lima Traction Company has filed a first-lien mortgage on its property to secure bonds for $2,000,000, and it is said that their sale has already been arranged. The Lima Trust Company, Lima, Ohio, has been designated as trustee. The line has been graded, bridges built and right-of-way secured. It will parallel the Pennsylvania road and is under the control of the McCulloch interest. O. M. C.

Michigan.

Detroit, January 15.—A new company is being organized in Detroit for the purpose of building and constructing steam and electric railways by George E. Fisher, former president of the Chase Construction Company, and B. M. Hopkins of Boston, a prominent engineer, formerly with the Boston Industrial Company. Mr. Hopkins will act as chief engineer and general superintendent. Ed. N. Chase will also be in the new company, and will superintend overhead and electrical construction. The name of the new company has not been fully determined. The main office will be in Detroit, and the authorized capital fixed at $50,000 or $100,000.

It has been given out that the South Bend and Southern Michigan Railway Company has decided to extend its South Bend-Niles interurban line to Buchanan, and that the rails and ties have arrived at South Bend. The company recently purchased the abandoned roadbed of the Michigan Central between Niles and Buchanan and work on the proposed spur will be commenced at once.

The West Michigan Interurban Company, the new electric line, has applied for a franchise through the village of Shelby. The officials have completed arrangements for crossings in the township and the Village Council will consider the application for a franchise inside the limits. This is the line which is organized to build from Muskegon to Hart through the peach district.

A new ordinance which has been prepared by a special council street-railway committee for the consideration of Detroit aldermen is now ready for submittal, but fear is being expressed in some quarters that it will fail of passage when put to the council. The ordinance, as drafted, would require the addition of a number of cars on several of the lines and this will meet with great opposition from the Detroit United Railway. It has been decided to present the ordinance and make the aldermen go on record. Before this is done the street-railway company will be consulted and its objections heard.

Superintendent Fitzhugh of the Bay City electric-light plant is figuring out how the city can go into commercial lighting. The present plant would be inadequate, and a new power house near the waterworks station on the river front is contemplated, at a cost of $100,000.

The Michigan Engineers' Association has been in session at Lansing this week. A meeting of the board of directors will be held next July to canvass the votes for officers and determine the next meeting plan. Among the papers read at the meeting were, "A Choice of a Water Supply," by W. W. Brigden; "All-electric-driven Pumping Plant," by J. DeYoung; "Bithulithic Pavement," by W. A. Hoyt. Reports were received on "The Relation of Sewerage and Water Supply to the Public Health," by George S. Pierson, and on "Roads and Paving," by F. F. Rogers. An address of welcome was delivered by Charles S. Smith of the Manufacturers' Association. C. G. W.

Southeastern States.

Charlotte, N. C., January 16.—It is reported that the Westinghouse Electric and Manufacturing Company is preparing plans for the proposed interurban electric line from Anderson, S. C., to Greenville. Dr. George E. Coughlin and other Indianapolis capitalists are said to be interested in the project.

The Town Council of Williamsburg, Va., has decided not to renew its contract with the Welsbach Street Lighting Company, but to purchase its own lights.

The following-named officers were elected at the annual meeting of the Virginia Passenger and Power Company at Richmond, Va.: Guy Phillips of New York, William Northrop, M. M. Martin, James B. Patton and F. Sitterding of Richmond, and Augustus Wright and Carter R. Bishop of Letersburg.

Since the talk of an electric line between High Point and Winston, N. C., there is now further talk of an automobile line between the same places.

The commercial bodies of Chattanooga, Tenn., it

is said, are collecting funds for securing a superintendent and replacing, on the electric cars the former mail service, boxes on the cars being used. L.

Kentucky.

Louisville, January 16.—According to a supplementary opinion rendered by Judge Miller of the Circuit Court, issued last Saturday, the judgment recently found against the Louisville Railway Company for $258,297.78, back franchise taxes, was reduced about $125,000. That amount of license tax was paid by the company, and Judge Miller holds that it should be credited on the claim originally made and judgment rendered for the remainder. The matter came up when the city attorney prepared the judgment for entry. This suit has been in the courts for years and appealed three times. City-attorney Stone says it will be appealed again.

Luther H. Leiber has put the electric-light plant at Jackson into operation again. On account of claims filed against the plant and the absence of Leiber, the superintendent of the plant closed the plant on January 1st. He states that all claims will be straightened up and the plant kept in operation hereafter.

Harry Weissinger and Henry W. Weissinger, formerly tobacco manufacturers in Louisville, are arranging to convert their building into a power building, and will fit it out with a large electric plant. This is the first regular power building to be equipped in the city.

Street-car conductors at Louisville have been victims of the counterfeiter's art the last few weeks. A large number of bad dollars and half dollars have been worked off on them. C.

Northwestern States.

Minneapolis, Minn., January 16.—The farmers south of Iowa City, Iowa, are talking of forming a company to build a rural electric line.

Swift & Co. have bought control of a $2,000,000 bridge across the Missouri River at Sioux City, Iowa, over which to run the electric line they are now building between that city and Omaha, Neb.

The Necedah (Wis.) Milling and Electric Company has been placed in the hands of A. W. Carlson of Necedah as receiver.

Caledonia, Minn., will extend the electric-light system of the town.

The electric-light service at Birnamwood, Wis., which was discontinued some time ago to allow moving into the new plant, has been resumed.

The Duluth-Superior Traction Company has announced that it will install its large new cars by the first of next month on its Duluth lines.

Judge Dibell has refused to grant a new trial in the case of Mrs. Sadie Wadleigh vs. the Duluth Street Railway Company and the Duluth-Superior Traction Company in which the plaintiff was awarded $5,500 damages for personal injuries.

A franchise will be asked for a third interurban line between St. Paul and Minneapolis to be built by way of the Franklin Avenue route. The names of the promoters have not yet been divulged.

F. W. Cappelen has submitted his estimate for a city lighting plant to the Minneapolis General Electric Company. The estimate, which includes the cost of installing the entire system, and provides for 1,000 lights, amounts to $372,203.

An interurban electric line is proposed from Oconomowoc, Wis., through Neosho and Mayville to Fond du Lac.

G. F. Wilson is promoting a new electric line from Cedar Falls, Iowa, to Des Moines by way of Dike and Fredsville.

A committee headed by W. K. Coffin has been appointed to investigate the question of a municipal lighting plant for Eau Claire, Wis.

Local men at Virginia, Minn., will petition the council for a franchise for another electric-lighting plant at that place.

The Montevideo (Minn.) Electric Light and Power Company has secured the power privileges at Minnesota Falls and will build a dam to furnish power for the electric-light plant at Montevideo.

The Gary (Minn.) Electric Light Company has been granted a 20-year franchise.

The Eastern Wisconsin Electric Railroad Company has accepted the franchise granted by Oshkosh. The company will pay the city $1,000 a year.

The city of Beaman, Iowa, has voted to grant a franchise to the Marshalltown Electric Street and Interurban Company.

C. A. Duncan has been elected president and F. A. Cokefair secretary of the Great Northern Power Company at Duluth, Minn.

The Cirkel Manufacturing Company of Boyd, Wis., will install another dynamo and furnish the village with electric lights.

Otto Somoke has been appointed manager for the Western Union Telegraph Company at Owatonna, Minn., to succeed J. A. Soper.

It is proposed to borrow $10,000 from the state to establish an electric-light and water plant at Shell Lake, Wis. R.

Pacific Slope.

San Francisco, January 14.—E. W. Winship, who is interested in electrical development at Napa, Cal., was in San Francisco last week.

J. M. Gardiner, president of the Santa Cruz and Capitola Railroad Company, with offices at Santa Cruz, was in town last week on business.

The Century Electric Company, 18 Second Street, has rented the space on the floor above its office and salesroom. New offices are being built and many new conveniences put in. This company does considerable government work and has just finished the installation of a complete lighting plant on the launch built for the use of the army officers at Alcatraz Island, including the dynamo, incandescent lighting and a powerful searchlight.

The John R. Cole Company has removed to 658-660 Mission Street, where it will have larger quarters and better facilities.

The wiring of the new Tivoli Opera House, under the personal supervision of Stanley Morris, reflects great credit for the neat manner in which the work has been installed. The house has over 2,800 electric lights, which are controlled from a handsome marble switchboard on the stage. The wires are laid in iron conduits and the dimmers and other stage accessories are of the latest design.

L. P. St. Clair, an electrical engineer of Bakersfield, was in San Francisco last week.

The Temescal Water Company of Riverside, Cal., is preparing to install a better method of pumping water from its wells. The new plan provides for the use of power which will be transmitted from a power plant to be erected at Ethanae.

Chief Engineer F. C. Finckle, of the Edison Electric Company at Los Angeles, reports the company is working about 300 men at its plant in Kern Canyon and is now driving from 2,000 to 2,500 feet a month. It is believed that the plant will be ready for business within another year. The company has now a temporary plant located at Frenchtown, two and a half miles beyond camp No. 1, which is used for carrying on the construction work on the larger plant. It is of 600 horsepower and is operated by waterpower from a fall of 50 feet. Six large air compressors are operated by this plant, each with seven drills, which are in constant use driving the tunnels, of which there will be 8½ miles. All will be cemented throughout when completed. Electricity is being furnished from this temporary plant to light all the camps and buildings now in use. The building of the line will commence at the southern end and will run by way of Tejon Pass. The company's camp No. 1 is about 16 miles from Bakersfield and the temporary plant now in use about 2½ miles further on. There are five camps of workmen at present.

The syndicate of San Francisco capitalists which bought the La Grange ditch at Modesto a year or so ago has contracted with R. D. Crowder of Modesto, Cal., to direct the work of reconstructing the flumes of the ditch. It is understood that the syndicate will install an electric-light and power plant to be used in operating dredges, which will be built in the spring.

Judge H. W. Magee, attorney for the Campbell-Johnston Railway Company of Pasadena, is authority for the statement that the company will commence construction work at once on the building of an electric railway to run from Garvanza to Pasadena.

Engineers are busy at Napa, Cal., surveying in the vicinity of Soscol for the purpose of determining the amount of fills and cuts for the Napa Electric Company in the construction of its road. The graders will continue the work on the marsh lands near Vallejo while the present good weather prevails and later will commence on the line between Soscol and Napa. A.

PERSONAL.

W. T. Jackson of Cincinnati, western representative of G. M. Gest, the conduit contractor, was among last week's visitors to Chicago.

Max Loewenthal, secretary and electrical engineer of the Prometheus Electric Company of New York, is making a trip through the principal cities of the eastern and middle western states in the interests of his company for the establishment of agencies.

Charles F. Elmes, president of the Charles F. Elmes Engineering Works, Chicago, died of paralysis at the Hotel Metropole, where he made his home, on January 10th. Mr. Elmes was a prominent mechanical engineer and was at one time extensively engaged in the manufacture of steam engines.

Christopher Hotz, a prominent civil engineer of Chicago, died at his residence on January 13th. Mr. Hotz was born in Wertheim, Baden, Germany, receiving his education in Carlsruhe. He came to Chicago in 1866 and soon opened an office as a civil engineer. He was connected with many financial, educational and social institutions.

E. L. Wayman, of the sales department of the California Electrical Works, will represent the Pacific Coast dealers at the National Supply Association convention at Cincinnati, Ohio, on January 28th. While in the East Mr. Wayman will visit large supply houses as well as the other offices of the Western Electric Company, which company his firm represents in San Francisco.

Ernest H. Davis of Williamsport, Pa., secretary of the National Electric Light Association, visited New York last week to look after association affairs. Mr. Davis reports that the association is in a very flourishing condition. The programme for the twenty-seventh convention is being rapidly formulated and will contain many novel features. The "Question Box," in the able hands of Mr. H. T. Hartman, is already pretty well filled up with queries, but there is room for as many more as members wish to ask, and it is hoped that they will avail themselves freely of this means of gaining useful information.

Ludger Trudeau, who has been acting as manager of the street-railway company of Alexandria, Egypt, has returned to Montreal, to assume his former position with the Montreal Street Railway Company. Three years ago Mr. Trudeau became manager of the street railway in Bordeaux, France, and while in that employment he received his appointment to the Egyptian concern.

Solomon H. Mudge has been promoted to the superintendency of the St. Louis office of the Postal Telegraph-cable Company, succeeding Guy E. Paine, who has gone to Atlanta, Ga., to accept the general superintendency of the southern division. Mr. Mudge is 32 years of age and has an excellent record in telegraph service. Since his initial work at Edwardsville, Ill., he has held office for the company as manager at Bloomington, Ill., Lincoln, Neb., and St. Louis.

Professor Curie, whose discoveries in relation to radium have brought him such widespread fame, has been honored by the presentation of one of the largest and best-equipped laboratories of the Pasteur Institute in Paris, which has been placed at the disposal of the great scientist and his wife. A bill has also been introduced in the Chamber of Deputies by Gerault Richard for the opening of a special credit of $30,000 to permit Professor Curie to continue his researches.

Referring to the Hon. W. W. Skiles, whose death was mentioned in the Western Electrician of last week, Mr. J. C. Fish, secretary of the Shelby Electric Company, writes: "Mr. Skiles was one of the original promoters of the Shelby Electric Company and was its president from the time of its inception until his death. * * * The Shelby Electric Company has lost in Mr. Skiles a splendid adviser and one who, although not actively engaged in the electrical line, had many friends among the manufacturers and large consumers of lamps." Mr. Skiles was also interested in the People's Telephone Company of Shelby, Ohio.

ELECTRIC LIGHTING.

About $15,000 is to be expended in improving the electric-lighting system in Negaunee, Mich.

Mr. E. Springer of Des Moines, Iowa, is reported as contemplating the erection of an electric-light and gas plant at Creston, Iowa.

The Dewitt Electric Light and Power Company will purchase a new and larger dynamo for its plant at Clinton, Iowa. A new engine is also being talked of.

The Gallup Electric Light Company, organized at Gallup, N. M., by M. Gunsel, H. F. Reynolds and K. K. Scott, has been incorporated with a capital of $50,000.

The city of Shawnee, Okla., has sold $125,000 worth of bonds, and the contract for the construction of a waterworks and electric-light plant has been let to the American Light and Water Company of Oklahoma City for $121,284.

R. L. McCreight of Mineral Wells, Texas, has secured a franchise to maintain an electric-light plant in Wichita Falls, Texas, and will erect a 50-ton ice plant in connection. He also contemplates purchasing the waterworks plant, which belongs to a private corporation.

T. B. Whitted of Denver has been granted a franchise by the city of Salina, Kan., to operate a gas and electric-light plant and a street railway. Work must begin on the electric and gas plant within 90 days and four miles of the street railway must be in operation by January 1, 1906.

The stockholders of the Merchants' Electric Light Company of York, Pa., have held their annual meeting and elected directors. The board then organized by electing C. H. Bear, president; George Campbell, vice-president; Thomas B. Laucks, secretary, and Harry Wasbers, treasurer.

A company to be known as the Alabama Electric Light and Power Company, has been incorporated at Opelika, Ala., to furnish light and power to Opelika and other Alabama towns. H. S. Persons of Montgomery, Ala., heads the list of incorporators. The authorized capital of the company is $50,000.

The North Shore Electric Company, which largely supplies the lighting and power facilities of the North Shore, between Evanston and Waukegan, Ill., has received a franchise from Wilmette and will soon be operating there. The growth of the company, of which Samuel Insull is president, has been highly satisfactory during the last year.

At the adjourned annual meeting of the Edison Sault Electric Company of Sault Ste. Marie, Mich., held January 15th, the following-named directors were elected: William Chandler, Sault Ste. Marie, Mich.; Henry W. Darling, Schenectady, N. Y.; Alex Dow, Detroit, Mich.; Alfred Jaretzki, New York, N. Y.; Frank P. Sullivan, Sault Ste. Marie, Mich. The directors elected Mr. Alex Dow [illegible]

president and Mr. William Chandler as vice-president. Messrs. Dow, Jaretzki and Sullivan are new names on the board and represent a change of control of the property. It is understood that Mr. Dow will be the active representative of the new interests, his residence in Detroit being sufficiently near to permit of effective supervision. Mr. Dow is well known as a manager of other illuminating properties, more particularly the Edison electric-light properties in Detroit. The stockholders at the same meeting authorized the increase of the capital stock of the company from $57,000 to $150,000.

ELECTRIC RAILWAYS.

A concession has been granted to a civil engineer, Eugenio de Andrade, for the building of an electric railway between Rio de Janeiro and Petropolis, Brazil. Work must be begun within two years.

The Spokane (Wash.) Traction Company has filed with the city clerk an application for an additional franchise for the extension of its street-railway system. The new road will probably connect with a Moran Prairie line and will be two miles in length.

Small stations are being built at every crossroad along the route of the Joliet, Plainfield and Aurora electric railway. They will be heated by electricity for the comfort of the country customers and visitors to the city stores. A large percentage of the traffic of the interurban line comes from the country.

Permission has been refused the Northwestern Elevated Railroad Company by the local transportation committee of the Chicago City Council to use Irving Park Boulevard for an extension of its line. The committee told the company that if it wanted a route it must go to the alley south of the boulevard and purchase its own right-of-way. It also was voted that the company must leave 20 feet clear headway where it crosses the tracks of the Northwestern Railway Company now being elevated.

Electric street railways in Stockholm, Sweden, now in course of construction, are nearly ready for use. The lines are being built by Swedish and German contractors in combination, a number of American bidders having been unsuccessful in securing the contract. The amount which will have been expended in this work will reach about 3,000,000 kronor ($795,000). Several other cities in Sweden —Gefle, Malmo, Norrköping, Sundsvali, and others —are contemplating changing their street-railway lines from horse to electric power.

Suits for five cents damages have been filed by the St. Louis Transit Company against two passengers who refused to pay their fares for a ride around the Third Street loop. The defendants, with a dozen other passengers, had boarded an eastbound car at Sixth or Seventh Street on Washington Avenue, because, they said, they were unable to get aboard of a westbound car. All refused to pay for the trip around the loop, and the conductor held the car at Third Street and Washington Avenue for three hours. The passengers defied cold and hunger and finally the car crew yielded.

It is reported that the way has been made open for a continuous electric road between New York and Philadelphia. This through service will be made possible by the closing of a deal between the Trenton Terminal Railway Company of Trenton, N. J., and Joseph H. Mayer for a consideration of $1,500 for the use of the land needed to join the tracks of the Camden and Trenton and the New Brunswick trolley lines. When the weather has moderated it will take but three weeks to make the connection, after which time, it is said, cars will be run through from New York to Philadelphia.

A new method of cleaning third rails of ice and sleet is to pour a solution of chloride of calcium along the rail, which will remove the ice almost instantaneously, it is said. This treatment is also said to prevent ice from collecting for three or four hours after each application. Experiments have been made on the Grand Rapids, Grand Haven and Muskegon Railway Company's lines. Three cars were used, each with reservoirs located in the motorman's vestibule. A stop-cock regulated the flow of the liquid, which worked effectively with one-eighth of an inch of ice on the rail. A solution of salt has been tried for the same purpose, but has been found unsatisfactory, since it reduces the insulation of the rail.

POWER TRANSMISSION.

Contracts for developing power at Fort William, Ont., will be let immediately by the Kakabeka Falls Land and Electric Company. The city will assist in securing the necessary legislation.

W. G. Sargent of Joplin, Mo., has purchased the Lowell and Baxter Springs (Kan.) waterpower and the powers and mills at Smithfield, Mo., and at several other points. It is said he will generate electric power for the Kansas and Missouri mining district.

The Olympia (Wash.) Light and Power Company will build a dam to divert the water from the Des Chutes River into the upper end of Lawrence Lake. Another dam will be built at the lower end of the lake. Water will be diverted into the lake during the spring freshets and held there in reserve until the dry season, when it will be let back into the river. This will insure a very even flow of water the year around at the power plant at Lower Tumwater Falls. It is estimated that the arrangement will give a minimum of 2,500 horsepower at all times, and the cost of establishing the system will be very small.

The contract for furnishing power for Winnipeg, Man., by the Winnipeg Power Company has been drafted. The franchise will revert to the city at the end of 15 years. D. A. Keizer has submitted an alternative offer for power, but it is unlikely that his offer will be accepted.

Harry J. Allen of Halley, Idaho, has been at work for some time upon a plant that is designed to supply power and light to the towns of Ketchum, Halley and Bellevue, Idaho, and to enterprises adjacent. A power house is to be erected at Greenhorn Gulch at a cost of about $75,000.

SOCIETIES AND SCHOOLS.

The University of Illinois has recently purchased a plot of ground adjoining its engineering buildings for the equipment of new structures for the development of its college of engineering.

The third annual reunion and banquet of the Veteran Employes' Association of the Westinghouse Air Brake Company at Wilmerding, Pa., was held on January 11th. The association numbers 91 workmen, none of whom has been in the company's employment for less than 21 years.

The Henry W. Oliver Chemical and Metallurgical Library of Lafayette College, Easton, Pa., has received as a gift from a generous friend all the pamphlets (about 3,000 in number) belonging to the library of the late Professor Johannes Wislicenus of the University of Leipsic. Professor Wislicenus was a famous chemist. He was a pioneer in the study of lactic acids and led in the work which was the foundation of the present knowledge of stereoisomerism. This library represents the collection of 50 years of great activity and will be a valuable addition to the Oliver Library.

PUBLICATIONS.

"Automobile Accessories" is the title of a catalogue from Emil Grossman, New York city. All the accessories of the automobile, such as horns, lamps, goggles and the hundred and one other things are listed.

The opinion of the United States Circuit Court of Appeals sustaining the Blades patent covering underload and overload release devices, has been issued in pamphlet form by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

The True & True Company of Chicago is sending out a cartoon calendar which is apparently a new idea in the art of calendar making. The pages are large and upon each is a cartoon by Phillips, which is in some way suggestive of the company's products.

Machinists will find in the little pamphlet entitled "Twist Drills," issued by the Clevedand Twist Drill Company, Cleveland, Ohio, a comprehensive collection of facts relating to the making and operation of twist drills. Numerous drawings explain the correct and incorrect action of the drill within the steel or iron.

The Chicago Fuse Wire and Manufacturing Company, whose main office is at Chicago, issues a catalogue of enclosed fuses, fuse links, telephone fuses, wire joints and similar electrical appliances. The products described in the catalogue have been examined and approved by the Underwriters' National Electrical Association.

Novelties in the way of desk-lighting devices are described in a little booklet from McLeod, Ward & Co., New York city, entitled "Save Your Eyes." A number of different styles of cylindrical reflectors are illustrated, adapted for use over desks, typewriters, pianos, paintings, etc. The articles are known as the "Kinsman Specialties" and all are furnished with adjustable socket holders.

The 1904 catalogue of the Knowles Steam Pump Works, New York city, is a book of about 150 pages showing nearly half as many full-page illustrations of different types of direct-acting steam pumps for boiler feeding, mine drainage, waterworks service, etc.; also electric and belt-driven pumps, artesian-well pumps, air compressors and ammonia pumps, both flywheel and direct-acting, jet condensers, relief valves, air and circulating pumps, wrecking pumps, vacuum pumps, sugar-house pumping machinery, etc. This catalogue will be supplied free upon request to those interested.

TELEGRAPH.

Everyone may not be familiar with the method by which the Western Union Telegraph Company regulates 70,000 clocks, all over the country. These are set at noon each day by an automatic arrangement in each electric equipment, which responds to the beat of the sidereal clock in the Naval Observatory when its hands point to 12 and make the circuit for the passage of the time current. A few minutes before this hour business over the Western Union wires is suspended and operators throughout the country put their instruments in shape to form an unbroken circuit from the observatory to every place where ticks a clock to be electrically influenced. There is a hush over all the great telegraphic system. Then the time ball strikes and instantly the time message flashes over the wires.

SPACE TELEGRAPHY.

Two space-telegraph stations have been opened in Porto Rico and are working satisfactorily. One station is at San Juan and the other at Culebra. They are to be especially for use during fleet maneuvers at the forts.

At the annual meeting of the International Wireless Telegraph Company in Camden, N. J., a resolution to consolidate with the American de Forest Wireless Telegraph Company was adopted without a dissenting vote. The International stockholders, it is said, will receive $7,500,000 in stock in the new concern and will have an interest in many patents.

MISCELLANEOUS.

During October, 1903, 1,770 thunderstorms were reported to the United States Weather Bureau, as compared with 1,800 in October, 1902, and 3,155 in September, 1903.

The Merchants' Electric Protective Company has asked the Chicago City Council for permission to install a fire-alarm and burglar-telegraph system in the Second Ward.

Dr. Francolini, a scientist of Rome, has published a statement to the effect that the source of the Clitumnus, a small Umbrian river, sacred to the Romans, gives evidence of containing radium. The waters at the source are said to be the color of violet.

The cause of the boiler explosion at the Geyer Avenue plant of the St. Louis Transit Company described at length in the January 9th issue of this journal was, according to the report of the board of engineers, who concur in the report made by City Boiler Inspector Joseph Branch to Comptroller Player, the forcing of the boilers beyond their capacity and irregular firing, which let the water get too low in one of the boilers under high pressure.

In carding and drawing cotton which has been dyed or bleached in the raw state static electricity is generated to such an extent as to cause considerable trouble, the web having a tendency to follow the doffer instead of being stripped off clearly by the doffer comb. This is hard to overcome, one method being to sprinkle the cards at intervals with water. This remedy has the effect, however, of rusting the card teeth at the base and is also detrimental to the finished product. Operators of cotton mills will be glad to hear of any method by which the bad effects of the electrical phenomenon can be obviated.

The large Congressional Library Building at Washington, D. C., built six years ago, has been found to be inadequate for the present demands in nearly every department. Superintendent Green in a report on the general situation to the house committee says among other things: "No serious failure of the machinery has thus far occurred, but, the use of the building having now reached all its parts, more power and illumination than the generating plant can supply are already beginning to be demanded. The present electric plant originally provided for only about two-thirds of the building, in the belief that it would be ample for many years, but it is already taxed to its full capacity and often overloaded." Congress may take some action on the recommendations during the present session.

It would appear from the calculations of Dr. Bauer of the United States Coast and Geodetic Survey that the earth's magnetic energy is dying out. Calculating the total energy of the magnetic field outside the earth's surface in spherical harmonics, Dr. Bauer finds that there has been a loss of three per cent. between 1838 and 1884. The magnetic survey of the United States is being reorganized and by 1910, it is planned, there will be one magnetic station to every 25 or 30 square miles; at present Holland has one to every 40 square miles, and England one to every 139 square miles. Canada, it is hoped, will join in this, as in other meteorological work of the United States. Five magnetic observatories are contemplated. Maryland is now said to have the best magnetic survey, with one exception, Holland.

Howard A. Fessenden of Detroit, Mich., has lately patented a new signal system which is especially applicable to that style of electric-signaling systems in which a return signal is sent from the receiving station to the sending station to apprise the latter that the signal has been received. The object of the new device is to guard against the possibility of mistake on the part of either operator. When one operator wishes to send a signal to another he moves a dial indicator around to a point indicating the desired signal. In so doing a series of contacts is made by a ratchet mechanism which close circuits and energizes relay magnets at the receiving station. These relays operate a local circuit there and set an alarm bell ringing which continues to ring until the operator at No. 2 station moves his dial indicator around to send the proper return signal back, which automatically opens the circuit of the bell.

TRADE NEWS.

Electric motors are to be manufactured by the Greacon-Derby Engineering Company, recently organized at Perth Amboy, N. J. The company was recently incorporated by S. B. Greacon, J. M., R. W. and A. H. Derby.

W. A. Roberts, E. H. King and J. L. Cooper, all of Pittsburg, Pa., have organized the Excelsior Electric Company, capitalized at $25,000. The company is installing machinery in a large building at Aliquippa, Pa., where it will manufacture toy engines.

The Swan Electric Manufacturing Company is making arrangements to move its factory from Middletown, Conn., to Newark, N. J., where it will occupy a large brick structure with modern conveniences and so situated as to make the shipment of its product to the West less expensive. The company has outgrown its present factory and the new site will be more suitable.

The electric-light company of Teneriffe, Canary Islands, is desirous of purchasing an American steam engine of at least 500 horsepower. The engine required must be of the latest pattern, of first-class material, and up-to-date in all respects. Price should be quoted c. i. f. Teneriffe. Communications should be addressed to Señor Don Nicolas Marti, presidente Compania Electrica e Industrial, Teneriffe.

A material for preventing loss by fire and danger to life from the short-circuiting of high-voltage electrical wires, for which the trademark "Niagrite" has been adopted, is placed upon the market by the H. W. Johns-Manville Company of New York city. "Niagrite" is furnished in strips of several widths from three inches to 36 inches and is held in place by asbestos fireproof glue, thus protecting the cables from external fire and confining the internal fire. The material presents a very neat and permanent finish and is not affected by atmospheric conditions. It has been adopted by the Niagara Falls Power Company, the International Power Company, Buffalo Street Railroad Company, the New York Edison Company, and other prominent and important electrical plants.

BUSINESS.

The Emerson Electric Manufacturing Company of St. Louis is pushing its automatic-start induction motors for motive power in running sewing machines. The motors are made in sizes small enough for use with one sewing machine, which, in factories, is a good feature, as it makes each machine entirely independent of the others.

The Central Electric Company, Chicago, is starting in 1904 with renewed enthusiasm to push the sale of D. & W. enclosed fuses and safety devices. The company makes the statement that the popularity of D. & W. material has been steadily growing, and with a constantly widening field ahead, there is every reason to believe that the present year will witness largely increased sales.

The Mechanical Appliance Company of Milwaukee, Wis., is now recommending its Watson motor for direct connection to laundry machinery. The motors are built in sizes from one-eighth to three horsepower.

The Ewing-Merkle Electric Company of St. Louis calls attention to the fact that for 1904 it will be agent for several large and representative electrical manufacturing companies. Believing that 1904 will be a year of unusal activity, the company is sparing no pains to be well prepared to furnish its customers with what they desire promptly.

Secretary R. J. Russell, of the Century Electric Company, St. Louis, was in Chicago on Monday. Mr. Russell was slightly indisposed with a heavy cold during a portion of his stay in Chicago, but he recovered sufficiently to finish his trip. Mr. Russell is on a long business journey, during which he will visit a number of western cities and be away from St. Louis possibly for a month to six weeks. He reports an exceedingly good business in the single-phase alternating-current motors now manufactured by the company, and he has been busy of late establishing agencies throughout the United States not only for the single-phase motors but for the Pillsbury alternating-current ceiling fans, for which at the present time there is a most excellent demand.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) January 12, 1904

749,160. Electrically Operated Railway Switch. Claude W. Breedlove and Rudolph R. Grant, Berkley, Va. Application filed March 25, 1903.

A switch tongue is connected to the armature of a motor, which moves the switch one way or the other, according to the direction of rotation. The motor is controlled by a circuit, under the control of the switch operator.

749,175. Automatic and Manual Fire Alarm. William L. Denio, Rochester, N. Y., assignor of one-half to Hobart F. Atkinson, Rochester, N. Y. Application filed May 14, 1903.

In connection with a signal wheel is a signal lamp, connected in the signal circuit. A normal short-circuit for the lamp is closed by a rotatable arm connected to one box terminal, a co-operating spring being connected to the other terminal.

749,178. Wireless Signaling Apparatus. Lee De Forest, New York, N. Y. Application filed March 5, 1903.

A signal key for use in wireless telegraphy comprises a lever pivoted intermediate its ends, a finger-piece upon one end of the lever, a spring acting upon the lever to raise the end carrying the finger-piece, a stationary contact member, a co-operative contact member carried by the lever, and means for maintaining an insulating fluid between the contact members.

749,191. Electric Signaling Apparatus. Felix B. Herzog, New York, N. Y. Application filed May 17, 1886.

At or in connection with each of several sub-stations is apparatus comprising both a magnet and a circuit controller, which re-establishes the normal-circuit conditions, and which controls apparatus at another point. Co-operating-circuit connections including separate lines are arranged in multiple.

749,193. Elevator. Nelson Hiss, New York, N. Y. Application filed November 11, 1903.

An electromagnetic transmission means communicates power from a constant source to the driving sheaves of the elevator. One member of mechanism is driven by the prime mover and the other member is arranged to drive its appropriate sheave.

749,200. High-potential Switch. John F. Kelly, Pittsfield, Mass. Application filed May 23, 1903.

In a high-potential switch are combined a device affording an easy path for abnormal frequency currents and a difficult path for normal frequency currents, and means for making and breaking a shunt around the device. (See cut on next page.)

749,204. Electric Heating Apparatus. Richard Küch, Hanau, Germany, assignor to the firm of W. C. Heraeus, Hanau, Germany. Application filed November 7, 1902.

An electric heating apparatus comprises a body to be heated and a heating resistance of platinum foil of .001 to .01 millimeter in thickness in intimate contact with the body.

749,213. Electromagnetic Device for Vibratory Massage. Eugen K. Müller, Zurich, Switzerland. Application filed September 20, 1902.

A massage body is operated by a pulsatory electric current through the agency of a coil inductively energized thereby. One terminal of the coil is connected with the massage body and the other terminal is adapted to be connected with the patient, the pulsations of the induced current corresponding to the period of vibration of the massage body.

749,224. Compound Applicable for Insulating Material or Other Purposes. Leonard M. Randolph, Newark, N. J. Application filed April 25, 1902.

The compound comprises a mixture of varnish residue and peat, held together by a binding material.

749,225. Telephone System. Hope Redmon, Rufus L. Hall and Robert H. Conway, Cynthiana, Ky. Application filed November 10, 1902.

A short-circuiting switch for normally cutting the instruments of a party line out of circuit is operated by a switch-operating lever, moved by hand; means for locking the switch lever when moved to open the switch being provided, which are under control of the operator at central. An actuator throws the selected instrument into circuit, and a resetting mechanism restores all the instruments to normal condition.

749,252. Synchronizer. Leonard Andrews, Manchester, England, assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed June 25, 1903.

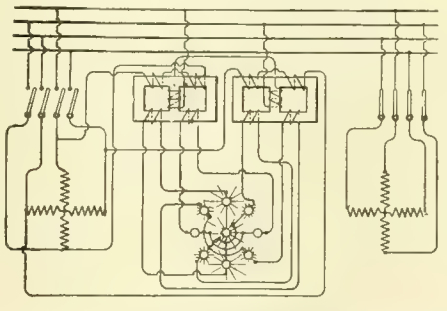
Transformers each having a primary winding connected to one of the different phases of the generator, and a second primary winding connected to a common pair of bus bars, have their two secondary windings on the transformers so disposed relatively to the primary windings that one of the secondaries is excited when the currents of the primaries are in phase and the other when the currents are in opposition. (See cut.)

749,255. Electric Interlocking Switch and Signal System. Gustave Bleynie and Théophile Ducousso, Paris, France. Application filed March 6, 1902.

The signals are adapted to be operated from a central station, the operation of a single member at the station operating and locking the switches. The switches and signals are operated by electric motors.

749,261. Switch. Troy Cope, New Waterford, Ohio. Application filed August 20, 1903.

Contacting arms are carried by the trolley-wire, each arm being connected with one of the coils of a pair of solenoids of a switch-throwing device. Solenoids are supplied with means for energizing either one of the coils to throw the switch in either direction. These means comprise contact blocks carried at the upper end of the trolley pole, wires leading down from the blocks within the pole, contact plates carrying the lower terminals of the wires mounted at the base of the trolley-pole, and means connected with the plates adapted to alternately place them in circuit with the car-running circuit.



NO. 749,252.—SYNCHRONIZER.

749,268. Electric Arc Lamp. George R. Davison, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed May 8, 1903.

Through the cover plate for the globe the carbon passes and extends into the globe. A cap closely surrounds the carbon and is supported below the plate so as to form a thin space between the plate and the cap extending from the carbon nearly to the inner periphery of the globe.

749,271. Electric-motor Control. Samuel T. Dodd, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed June 4, 1903.

In a motor circuit having a number of motors, connections are placed intermediate the motors and a controlling device to shift the former from series to parallel, each armature being always connected to the corresponding field, and that armature and half of its field being always used as one element in all combinations.

749,272. Motor Control. Samuel T. Dodd, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed June 13, 1903.

Throughout all combinations of a number of motors, each armature is connected to its own field. The leads from each motor are so connected as to leave, in all combinations, each armature connected in series with a section of its own field sufficient to force an approximately equal division of current between the armatures when connected in parallel with each other.

749,301. Trolley Stand. Washington H. Kilbourn. Greenfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed August 14, 1902.

Mechanical parts are described, which act as a hinge and guide for the trolley pole.

749,306. Telephone System. Albion D. T. Libby, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed December 3, 1902.

Means are specified to open the normal connection with the source during calling, while an auxiliary path for current is completed from the source through the cut-off relay during calling. A retardation coil is connected in the auxiliary path.

749,308. Telephone Exchange. Frank A. Lundquist and John K. Norstrom, Chicago, Ill., assignors to M. E. Richardson, trustee, Sterling, Kan. Application filed November 19, 1900.

In a switching mechanism operated by a clock mechanism and released by a magnet is a contact maker and a support, upon which a lever is pivoted and adapted to engage teeth on one of the gears of the clock mechanism, and a guide for the lever carried by the support at a point adjacent to the teeth of the gear engaged by the lever.

749,324. Electric Sparking Ignition Apparatus for Gas Rock Drills. John V. Rice, Jr., Edgewater Park, N. J., assignor to the John V. Rice, Junior, Company, Edgewater Park, N. J. Application filed June 8, 1895. Renewed July 16, 1898.

The devices consist essentially of fixed, separate electrodes and a circuit-closing diaphragm, and pipes leading to the diaphragm from the interior of the cylinders.

749,335. Insulator. Louis Steinberger, Brooklyn, N. Y. Application filed September 18, 1902.

Details are described.

749,365. Electric Bell. Harry E. Dey, New York, N. Y. Application filed August 15, 1901.

An electromagnet is placed inside the bell and an armature for the magnet is so hung that as it oscillates the bell is sounded.

749,370. Wireless Signaling System. Cornelius D. Ehret, Ardmore, Pa., assignor to the International Wireless Telegraph Company, New York, N. Y. Application filed November 15, 1902.

Electroradiant energy is transformed into the energy of electric currents, the current component being increased by supplying the energy to a circuit including a closed resonant circuit comprising capacity and inductance, arranged in branches which are in parallel with each other.

749,371. Wireless Telegraph Receiver. Lee De Forest, New York, N. Y. Application filed June 4, 1903.

Two differently tuned receiving systems have each a solenoid with its coil in circuit with the aerial conductor. The solenoids produce a varying magnetic field, which in turn act upon a local circuit containing the receiving apparatus.

749,372. Art of Wireless Telegraphy. Lee De Forest, New York, N. Y. Application filed June 4, 1903.

Radiating high-frequency electrical waves are varied in their mechanical frequency in a predetermined cycle thereby producing at the receiving station manifestations which vary in a corresponding cycle.

749,387. Automatic Non-interfering Repeater for Fire-alarm Circuits. William H. Kirnan, Bayonne, N. J., assignor to the Gamewell Fire Alarm Telegraph Company, New York, N. Y. Application filed October 4, 1902.

A normally open circuit embraces non-interference magnets corresponding with the street magnets, which operate repeating mechanism. Means controlled by the non-interference magnets prevent the operation of the repeating mechanism by any one of the street magnets while under the control of any other of the street magnets.

749,388. Locking Device for Telephone Apparatus. Sherwood J. Larned and James S. Ford, Chicago, Ill., assignors to the American Telephone and Telegraph Company. Application filed October 9, 1903.

A device for locking the receiver upon the switch is described.

749,391. Bond for Conduits for Electric Wires. George A. Lutz, New York, N. Y., assignor of one-half to Frank K. Boland, New York, N. Y. Application filed May 7, 1901. Renewed June 5, 1903.

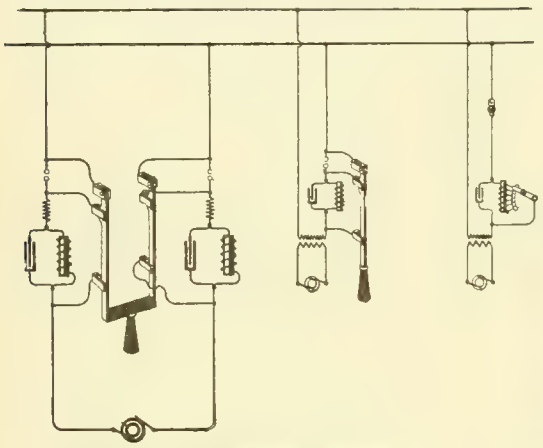
Each bond is a metallic member having a bottom and sides provided with inwardly extending projections having an inward spring tendency forming a channel or space to receive conduits, the projections being adapted to overlie and bear upon conduits to clamp them upon the bottom of the bond.

749,392. Elbow for Conduits for Electric Wires. George A. Lutz, New York, N. Y., assignor of one-half to Frank K. Boland, New York, N. Y. Application filed May 7, 1901. Renewed June 5, 1903.

A channel has projections at distances apart along the upper edges of its sides, which form grooves between. A cover corresponding substantially to the contour of the elbow has its edges received in the grooves.

749,399. Alternating-current Relay. Greenleaf W. Pickard, Amesbury, Mass., assignor to the American Telephone and Telegraph Company. Application filed August 21, 1903.

The iron core of the coil is arranged so as to pass through the bore of the coil and back over the exterior, forming nearly an inclosed path for the lines of force.



NO. 749,200. HIGH-POTENTIAL SWITCH.

749,401. Electric Railway. Leon W. Pullen, Philadelphia, Pa., assignor to the Wireless Railway Company, Philadelphia, Pa. Application filed April 18, 1903.

Magnetic switches are arranged along the railway, each having a tubular armature of magnetic material placed transversely to the length of the track. Two magnetic contact caps have contacts to constitute a two-pole switch. A supply circuit having branch conductors controlled by the series of switches supplies current to exposed portions on the surface of the railway.

749,416. Safety-appliance System for Electrically Actuated Elevators. Harry G. Wright, Providence, R. I., assignor to William C. Woodward, Providence, R. I. Application filed May 9, 1903.

Automatic control for elevators is accomplished by embodying a normally closed master-switch shunt-connected to the brake and controller circuits of the elevator car with a magnet coil of high resistance electrically connected with the power circuit and forming a part of the switch. Normally closed door locks are located in an electric circuit connected to the master-switch. Upon energizing the magnet coil of the switch, the latter operates to open the brake circuit in advance of the controller circuit.

749,426. Lightning Arrester. William E. Cone, Memphis, Mo. Application filed May 28, 1903.

Upon a base plate is a pivoted switch-arm normally held in circuit-closing position by the weight of the current-conducting wire to which it is attached. A binding post for a local wire having switch-arm engaging jaws and a second binding post for a ground wire and means carried by the base plate for preventing direct contact between the switch-arm and the second binding post are the features of the invention. (See cut.)

749,434. Wireless Signaling Apparatus. Lee De Forest, New York, N. Y. Application filed June 4, 1903.

Combined with a transmitting and a receiving apparatus at the same station are means controlled by the spark-determining member of the transmitting apparatus to cut the indicating member of the receiving apparatus out of the circuit during the time of each spark in the transmitting apparatus.

749,435. Generating Set for Wireless Telegraphy. Lee De Forest, New York, N. Y. Application filed June 17, 1903.

A transmitting set for wireless telegraphy comprises an explosive engine, a dynamo, a unitary or choke transformer receiving the current from the dynamo, a step-up transformer receiving the current delivered by the choke transformer, a sparking circuit receiving the current delivered by the step-up transformer, and a radiating conductor and earth connected with the sparking circuit.

749,436. Wireless-telegraph Range-finder. Lee De Forest, New York, N. Y. Application filed June 17, 1903.

For indicating distances in sending messages a variable resistance is inserted in circuit with the indicating device to counteract the aerially received impulses, the necessary resistance to accomplish this bearing a definite ratio to the distance and power of a standard transmitter.

749,439. Electrical Controlling Apparatus. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed March 22, 1902.

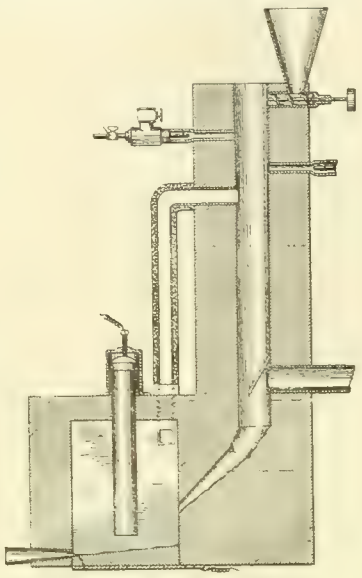
Combined with an alternating-current motor and means for starting it at a slow rate of speed are automatic means for increasing the speed to full speed after the motor has started at slow speed, and means for automatically reducing the speed of the motor to slow speed again before stopping.

749,442. Outlet Box. Hubert Krantz, Brooklyn, N. Y. Application filed May 25, 1903.

Openings in an electrical outlet box with removable disks punched out of the metal of the box contain radially projecting ears expanded out of one of the parts to prevent the disks from being forced inwardly into the box.

749,448. Telephone Transmitter. Philip G. Randall, Boston, Mass. Application filed February 9, 1903.

A comparatively stiff or unbending vibrator or diaphragm has a number of groups of springs yieldingly supporting it at different points around its margin and each comprising springs pressing against opposite sides of the diaphragm. Electrodes forming parts of different resistance-varying units co-operate with the diaphragm.



NO. 749,460—ELECTRIC FURNACE.

749,460. Electric Furnace. Le Roy W. Stevens and Bernard Timmerman, Chicago, Ill., assignors to the Advance Furnace Company of America. Application filed August 8, 1902. Renewed May 23, 1903.

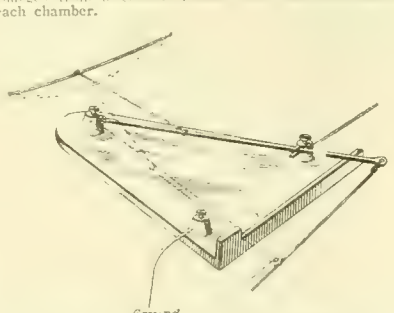
The heating chamber is provided with an electric furnace comprising a vertical electrode and a substantially horizontal electrode forming the floor of the chamber. (See cut.)

749,461. Electric Furnace. Le Roy W. Stevens and Bernard Timmerman, Chicago, Ill., assignors to the Advance Furnace Company of America. Application filed October 29, 1902. Renewed June 17, 1903.

The material is forced into the heating chamber by a ram, where it is reduced by an electric arc.

749,462. Furnace. Le Roy W. Stevens and Bernard Timmerman, Chicago, Ill., assignors to the Advance Furnace Company. Application filed October 30, 1902.

Two chambers containing electrodes receive their charges from a common funnel-set hopper leading to each chamber.



NO. 749,442.—LIGHTNING ARRESTER.

749,476. Apparatus for Governing Elastic-fluid Turbines. Charles G. Curtis, New York, N. Y. Application filed June 17, 1903.

For covering a battery of turbine units including alternating-current dynamos a synchronous motor driven by the current from the dynamos is used. A speed governor driven by the motor controls a power device, connections from the power device to the valves of the dynamos being made for controlling the turbines.

749,481. Telephonic Repeater. Merritt Gally, Brooklyn, N. Y. Application filed April 18, 1903.

Connections for two telephone lines are combined with one receiving magnet having two receiving coils, the two coils acting together as repeating coils. One of the coils connects with one telephone line and the other coil with the other telephone line. One primary coil acts as primary to both of the receiving coils in their operations as secondary induction coils.

749,500. Miner's Electric Lamp. Henry G. Prested, Camden Town, England. Application filed February 7, 1902.

A miner's electric lamp comprises a diffusion device, a lamp and a circuit short-circuiting the lamp so as to render the latter useless when the diffusion device is in action.

749,505. Variable Sparking Mechanism. George E. Tregurtha, Malden, Mass. Application filed June 18, 1903.

Details are described.

749,509. Trolley. Willis D. Williams, Kirkland, Ariz. Application filed August 19, 1903.

A guard attachment journaled on the shaft directs the trolley wheel along the wire.

749,584. Wireless Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to the International Wireless Telegraph Company and Marie V. Gehring, Philadelphia, Pa. Application filed October 3, 1902.

In a wireless signaling system is a wave-responsive device, a circuit controlled thereby, a circuit in inductive relation with the first circuit and frequency-determining elements for rendering the last-mentioned circuit resonant with a current of a frequency dependent upon the frequency of succession of the wave trains representing a predetermined signal.

749,597. Electric-railway Switch. Johann G. Weniger, New York, N. Y. Application filed June 9, 1903.

A railway switch for underground-conduit systems comprises a switch-tongue at the junction of a main and side track, an underground pivoted guide-piece at the junction of the main and side conduits, and an auxiliary conductor in the conduit connected with a source of electric power. Means adapted to contact with the auxiliary conductor for actuating the pivoted switch-tongue and guide-piece are added.

749,601. Trolley-harp Device. Frederick H. Allen, Dunkirk, N. Y. Application filed November 2, 1903.

In a trolley-harp device is a bifurcated harp-arm having one of its sides cut off crosswise at the center of the trolley-sheave spindle to allow the removal of spindle.

749,628. Electric Heater. George J. Peacock, Pittsburg, Pa., assignor of one-fourth to Charles Bonini, Pittsburg, Pa. Application filed April 10, 1902.

An inner-insulating cylindrical casing fits upon the supply pipe. An exterior casing of insulating material surrounds it, the partitions between being filled with a protective-insulating material. Resistance coils for heating are placed in each of the partitions and embedded in the protecting material.

749,633. Electrical Hose-signaling Apparatus. William G. Seeley, Brookline, Mass. Application filed May 25, 1903.

Two half-couplings are screwed together, an insulating device separating the engaging screw-threaded portion of each half-coupling into two sections, each adapted to engage the corresponding section on the other half-coupling. Circuit wires are electrically connected with the sections respectively.

749,690. Massage Instrument. Nicolay Jacobsen, Christiania, Norway, assignor to E. Klaveness, Brookings, S. D. Application filed May 16, 1903.

Massage is accomplished electrically by oscillating armatures attracted and released successively by electromagnets.

749,705. Regulator for Incandescent Lamps. Frederick C. Schofield, Washington, D. C. Application filed May 7, 1903.

A central tube, a hollow core surrounding the tube and forming an air space, heads supporting the core at each end, a resistance coil wound on the core and means for connecting varying amounts of the coil in the lamp-circuit are the principal parts.

749,710. Electric Block-signal System. Louis C. Werner, Broadbrook, Conn. Application filed December 12, 1901.

In a block-signal system for railways are combined a semaphore-arm and a pair of motor-arms, a pinion operatively related to the semaphore-arm and bodily movable therewith, and racks engaging the pinion and connected to the motor-arms at different distances from the axes. Means for operating the motor-arms positively in both directions to shift the semaphore-arm to different positions are further specified.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on January 18, 1904:

356,151. Underground Conduit for Electrical Conductors. James F. Munsie, Chicago, Ill.

356,152. Conduit System for Electrical Conductors. James F. Munsie, Chicago, Ill.

356,153. Electric-wire or Cable-distributing System. James F. Munsie, Chicago, Ill.

356,156. Insulating Telegraph Cables. William R. Patterson, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.

356,197. Telephone Receiver. Ezra T. Gilliland, New York, N. Y.

356,199. Incandescent Electric Lamp. William Holzer, Harrison, N. J.

356,206. Manufacture of Telegraph Cables. William R. Patterson, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.

356,211. Dash Pot for Electric Arc Lights. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.

356,261. Primary Voltaic Battery. James E. Pearce, Maldenhead, County of Berks, England.

356,282. Electric Arc Lamp. August Hoarding, Oakland, Cal.

356,300. Telephone System. Alfred M. A. Beale, New York, N. Y.

356,390. Electric Accumulator. Charles Barral de Montaud, Paris, France.

356,418. Electrical Call Box. George S. Nickum, Dayton, Ohio, assignor of one-half to E. Fowler Stoddard, Dayton, Ohio.

356,425. Test Circuit for Multiple-switchboard Systems. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.

356,426. Multiple-switchboard Test Circuit. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.

356,427. Factory Telephone Exchange. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.

WESTERN ELECTRICIAN

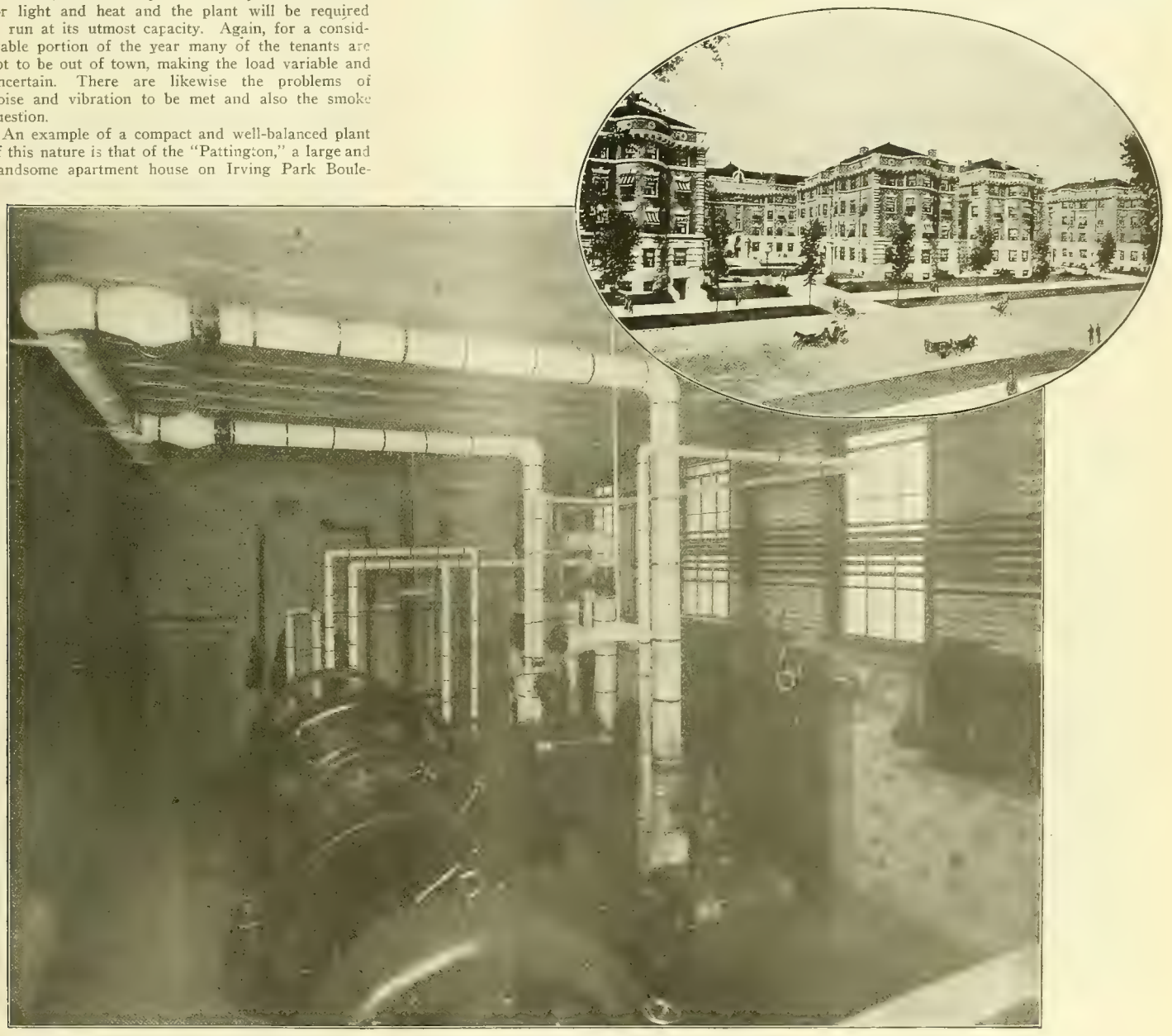
EVERY SATURDAY.

Vol. XXXIV. CHICAGO, JANUARY 30, 1904 No. 5

Light, Heat and Power in a Large Apartment Building.

An isolated plant for a large, high-class apartment building has peculiar conditions to meet which are not found in other installations. The variations in load cannot be determined in advance with any degree of accuracy. For some of the time, especially in winter, all of the apartments may make demands for light and heat and the plant will be required to run at its utmost capacity. Again, for a considerable portion of the year many of the tenants are apt to be out of town, making the load variable and uncertain. There are likewise the problems of noise and vibration to be met and also the smoke question.

An example of a compact and well-balanced plant of this nature is that of the "Pattington," a large and handsome apartment house on Irving Park Boulevard in Chicago, which was completed last fall. The building is of unusual size, containing 72 apartments and nearly 600 rooms. It is modern in every way and is as safe from fire as it is possible to make it. The framework of the building is reinforced concrete. Under each floor concrete is laid six to 10 inches thick, deadening sound, and 13 double fire-walls with automatic steel fire-doors effectually divide the building up into sections.



A MODERN APARTMENT BUILDING AND ITS POWER PLANT.

To assure the inmates freedom from annoyance due to the vibration and noise of machinery, the generating and heating plant has been placed in a separate building back of the main building. The power house is a one-story brick structure set partly under ground and divided by a brick wall into a generator and a boiler room.

The generating units are two in number—one of 75 kilowatts and the other of 125 kilowatts capacity, each consisting of a Crocker-Wheeler direct-current generator direct-connected to an Ideal engine. The smaller generator runs at a normal speed of 275 revolutions per minute and has a capacity of 600 amperes at 125 volts. It is a six-pole machine, each of the six sets of brushes having an area of 7½ square inches, or a total brush area of 45 square inches. The armature is especially well supplied with air ducts, securing good ventilation and cool operation. The engine has cylinder dimensions of 14 by 14 inches and is supplied with a Patterson trap in connection with the separator, which feeds back into a heater. This unit is shown in the foreground in the accompanying illustration.

Farther back in the picture is shown the other generating set, which is similar to the first, except that it is larger and the generator is an eight-pole machine. The speed of this machine is 250 revolutions per minute and the normal current is 1,000 amperes at 125 volts, which requires a total brush area of 80 square inches. The engine is 17 by 16 inches and is fitted with steam-trap separator and all accessories.

A handsome four-paneled black slate switchboard is a feature of the installation and was furnished, together with the switching apparatus, by the Western Electric Company. The circuit-breakers are mounted at the bottom of the board, although this arrangement has its disadvantages. The main circuit switches are arranged at the bottom of the board on the left-hand side and above them the various cut-out switches. Two Weston ammeters are mounted at the top and also a Weston voltmeter hung on a swinging bracket on the end of the board. All of the fuses are of the enclosed cartridge type and all of the wiring throughout the building is carried in iron-pipe conduit, the cutout terminals being enclosed in steel boxes.

Two boilers supply the steam and each is of the horizontal tubular type, 72 by 18 inches, and of 150 horsepower, made by the Frost Manufacturing Company. They are hand-fired, and back of the boiler room is an underground coal cellar having a capacity of 150 tons, which will, however, later be enlarged.

The Paul system of heating, controlled by expansion regulators, is used throughout the building. The condensed steam from the radiators and the exhaust steam from the engines enter the hot-water heater shown just beyond the switchboard in the picture. A reserve supply of hot water is also held in two large tanks in the basement and heated by a garbage burner, the water in these tanks being under pressure at all times and ready for immediate use.

Steam-driven pumps supply the boilers and are located in the engine room. These pumps are two in number, seven by 4¾ by eight inches.

A large refrigerating plant is necessary. It is situated in one of the basements of the building. The compressor is driven by a 40-horsepower di-

rect-current motor. The plant has a capacity of 30 tons of ice a day besides supplying refrigeration in each apartment. A refrigerating vault is placed in each apartment containing a 20-gallon brine vat. In these vats are ammonia coils connecting with the compressor in which the ammonia is expanded, giving the brine a much lower temperature than ice, and cooling the vaults to a corresponding degree.

Another convenience to tenants is a complete private telephone system connecting all the apartments and also connecting with telephones in the janitor's quarters, office, laundries, café, engine room, etc. This system is entirely within the building, however, no outside connections being given. An operator at a small wall switchboard in the office furnishes connections. At the present time there are over 100 of these telephones in the building. Ericsson telephone apparatus is used.

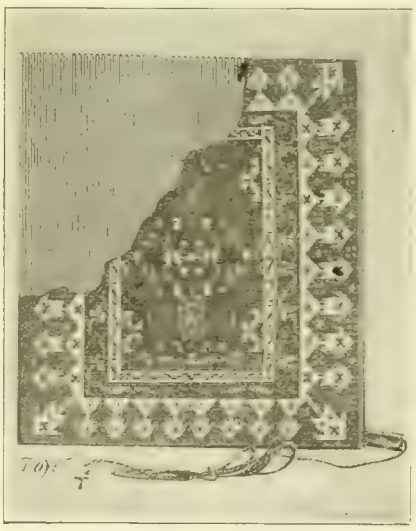
To supply all the rooms and corridors with light 3,000 incandescent lamps are necessary. Unless in fixtures in groups of five or more these lights are all 16 candlepower, what few smaller ones there are being of 10 candlepower.

An automobile room is furnished in the basement for 12 automobiles. This room is reached from an inclined pathway. Here wiring is carried in from the main switchboard, but no terminal facilities provided. Each owner of an electric vehicle must furnish his own plugging apparatus and any current-changing device necessary for his particular machine. Current is furnished at a nominal rate, the necessary metering apparatus being furnished by the management of the building.

The architects of the Pattington were D. E. Postel of Chicago and A. C. Clas of Milwaukee. Telford & McWade of Chicago were the builders. The engineer of the plant is John H. Wales.

French Electric Thermophile.

In the accompanying illustration is shown a bed covering made on the principle of the electric thermophile, by which the resistance of wires woven in the fabric generate heat by the application of a current of electricity. The idea is not new, and bed warmers of similar construction have been on the market in the United States for several years. In France Camille Hergott has devoted attention to the subject, and by his system fabrics of hemp, cotton, wool or silk are produced susceptible of producing heat at moderate temperatures without interfering with their ordinary appearance or flexibility. The picture, re-



FRENCH ELECTRIC THERMOPHILE.

produced from La Nature, depicts such a fabric, the wires being shown at the left and the connections at the right.

The result is accomplished by means of an "electrothermic fiber," which is made up of a textile filament and a metallic thread, which latter may be stretched 10 per cent. in use, and serves as a conductor of electricity. The heat-emitting conductor is proportioned as to size to the style of fabric, light or heavy. The feeding wires are at a trifle superior temperature to that of the entire fabric, and protected by fuses, so that all danger of trouble from overheating is prevented, in case of defects of apparatus or want of care on the part of the user. The great number of ducts comprising a circuit allows a maximum of potential between two consecutive threads of only one-half to one volt; secondly, in the case of multiple circuits, these will receive the current by collecting wires specially insulated with a single pole in each of the two selvages of the fabric, and, finally, the various circuits in the fabric are branched in the weaving in such a manner that the difference of potential is nil between the ducts of two successive circuits. The security is so complete that a fabric may be wet and subsequently dried by electric heat through the conductors of the thermophile. The electrothermic wires are nearly invisible in the fabric, and are so embedded into the material of the fabric that they yield pliably to all manipulations of the article, and cannot be injured by ordinary usage, while arrangements are made for readily testing out any injured part of the system through the use of well-known methods.

The applications may be made to embrace temperatures ranging from that of the human body, 25° to 35° Centigrade, for ordinary bed clothing, for medical applications, dry or humid, by contact or radiation, up to 150° Centigrade. The industrial applications are many, including the heating of automobiles, railroad and street cars.

Protection from Transmission Lines.

By W. A. Blanck.

Mechanical breaks in the wires of a high-tension transmission line, where these wires are run in exposed places, are attended with more or less danger of damage to life and property. A recent accident of this character, which happened on a 15,000-volt transmission line near Chicago and was caused by contact with a telephone circuit, resulted in setting

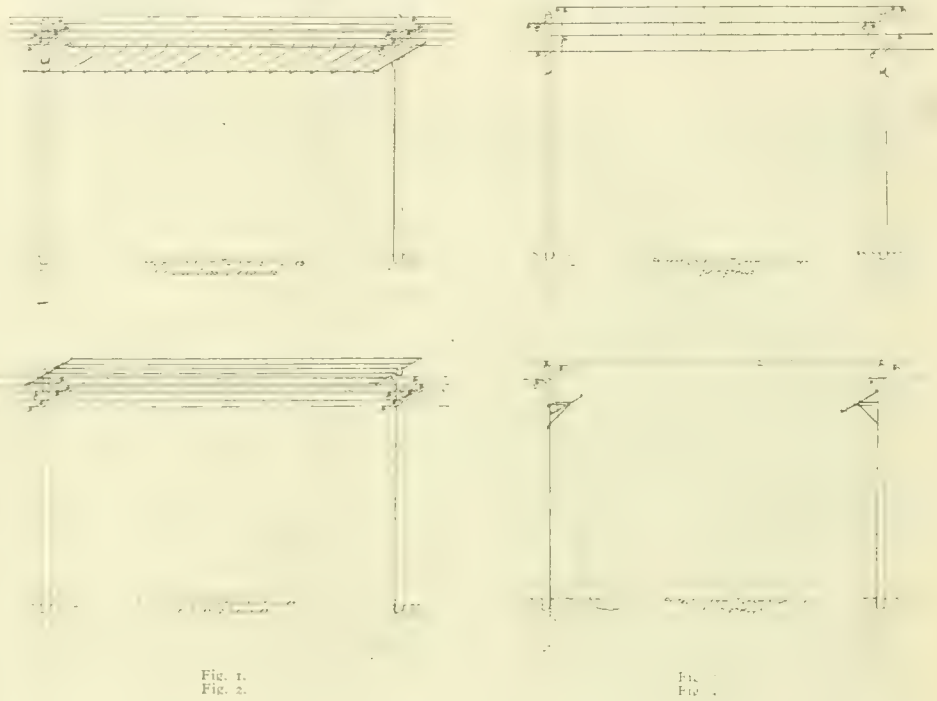


Fig. 1.
Fig. 2.

PROTECTION FROM TRANSMISSION LINES.

on fire three railroad stations. An occurrence of this sort calls imperatively for the proper protection, to avoid further loss of the same sort.

In reference to telephone circuits, it should be noted that telephone fuses cannot ordinarily be subjected to the partial high-potential strain when connected with one leg of a delta-connected transmission line. If the transmission line is operated with a grounded neutral, a contact with a telephone circuit would require such a size of fuses on the latter wires as would safely break the full star pressure of the transmission system. On account of cost and space, such an arrangement will be prohibitive.

It remains, therefore, to forestall accidents similar to the one mentioned, by installing a proper protection on the transmission line. This should, in the case of a mechanical breakdown, prevent a contact with the telephone circuits and cause, furthermore, the tripping of the main circuit-breaker of the disabled transmission line, or at least the indication of a dead ground in the power house.

In case telephone wires cross under the line, the arrangement shown in Fig. 1 may be used. This represents a certain form of network suspended between two grounded angle irons mounted on adjacent poles. The strain wires of galvanized-iron wire are fastened to the angle iron with eyebolts and checknuts and carry the cross-wires made up of galvanized-iron wire, the ends of which are horn-shaped. This form has been chosen to make it practically certain that any broken wire will be caught and grounded, and thus indicate the fault in the power house at once, as above noted.

Fig. 2 shows a simple network for the protection of telephone circuits running over the lines, in case they break down. This network also protects the transmission line against short-circuits caused by a falling telephone wire.

For highway crossings of increased span protection from a falling high-tension wire can be obtained by the arrangement shown in Fig. 3. The high-tension wires are in this case suspended by steel wires and hangers, as indicated. The distance of these hangers is determined by the height of the line, and will be such that no broken end can come within six feet of the ground, thus clearing the heads of all passersby.

Another method of protecting highway crossings from broken transmission wires is given in Fig. 4. In this case, a metallic catch-arm is mounted at a suitable distance from the pole on a grounded bracket, thus giving the broken wire ground potential, or, in case the line is operated with a grounded neutral, causing the tripping of the circuit-breaker in the power house.

In closing, it may be noted that the methods of protection of transmission lines given above conform to the European practice of the last few years.

A Generous Offer to Mr. Tuke.

In an address before a committee of the City Council of Cincinnati President Norman G. Kenan of the Cincinnati Gas and Electric Company made an argument against fixing the minimum price to be charged for electricity at 10 cents a kilowatt-hour. He said that it should be 15 cents, and in no case less than 12; not that the company expected to charge the full amount, but that some margin should be left in case of increase in the price of coal, or labor or that the company should be required to place all lines underground. In other words, some contingency might arise which would not permit the company to furnish current at that price. Mr. Tuke of the Taxpayers' Association made the statement that current can be produced at one cent a kilowatt-hour. Mr. Kenan said that his company was ready at any time to pay Mr. Tuke $100,000 a year if he could produce electricity at its plant for that price, and that he might consider the position open to him at any time.

New York Central Plans Speed Trials.

Since the recent official announcement of the decision of the New York Central Railroad to equip its New York terminals and suburban service with electric power many reports of the company's plans have appeared. It is now stated, in connection with the conversion from steam to electricity, that the Central is anxious to help solve the problem of high speed on electric railways, and is now arranging for a series of tests in which an attempt will be made to equal, if not surpass, the Marienfelde-Zossen record of 130 miles an hour. For this purpose a stretch of track about nine miles long between Schenectady and Amsterdam, N. Y. is to be especially prepared. When the contract for electrical equipment was let with the General Electric Company it was not stipulated, apparently, that a high rate of speed was desired. At a recent conference, however, between officials of the Central and the General Electric Company, definite plans are said to have been outlined for the speed tests.

Steinmetz Contending for Meter-patent Claims.

Washington, D. C., January 20.—The case of the United States ex rel. Charles P. Steinmetz of Schenectady, N. Y., the noted electrical engineer, vs. Frederick I. Allen, commissioner of patents, has just been up for argument before the Supreme Court, where it was brought on a writ of error to the Court of Appeals of the District of Columbia, affirming the judgment of the Supreme Court of the District of Columbia dismissing the petition of Steinmetz for a writ of mandamus against the commissioner of patents to compel the latter to allow an appeal to the Board of Examiners-in-chief of the Patent Office from a decision of the primary examiner refusing and rejecting a second time Steinmetz's application for a patent because he would not cancel from it certain claims as required by the primary examiner, under the asserted authority of certain rules of Patent Office practice and the decisions of the commissioners of patents under those rules.

The case is briefly as follows: On November 21, 1896, Steinmetz filed an application for a patent for his invention covering new and useful improvements in motor meters. This application contains 13 claims, of which the first six are connected with the novel process or method involved in the working of the invention. The remainder of the claims refer to the novel means or apparatus by which the method is to be carried into practice.

On May 15, 1900, the primary examiner decided that claims 7 to 13, inclusive, belonging to the apparatus part of the invention must be canceled. A reconsideration was requested and granted, but on July 13, 1901, the examiner repeated his requirement. An appeal was taken to the Board of Examiners-in-chief, and on August 9, 1900, the primary examiner refused to forward the appeal, on the ground that the question involved in the appeal was not one of which the board had jurisdiction, and therefore was not appealed to that tribunal. A reconsideration of this action was requested, and granted, only to have the same action repeated on August 16, 1900. On August 20th Steinmetz petitioned the then commissioner to instruct the primary examiner to answer and forward his appeal. This petition was denied on December 28, 1900. A similar petition was presented to the present commissioner under date of January 16, 1902, and it was denied on February 7, 1902. On February 28, 1902, Steinmetz petitioned the board direct to take jurisdiction of his appeal. This was denied on March 6, 1902, on the ground that the examiners-in-chief could not, under the rules of the Patent Office, revise and determine the validity of the primary examiner's action without the latter's answer to the appeal, and also because of the previous action of the commissioner in the premises.

Steinmetz came to the United States Supreme Court with a request that the commissioner be commanded to direct the primary examiner to answer and forward his appeal to the Board of Examiners-in-chief in order that he—Steinmetz—may have the right of a review of the primary examiner's action by the last-named tribunal and of the other appellant tribunals, if necessary.

Steinmetz's invention is complex and difficult of comprehension save by a skilled electrician. It belongs to a comparatively small but important class of cases constantly brought to the attention of the Patent Office, in which the novelty relates to the action of alternating electric currents and magnetic fluxes. The invention is founded upon the conception that the 90° relation, which was formerly supposed to be an essential characteristic of the alternating wattmeter, is not necessary, provided that three or more fluxes are used, and provided that these fluxes are properly proportioned in magnitude and phase. This conception being attained and the proper relation having been worked out, the invention, as far as the broad claims are concerned, is made. The conception involves not only the method of the operation of the instrument, not only the complex interaction of the magnetic fluxes and electric currents, but also a motor meter having coils, etc., so wound, related, and proportioned as to carry out the method. It would be impossible to disclose the method to a skilled electrician without putting him in possession of information by which he could immediately and without invention work out the broad features of the apparatus. On the other hand, it would be impossible to describe the apparatus to a skilled electrician in such a way that he really understood it without putting him in possession of the method.

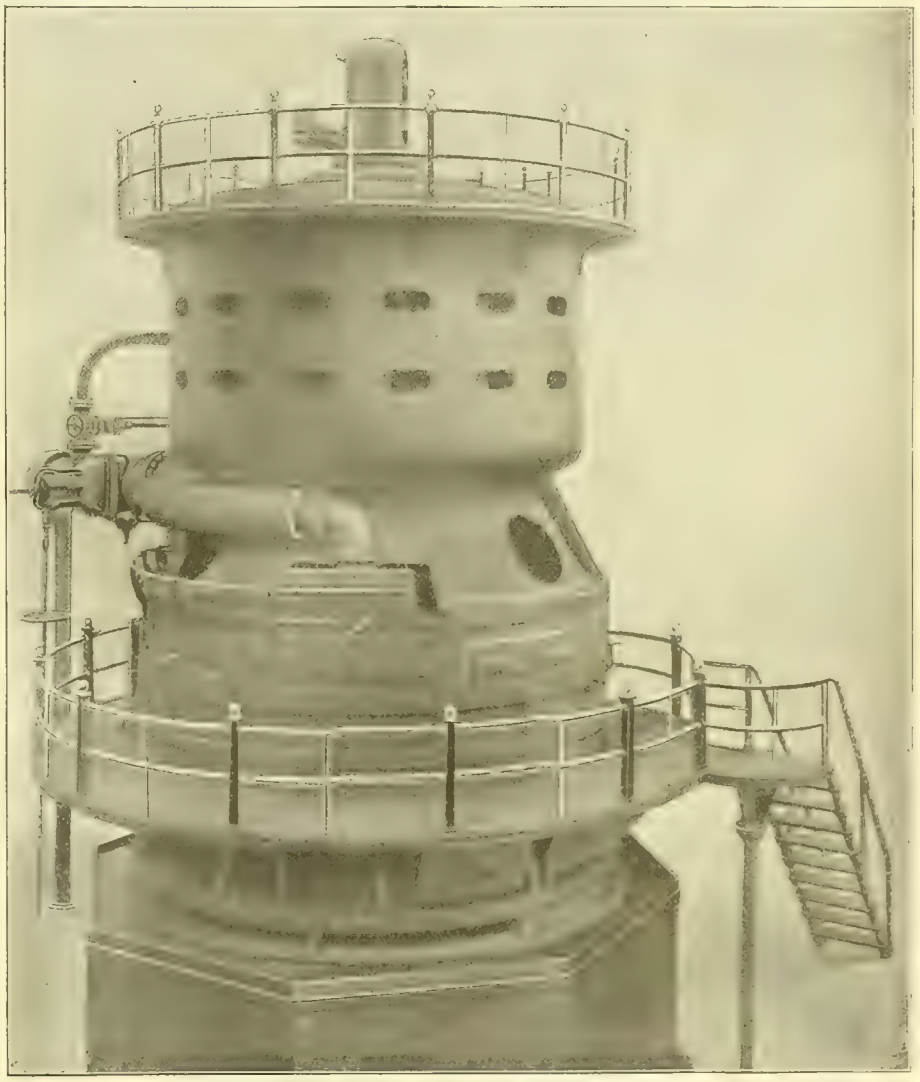
It was argued, on the part of Steinmetz, that it is quite clear that all the method claims are patentable, as they stand, and are not for the mere function of the apparatus; but he fears that if two patents are taken out, one for the method and the other for the apparatus, it might be necessary, in accordance with the ruling of the Accumulator Cases, to elect which of these two patents he would rely upon. If he elected to retain the method and abandon the apparatus, he would be obliged to proceed against all manufacturers, under the doctrine of contributory infringement, and would also be obliged to abandon any detail-apparatus claims which he might make in the case.

On the other hand, if he elected to abandon the method claims and were to rely entirely upon the apparatus claims, he would lose some of the most important claims in the case and very likely might be unable to proceed successfully against some infringer utilizing the real gist of his invention. No case could better be presented illustrating the hardship of requiring a division.

This is a very pertinent matter in connection with patent legislation. It has been brought before the courts a number of times, and the result of the present case before the United States Supreme Court will be waited for with a great deal of interest. The argument, which has been merely sketched in this article, covered nearly two days. A. F. T.

5,000-kilowatt Turbo-generator at Fisk Street Station.

Work upon the installation of the second Curtis turbo-generator at the Fisk Street station of the Commonwealth Electric Company in Chicago is nearly completed. The first unit has been in service for several months. It is shown in the accompanying picture. Comparing this picture with that in the Western Electrician of May 23, 1903, page 399, some additions will be seen to have been made. The picture in the early issue was the first ever published of one of these units and represents it as it appeared in the shop where it was assembled for testing. The accompanying illustration is taken from a slightly different point of view and has added the railings and stairway, some more piping and other minor details. Fourteen of these units will be the ultimate capacity of the plant. The generators have a nominal rating of 5,000 kilowatts, but the actual output of the machine illustrated has been as high as 6,800 kilowatts, or about 9,000 horsepower.



5,000-KILOWATT TURBO-GENERATOR AT FISK STREET STATION.

Considering the great capacity of these machines, the comparatively small size is a striking feature, the height over all being only 25 feet six inches. The small amount of floor space is a saving which amounts to a large sum in a city where real estate is at a high figure. There being no heavy reciprocating parts, there is no strain on the foundation other than that due to the weight of the machine alone; consequently the foundation construction need not be nearly as heavy as that of a reciprocating engine of the same capacity.

The picture shows quite plainly the row of valves on one side of the turbine casing which regulate the flow of steam to the buckets. A duplicate set is arranged diametrically opposite. The revolving field of the generator is carried on the vertical shaft passing down to the bottom. It turns at 500 revolutions a minute. The shaft is not carried on ordinary bearings but rests on a film of oil in a specially designed bearing, this film of oil being only a few thousandths of an inch thick, kept circulating under pressure of 1,200 pounds to the square inch.

The picture is reproduced by the courtesy of The Electric City, the attractive monthly devoted to the central-station interests of Chicago.

Tunnels and Telephones in Chicago.

An unusually large transaction, involving public-utility service in Chicago, was that by which the Illinois Telephone and Telegraph Company last week filed for record with the county recorder a bill of sale for all its property, including tunnels, tracks, telephone cables and automatic-switchboard appliances and telephone system. The bill of sale runs to the Illinois Tunnel Company, an Illinois corporation recently chartered with an authorized capital of $30,000,000 and the power to issue as much more in bonds. Accompanying the bill of sale there was also filed for record a trust deed for $30,000,000 on the assets of the new corporation to secure a bond issue.

With this transaction is insured the speedy working out of a freight transfer system by small electric cars in the company's already extensive system of tunnels throughout the business section of the city. Work on the extension of the tunnels will now be pushed with vigor until a system of probably 90 miles is completed. The other branch of the company's business—the automatic telephone system—is gradually increasing, each day seeing the connection of additional telephones.

The village of Cortland, Ohio, has voted to accept the proposition of Warren Cortland and the Jefferson Electric Railroad Company for the location of its $150,000 power plant in the village, for which it will give a site.

A New Surface-contact System.

[From the London correspondent of the Western Electrician.]

The idea of collecting current for the propulsion of electric tram cars from contacts arranged on the surface of the road has long appealed to those interested in electric traction. The advantages, æsthetic and otherwise, which such a system offers, have been so obvious that many attempts, as is well known, have been made to design such a system that would be both simple and effective. There are already several systems in Great Britain, but none, with the exception of that at Wolverhampton (the Lorain), is at work and seriously doing public service. An additional system, however, is now being exploited, an experimental length of track having been in existence for some time at Ilford, near London. The owners of this system, which is known as the "G. B." surface contact system, feel that they are now in a position to offer it to the public.

The current from the generating station is conveyed through a bare cable carried on insulators in a conduit, and it is conveyed to the cars through the studs which are, of course, placed at intervals along the middle of the track. The connection between the studs and the cable is effected magnetically at the moment the car magnet comes over them and ceases immediately it leaves them. The cable conduit is of ordinary glazed five-inch vitrified stoneware pipe, which is completely imbedded in concrete, and is placed 19 inches below the street level. The insulators in this conduit, shown in Fig. 1, are of insulator clay vitrified and glazed. The pins upon which the insulators are mounted project through the conduit on one side and are there connected together by means of a galvanized iron strip, which is connected at intervals to the rails, thus forming an earth. This device the promoters of the system put forward as a guaranty that no stud can ever become "live" in consequence of leakage. The cable supported by these insulators is composed of stranded galvanized wires, although on heavy lines of traffic a copper core is inserted to increase the conductivity. Access boxes are placed every 200 to 400 yards.

The studs have cast-iron heads, the tops being level with the rest of the paving. They measure 2½ by 14 inches and are supported on natural granite blocks. The lower end of the stud, all of which is contained in a pipe branching from the conduit, is forked and lined with brass. Inside this fork is a piece of iron protected with copper and suspended by means of an insulated phosphor-bronze spring. Upon the lower end of this a carbon-contact block is fixed. Flexible copper leads connect the moving part with the main portion of the stud. When the magnet carried by the car passes over the stud the moving piece is magnetically attracted toward the cable against the pull of the spring, and thus current passes to the stud head.

The magnets, of which there are two (see Fig. 3), are suspended rigidly from the car, and the collectors consist of iron tongues, spring-suspended within one pole of the magnet, their motion being limited by manganese steel pins passing through slots on their centers and fixed to the sides of the magnet pole, which is split down the center. Their method of operation is as follows: When the pole of the magnet passes over a studhead the magnetic attraction causes the tongues to move down and make contact with it. As each collector reaches the end of a stud it is drawn up out of contact with the road by the spring. The magnet itself is mounted two inches above the road level. It is excited by a small set of accumulators carried on the car.

At some public trials a few days ago a double-deck car having a capacity for 54 passengers was used. It was fitted with two 25-horsepower motors and series parallel control. The current taken was between 30 and 35 amperes when the car was running empty, and the track leakage was .05 ampere. A current of 95 amperes was taken when the car was set in motion with the brakes set. Mud and other coverings to the studs also failed to prevent the current flowing to the car.

It remains to be seen if the new system will be adopted very largely, but I believe that negotiations are proceeding with one local authority.

Referring more particularly to the drawings, Fig. 1 is a cross-section of conduit through center of stud, showing switch-piece down; Fig. 2 is a longitudinal section of conduit through center of stud, showing switch-piece up, and Fig. 3 shows the magnet with the collectors in operation and also a diagram of the electrical connections on the car. G.

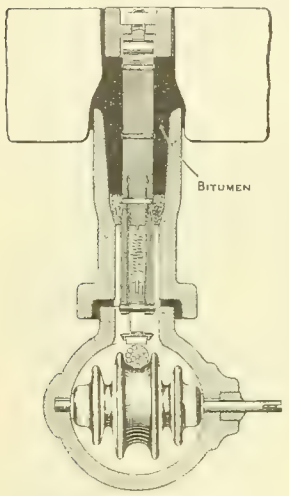


Fig. 1. Cross-section of Conduit, Showing Switch Piece Down.

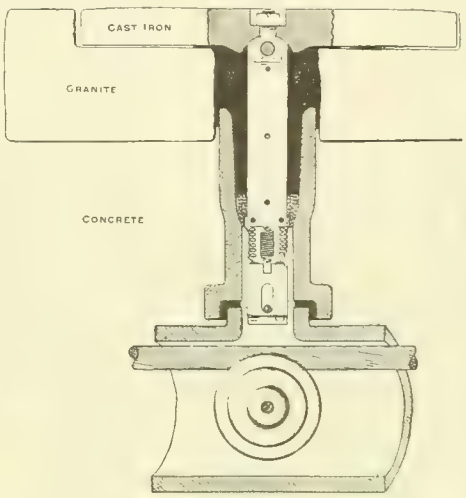


Fig. 2. Longitudinal Section of Conduit, Showing Switch Piece Up.

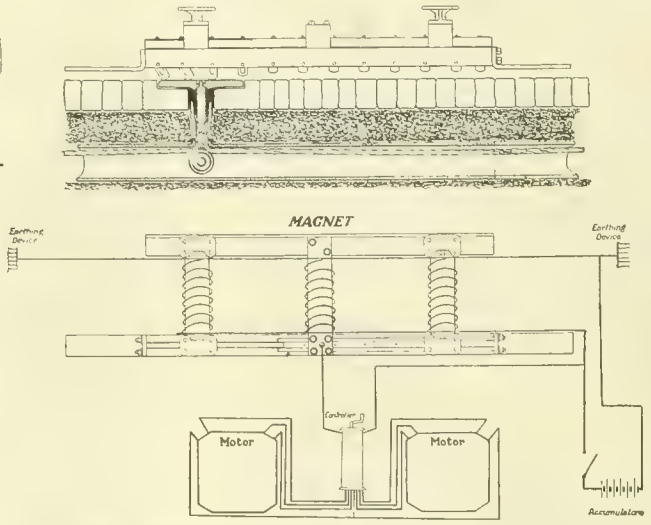


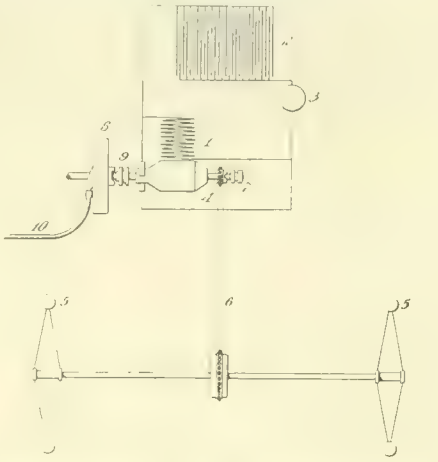
Fig. 3. Showing Magnet and Collectors and also Diagram of Connections.

A NEW SURFACE CONTACT SYSTEM.

[Attentive readers of the Western Electrician will note that the system briefly described above by our London correspondent seems to be much the same as that of Benjamin Harry Bedell of London, England, recently patented in the United States and briefly described in the Western Electrician of September 19th last. It is possible that the Bedell system and the "G. B." system tested at Ilford are identical. However, our correspondent furnishes additional data that are of interest.—Ed.]

Charging Automobile Battery from the Motor of the Vehicle.

It has occurred to the active mind of Thomas A. Edison that the motor of an electric automobile may be conveniently utilized as a generator to charge the storage-battery cells of the vehicle. The inventor has recently patented a method for accomplishing this object. The idea consists in providing a small steam or other elastic-pressure engine, preferably of the turbine type, either connected at all times to the armature of the electric motor or adapted to be connected thereto through a suitable clutch, so that by reversing the electrical connections or by reversing the rotation of the motor armature, the electric motor will be converted into a generator for charging the batteries. A clutch connection can also be effectively utilized for disconnecting the electric motor from the driving wheels during the charging operation, although it will be, of course, understood that the driving wheels may be jacked up, so as to be driven during the charging operation.



CHARGING AUTOMOBILE BATTERY FROM THE MOTOR OF THE VEHICLE.

In the accompanying drawing Mr. Edison illustrates a diagrammatic view of a convenient apparatus for the purpose. The electric motor (1) is illustrated diagrammatically as being shunt-wound, although, of course, any other winding may be utilized. The reference figure (2) represents the storage batteries, and (3) a suitable controller either for interposing resistance in the motor circuit or for effecting variations in the electrical connection between the batteries and the motor for controlling the speed of the latter. On the armature shaft of the motor is mounted a sprocket wheel (4), which drives the vehicle wheels (5) through a chain (6). A clutch (7) may be used for connecting or disconnecting the sprocket wheel (4) to the armature shaft. A small steam or other fluid-pressure engine, preferably of the turbine type, is represented at (8), adapted to be connected to or disconnected from the motor armature by a clutch (9). A turbine engine is preferable on account of its simplicity and lightness. A connection with the engine is made through a hose section (10) with any suitable source of steam or other fluid pressure.

While the inventor prefers to employ means for connecting and disconnecting the driving element of the engine (8) with the motor (1), it will be understood that the clutch may be dispensed with, and particularly if a turbine engine is used, whereby its rotating part acts as an effective flywheel.

In operation the motor (1) drives the carriage in the usual way, its speed being regulated by the controller (3). When the batteries become depleted, the clutch (7) may be operated to disconnect the sprocket wheel (4) from the armature shaft. The clutch (9), if used, connects the engine with the armature shaft, and the supply hose (10) is led to the boiler or other source of steam supply. By now operating the engine (8) to reverse the rotation of the armature shaft, the motor (1) will be converted into a generator to recharge the batteries (2).

By means of this invention, Mr. Edison contends that the radius of action of electric automobiles is very greatly increased, since even in small towns it is possible to secure a supply of steam where the electric current is not used. When the engine (8) is of the turbine type, it adds but little weight and bulk to the entire apparatus.

From the upper sections of New York state comes the report that the most intense cold in the history of the state prevailed there for a portion of last week. At Schenectady it is reported that the shops of the General Electric Company were compelled to close down early in the week because sufficient heat could not be produced to warm the departments. Telegraph and telephone service was badly crippled on account of the cold, and at some points it is reported that trolley-car and steam-road service was suspended. The lowest mark reported was from Boonville, where 52 degrees below zero was recorded. At Saratoga a new record was established at 45 degrees below zero.

Electric Light and Railways in Durban, South Africa.

South Africa has already acquired prominence as a market for electrical apparatus, and some notable installations are now operating in that region, particularly in the mines. Among central-station plants, one of the most interesting is at Durban, the seaport of Natal, which is a city of over 60,000 inhabitants and has one of the finest harbors in South Africa. In Durban there are installed or in contemplation 30 miles of electric railway and approximately 2,000 consumers are taking current for power or lighting, in addition to about 200 street arc lamps and nearly 700 incandescent lamps. The plant is owned and operated by the municipal corporation.

The present combined power station furnishing current for these purposes is an outgrowth of an old plant which was installed by the Electric Construction Company of Wolverhampton. According to a description in the Electrical Review (London), the boiler plant consists of four 250-horsepower Danks boilers, four 220-horsepower Babcock & Wilcox boilers and three upright Hornsby 730-horsepower boilers fitted with superheaters, or a total of 4,070 horsepower. The stack is 120 feet high, a Green economizer being used in connection. The boiler pumps and accessories are operated by steam.

The electrical equipment consists of four railway generators and four generators for lighting purposes. The former are of 250-kilowatt capacity each, direct-connected to horizontal cross-compound condensing engines, which develop 450 horsepower each at 160 pounds pressure, the normal speed being 100 revolutions a minute. These units are seen at the far end of the generator room, Fig. 1. Lubrication is effected by an oil pump driven by the engine shaft. The generators were built by the English Electric Manufacturing Company. These machines are direct-current, external-field, compound-wound, and generate 500 to 550 volts, the armature being mounted directly on the engine shaft, between the high and low-pressure sides.

For lighting purposes three 550-horsepower vertical condensing engines are direct-connected to three E. C. C. alternators of 350-kilowatt capacity each, while the fourth generator, a Dick-Kerr 500-kilowatt alternator, is driven by an 800-horsepower engine of the same type as the other three. Provision is also made for a later installation of 800-kilowatt capacity. Fig. 1 shows the lighting units in the foreground.

Lighting and traction switchboards are arranged in a recess on an elevated platform running lengthwise of the generator room and facing their respective units. The switchboards are of polished

FIG. 2. ELECTRIC LIGHT AND RAILWAYS IN DURBAN.—TRANSFORMER SUB-STATION.

white marble and fitted with up-to-date switching appliances, ammeters, voltmeters, etc. The voltmeters are mounted on swing brackets on the ends of the boards and are of the illuminated-dial type.

The 17¼ miles of feeders for the street-railway system are of two-tenths and three-tenths square-inch section and are laid mostly in wooden troughs filled in solid with bitumen. The trolley line is practically doubled throughout and is of No. 00 B. & S. gauge. "Flexible protected" bonds are used under the fish-plates of the rails and cross-bonding is effected about every 120 feet on single track, and on double tracks all four rails are bonded about every 240 feet. Sidings are arranged at various places for special cars, and convenient stopping places are arranged for, the poles being distinctively painted. The track is paved throughout with Jarrah blocks set in cement, and the streets are admirably suitable for electric traction, being in many cases 100 feet wide, and lined with trees in the Berea. The side poles are in no way an eyesore.

To meet the large demand for electric power, an arrangement has been adopted which is unusual from the American point of view. Some 6¼ miles of special motor mains have been laid in various places in town for a 500-volt direct-current supply with switch boxes, which are interconnected to the traction switch boxes, thus practically duplicating the town portion, the rails being also used as the return. Where motor mains are laid in streets off from the railway routes a bare copper wire has been laid, connected to the nearest rail.

There are 46 cars in use at present, also two road sprinklers and two stone trucks. The cars are of the double-decker type, with canopy; the length of the body is 15 feet nine inches by eight feet (inside dimensions), and the height between the

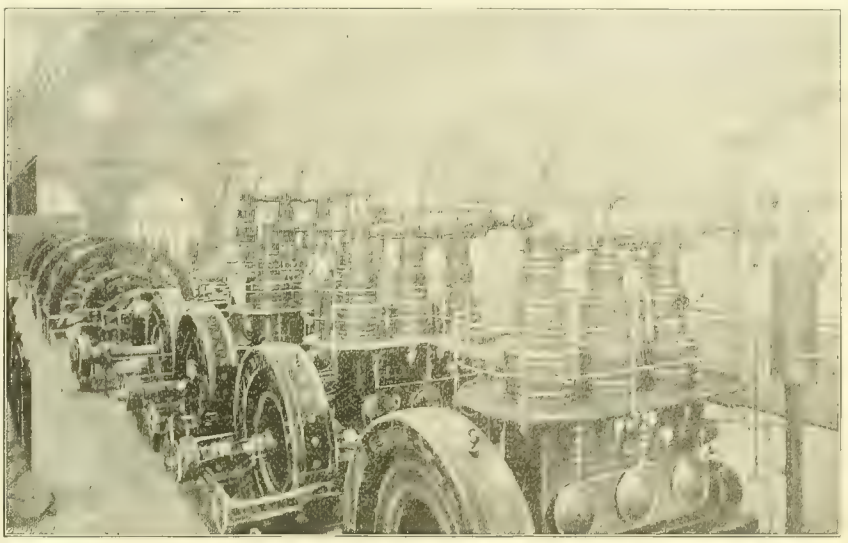


FIG. 1. ELECTRIC LIGHT AND RAILWAYS IN DURBAN.—INTERIOR OF POWER PLANT.

lower and upper decks is six feet seven inches. The trucks are of the Brill type, and the length of wheel base is seven feet. There is a five-minute service in town and 10-minute to the Berea during the daytime, and after 7 p. m. there is a 10-minute and 15 minute service, respectively, up to 11 p. m.

The mains for the lighting system are of various makes and classes; up to the present about 39 miles of high-tension mains have been laid in wooden troughing with bitumen, while some of the lead-covered armored type has been laid under planking. Arc lights for the street are used entirely in the city of Durban, while in the Berea both arcs and incandescents are used for this purpose.

The sub-stations are striking in appearance, as will be seen by Fig. 2, which is a view of one of them. The sub-station transformers are mostly of the General Electric (American) oil type of 30-kilowatt, convertible either to 100 or 200 volts. Each sub-station feeds on its own particular low-tension network, only the transformers in any one sub-station being in parallel with each other. On the Berea the districts fed from each transformer are also isolated from each other. The use of bare overhead low-tension mains is a great feature in this system.

The lighting mains radiate from the various cross-roads where the transformers feeding that district are fixed and are carried on porcelain insulators fixed to strong cross-arms near the tops of the poles, from whence the house services of No. 10 weather-proof wire are led off to the roof through a porcelain "flying fuse." The house mains are led through insulated tubes to meet the supply mains on the roof, and run to the meter board, which carries also a main switch and fuses.

The principal roads on the Berea are lighted by arc lamps also, in this case suspended from the span wires close to the poles; in other cases incandescent lamps are suspended from the span wire in a special water-tight fitting. A special switch wire is run for the control of these from any desired point. The mains in the side streets are of No. 6 B. W. G Such streets are lighted by incandescent lamps fixed on brackets to the poles, the total number of incandescent lamps used for street lighting up to date being 682.

An example of strict attention to duty is given in the case of Charles Wolf, a motorman on the Reading (Pa.) and Allentown electric road, who, while running his car past his own home in Walnut, noticed flames issuing from the building. Such was his idea of duty that he ran his car to Reading without trying to save his house. Here he secured a relief man and went on another car to his home, which he found in ashes.

Something About Relays.

An Iowa correspondent sends the Western Electrician the following inquiry: "I take the liberty of asking you for a little information. I have a cable about 1,500 feet long made of 10 strands of No. 28 copper wire. I want to place a relay in circuit and I want to know what size coils to use on relay. I expect to use closed-circuit battery, and I would like to use as little battery as possible and still have armature pull enough to hold armature up. What size coils shall I use on relay? And how many cells of battery will it take? I want to keep current on relay all the time. How often will battery need to be renewed? I am now using small coils on relay, but it takes about 30 cells of battery, and I wish to cut the battery down to five or 10 cells. What sized coils will be needed on relay?"

ANSWER.

The correspondent has a cable 1,500 feet long consisting of 10 strands of No. 28 copper wire. This size of wire singly runs about 65 ohms to the 1,000 feet. Therefore, taking 10 strands, the resistance of the 1,500 feet of cable, with the strands twisted together, is approximately 9¾ ohms. Owing to this resistance being quite low, it is necessary to wind the relay considerably higher in order to make use of the cells of battery for holding up the relay armature.

The correspondent does not state how much work he expects to do with the armature, but it is taken for granted that the armature is to be used only for closing a local circuit. Therefore, the current needed for pulling up the relay armature can be very low. If gravity batteries are available, then it is suggested that a regular Western Union pony relay, with each of its coils wound to a resistance of 250 ohms and with the coils connected in series, be used. This gives a total resistance of 500 ohms plus the resistance of the cable, which, as stated before, is less than 10 ohms. However, upon connecting the relays to the circuit in series with the batteries, it is found that there is a flow of approximately .01 of an ampere, and with this amount of current the gravity batteries (crowfoot style) would stand up for a long time—six months at least. At any rate, the batteries would require cleaning before they would require the addition of any bluestone, and the maintenance would therefore be very low.

The question as to the dimensions of the coil, it is thought, is answered by giving the resistance at 500 ohms and stating that the Western Union pony type of relay will serve the purpose well. The coils on this relay measure about 2½ inches by one inch.

If a still further reduction in the number of batteries used is desirable, this may be done by simply reducing the resistance of the relay. Thus, with one cell of battery, the resistance should not be much over 100 ohms.

Attention is drawn, however, to the fact that, using so few cells is not advisable where the circuit over which the battery is required to work is liable to introduce some additional ground resistance and possibly, even street-railway currents are encountered, which might, at times, be of such a polarity and strength as to completely neutralize the current given by the battery. It is suggested, therefore, that at least five cells of battery should be used, and when the number of batteries is increased to 10 cells, the resistance of the relay should be increased correspondingly, say, to 1,000 ohms.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company**, and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

Independent Telephone Association of Wisconsin (annual convention), Hotel Pfister, Milwaukee, February 10th and 11th.

Ohio Independent Telephòne Association (annual meeting), Grand Hotel, Cincinnati, February 17th to 18th.

National Electric Light Association (annual meeting), Boston, May 24th to 26th.

JANUARY has made a bad name for the new year in the matter of deaths of electrical men. Von Hefner-Alteneck abroad and Frank H. Clark, General C. H. Barney and William O. Garrison in this country have joined the silent majority. The German, von Hefner-Alteneck, was a physicist and engineer of international reputation. The others were business men well known in this country. Let us hope that January, which has always a bad mortuary record, will prove to be an exception to the remainder of the year.

ONE of the most interesting characteristics of the present status of electrical advancement is the "electrification" of steam railroads in Great Britain. Our English correspondent's brief article in last week's issue set forth the situation succinctly. It is rather remarkable that in conservative England a greater proportion of steam-railroad men appear to favor electricity for train operation than in the United States, which has been the scene of the marvelous development of the electric railway in city systems and interurban lines. But the conditions in the two countries are quite different, and while the managers of trunk-line systems here are slow in taking up electricity, the electric-railway mileage of the United States is, of course, very much larger than that of Great Britain.

TRAVELING by electric railway is pleasant enough, particularly in summer, when the windows may be left open without annoyance from smoke or cinders, but it is quite astonishing to read that such a method of locomotion is valuable for "medicinal purposes" by reason of the escaping electricity. Such a story is told, however, by a correspondent of a Detroit paper in the following words:

A new and novel use has been discovered for the electric interurban. The Jackson-Battle Creek suburban is actually being used for medicinal purposes, and it has become the habit to remark, "There goes Battle Creek's moving sanitarium," as one of the long green "limited" cars goes by. Victims of rheumatism, locomotor ataxia and nervous troubles are using the cars for the electricity in them, as funny as the statement sounds. The cars have two 650-horsepower motors and are geared to 80 miles an hour. Thus surplus electricity passes through the floors and keeps the inmates healthy. It may sound like a joke, but several well-to-do people have taken trips on the cars for the sole purpose of destroying headaches.

This not only sounds like a joke, but we believe that it is a joke; the sly humorist cannot deceive us, for we are charitable enough to believe that he means to contribute to the world's stock of innocent merriment rather than exhibit his own stupidity. We have grave doubt as to the size of the "650-horsepower motors," but no matter how large the motors are we are confident that the current going through them reaches the return side of the circuit safely without the least effect, exhilarating or otherwise, on the passengers. No doubt the pleasant, smooth, rapid motion may charm away a headache, but electricity has no more to do with the cure than it has with Dr. Quack's celebrated "electric belt."

FAIR words and fitly spoken are those of Mr. Charles P. Mellen, president of the New York, New Haven and Hartford Railroad Company, in addressing the Hartford Board of Trade: "If corporations are to continue to do their work as they are best fitted to, those qualities of their representatives that have resulted in the present prejudice against them must be relegated to the background. They must come out into the open and see and be seen. They must take the public into their confidence and ask for what they want and then be prepared to explain satisfactorily what advantages will accrue to the public if they are given their desires. They are permitted to exist, not that they may make money solely, but that they may effectively serve those from whom they derive their power. Publicity and not secrecy will win hereafter. Laws will be construed by their intent, not killed by their letter, otherwise public utilities will be manned and operated by the public which created them, even though the service be less efficient and the result less satisfactory from a financial standpoint. To my mind the day is gone by when a corporation can be handled successfully in defiance of public will, even though that will be unreasonable and wrong. The public may be led, but not driven, and I prefer to go with it and shape or modify, in a measure, its opinion rather than be swept from my bearings with loss to myself and to interests in my charge."

This is the attitude of the most enlightened and far-seeing managers of public-service utilities of the present day. Public ownership of industrial enterprises is an economic blunder in this country, where private initiative is so urgently and successfully appealed to; but private ownership has its responsibilities as well as its privileges. The private corporation must give reasonable, high-class, honest service as a part of the consideration for the franchise benefits it receives. Otherwise the public-ownership advocates have an almost irrefutable argument with the voters, who, smarting under a sense of injustice, are easily led to the unwise and illogical but seemingly effective remedy of establishing a municipal plant. More than one municipal electric-light plant, for instance, owes its origin to an unreasonable, grasping policy on the part of the private company. After several years' experience, the municipality, or the thinking portion of it, may regret its venture, but such a state of mind will not help the local company. The mischief will have been done; mutual respect and forbearance might have averted it.

THE VERDICT of the coroner's jury in the inquest over the victims of the Iroquois Theater fire has excited and will excite great attention. It is severe, but it seems to be the outgrowth of an honest effort to ascertain the causes of the deaths of the 571 persons who lost their lives by the calamity and to place the responsibility where it belongs. Eight men are held for the action of the grand jury as responsible for the fire. Four of these were connected with the theater management, and of these Will J. Davis, president and manager of the theater company, is spoken of as "principally responsible." The other theater employes held are the stage fireman, the stage carpenter and the electric-light operator. The last named is held for "gross neglect and carelessness in performance of duty." Officers of the city government constitute the remaining four who are held as culpable. One of these is Mayor Harrison, whose "lamentable lack of force" is rebuked in caustic language. The others in this group are the building commissioner, the building inspector who "O. K.'d" the Iroquois Theater, and the fire marshal. Thus the responsibility is about evenly divided between the city administration and the theater management, the blame seeming to be apportioned in a careful, logical, systematic manner.

From the testimony presented to it, the jury finds as the first cause of the fire "Grand drapery coming in contact with electric flood or arc light, situated on iron platform on the right hand of stage, facing the auditorium." The use of the word "grand" is rather obscure; possibly some stage term is employed; in another place this drapery is spoken of as "the drapery over the stage at the proscenium arch." But readers of the Western Electrician will note with particular interest that there is no assertion that sparks flying from the lamp caused the fire; the jury believes that the direct contact of the drapery with the unprotected, or partially protected, arc caused the first tiny flame. There is no censure of the character of the electrical apparatus or of the manner in which it was installed. As the Western Electrician said in its editorial of four weeks ago, the original cause of the fire was the propinquity of a highly inflammable curtain or drapery to an open arc lamp.

In its recommendations the jury demands that there shall be two separate sources of current supply in theaters where electric lighting is used—one for the stage, controlled at the stage switchboard, and the other for the auditorium and exits, controlled from a switchboard in the box office. This recommendation can be complied with without great difficulty. Its object is to provide means of instantly lighting the body of the house and all passages and exits in case of necessity from a point near the main street entrance, no matter what may befall on the stage. It will be remembered that the Iroquois fire began during a "dark" scene on the stage, and the lack of light at the exits materially increased the danger.

There seems to be no reason to doubt that the jury has arrived at a fair, honest and impartial verdict. Whatever may follow it, it is evident that retribution for those regarded as primarily responsible has begun.

NORTHWESTERN ELECTRICAL ASSOCIATION.

The twelfth annual convention of the Northwestern Electrical Association was held in Hotel Pfister, Milwaukee, January 20th, 21st and 22d, and though the attendance was not large, the sessions aroused much interest and the papers were discussed with enthusiasm. The club room of Hotel Pfister was used for the convention, and in adjoining rooms on the same floor were to be found the exhibits of the manufacturers.

Those in Attendance.

Most of Chicago's delegation and some from Illinois and Indiana went up Wednesday morning on the Chicago and Northwestern train, and, as usual, divided up in jolly groups. The party consisted of the following-named gentlemen:

G. H. Atkin and J. M. S. Waring, Electric Storage Battery Company; A. J. Pardridge, Pardridge Shade and Reflector Company; Fred M. Insull, North Shore Electric Company, Evanston, Ill.; F. E. Donohoe, American Electrical Works; E. Kuhlmann, Kuhlmann Electric Company, Elkhart, Ind.; W. W. Low, Electric Appliance Company; J. H. Harding, La Porte Electric Company, La Porte, Ind.; M. B. Austin, M. B. Austin Company; R. N. Kimball, Kenosha Gas and Electric Company, Kenosha, Wis.; C. R. Underhill, Varley Duplex Magnet Company, Providence, R. I.; A. L. Millard, Westinghouse Electric and Manufacturing Company; W. F. Hruby, Simplex Electrical Company; I. R. Kimball, Walker Electric Company; Geo. A. Gray, Thomas G. Grier Company; Arthur L. Rice, The Engineer; L. Owen, Peoria Gas and Electric Company, Peoria, Ill.; Francis Raymond and Louis Friedmann, General Incandescent Arc Light Company; L. L. Sawyer, Bryan-Marsh Company; F. F. Skeel, Crouse-Hinds Comany; H. Almert, Cicero Light, Heat and Power Company, Oak Park, Ill.; John W. Brooks, Pass & Seymour, Solvay, N. Y.; Charles Messer, Dearborn Electric Company; L. G. Kalloch, Benjamin Electric Manufacturing Company; Frank L. Perry and H. W. Young, Western Electrician; Geo. Cutter, Geo. Cutter Company; Benj. Kaufman, Western Steam Specialty Company; T. G. Grier, American Circular Loom Company; W. H. Schott, M. O. Payne and J. C. Horning, Cenrtal Station Heating Company; H. W. Frund, Vincennes Electric Light and Power Company, Vincennes, Ind.; John W. Mason, Central Electric Company; W. J. Ferriss, General Electric Company.

In addition to the visitors on the Chicago train the following-named gentlemen were in attendance:

S. F. Dibble, J. Scribner, F. N. Boyer, Thomas Ferriss, W. J. Ferriss, James Lyman and W. W. Geisse of the General Electric Company, A. R. Becker of the Elliott Addressing System, D. B. Bronson and G. N. Eastman of the Chicago Edison Company, R. W. Watson of the Gregory Electric Company, W. Forman Collins of the Western Electrician, W. R. Bonham of the Buckeye Electric Company, A. J. Witherall, F. G. Dickerson and J. E. Goodwin of the Kester Electric Manufacturing Company, I. C. Hornung and C. G. Burton of the National Electric Company, I. J. Kusel of the Eureka Electric Company, Benj. Kauffman of the Western Kieley Steam Specialty Company, Arthur Jones of the Arthur Jones Company, L. G. Bassett and H. J. Meyer of the Bullock and Wagner companies, J. V. S. Church and R. E. Sack of the Electrical World and Engineer, William Goltz and W. E. Sinclair of the Goltz Engineering Company, B. H. Ryder of the Chicago Insulated Wire Company, Frederick L. Merrill of the Standard Railway Materials Company, E. J. Pietzcker of the Standard Underground Cable Company, Edward H. Fox of the Phœnix Glass Company, V. R. Lansingh and H. N. Lauritzen of the V. R. Lansingh Company, John Goldsbury of the Midvale Steel Company, F. J. Alderson of the Stanley Instrument Company, Paul A. Westburg of F. B. Badt & Co., W. R. Pinckard, W. D. McDonald, Norman Stewart and C. A. Ross of the Westinghouse Electric and Manufacturing Company, Wayne C. Bogue and Walter Gains of the American Steel and Wire Company, William Porter of the Alphaduct Manufacturing Company, C. E. Sedgwick and J. H. Raymond of the Fort Wayne Electric Works, all of Chicago; J. C. Schmidtbauer, F. L. Andrae and A. E. Stadlbauer of the Julius Andrae Sons Company, F. W. Ells, Roy Holden and Franklin Sweet of The Browning Company, A. P. Peck, C. T. Tollman, H. M. Klingenfeld, Mr. Waters and Mr. Knight of the National Electrical Company, I. S. Watson and Frederick H. Ford of the Mechanical Appliance Company, H. H. Cutler and A. W. Beresford of the Cutler-Hammer Company, Mr. Rau and Chas. J. Sheler of the Milwaukee Electric Railway and Light Company, Geo. W. Colles, J. H. Nibbelink, Arthur Polacheck of Charles Polacheck & Brothers Co., James Bradshaw and J. C. Blackford of the Viscocity Oil Company, Irving B. Cary, Walter Cary and Thomas G. Whaling of the Milwaukee Electric Company, all of Milwaukee; Irving P. Lord, Waupaca, Wis.; H. F. Pearce, Negaunee, Mich.; G. R. Lindsay of the Little Wolf River Lumber Company, Manawa, Wis.; P. H. Korst, Janesville Electric Company, Janesville, Wis.; Edward Daniell, Menominee and Marinette Light and Traction Company, Menominee, Mich.; P. L. Utley, Watertown Electric Company, Watertown, Wis.; Loren W. Burch, Madison, Wis.; R. W. Loose, Standard Electrical Manufacturing Company, Niles, Ohio; Prof. C. F. Burgess, University of Wisconsin, Madison; Llewelyn Owen, Peoria Gas and Electric Company, Peoria, Ill.; Geo. H. Lukes, North Shore Electric Company, Evanston, Ill.; W. B. Jackson, Madison, Wis.; Harry Byrne, Wagner Electric Manufacturing Company, Indianapolis, Ind.; T. F. Whitfield, Northern Electrical Manufacturing Company, Madison, Wis.; P. F. Lyons, National India Rubber Company, Bristol, R. I.; W. E. Phelps, Phelps Company, Detroit, Mich.; V. C. Gilpin, De Veau Telephone Manufacturing Company, New York city; Thomas Duncan, Duncan Electric Manufacturing Company, Lafayette, Ind.; G. D. Goss, Sterling Electrical Manufacturing Company, Warren, Ohio; G. E. Bissell, Wagner Electric Manufacturing Company, St. Louis; Jos. L. Barnard and J. S. Corby, Bryan-Marsh Company, Minneapolis, Minn.; Rudolph Miehling, Northern Electric Company, Duluth, Minn.; T. F. Grover, Eastern Wisconsin Railway and Light Company, Fond du Lac, Wis.; F. W. Bowen, Kenosha, Wis.; Thomas R. Mercein, Milwaukee.

Wednesday's Sessions.

President F. W. Bowen called the convention to order at 12 o'clock Wednesday. So few were present at the opening session that it was thought best to change the order of the programme somewhat that the president's address might be transposed to the afternoon sessions when the members were all present. A motion to this effect was carried, after which Secretary and Treasurer Thomas R. Mercein read his report, in which he said:

"There being no committee for the purpose, I have, with the assistance of the president, made up the programme for this convention. It is the largest, and I think the best, programme we have ever had, but it will require promptness at sessions and attention to business at them to give the different papers the consideration they all deserve. I call your attention to the resolution adopted last January to hold a summer meeting at St. Louis this year in connection with the National Electric Light Association. I learn that the National association will hold its regular meeting at Boston in June next and another meeting in September in St. Louis. Whether or not this will make any change in our plans is for this convention to decide. * * * The plan of printing convention papers in advance is continued, as it evidently meets with favor and is, in my judgment, worth the extra cost."

After the report was read and accepted the association adjourned until 1:45 p. m.

At the appointed time on Wednesday afternoon the meeting was called to order by President Bowen, who then read his address.

President Bowen's Address.

It is with the utmost pleasure that I welcome and greet you at this the twelfth annual convention of this association, which will, I hope, if such a thing be possible, be of even greater interest to our membership than any which has preceded it. I would, however, expressly disclaim responsibility for such a happy result, but, on the contrary, place the credit for it where it is due, with our worthy and esteemed secretary.

Having thus unburdened my mind and set myself right on the matter of the programme to be presented for your consideration, I wish now to express my regret for the fact that one of the features which I had hoped to make prominent at this convention will not be among the possibilities at this meeting

T. F. GROVER, PRESIDENT NORTHWESTERN ELECTRICAL ASSOCIATION. (SEE PAGE 92.)

of our association; I now refer to the "Question Box" and "Wrinkle Department," which I had hoped to make a matter of personal work during the last year, but have been prevented by the fact that twice within the year 1903 our central station has been destroyed by fire, thus entailing much additional work upon our force and seriously interfering not only with our own service and business, but also with whatever plans I had for the work of the Northwestern association.

It is not, however, of personal matters that an address of this kind should treat, and I beg your indulgence for their mention.

Again returning to the subject of the programme, I would say that it has been most carefully considered and will cover many matters that will be of extreme interest to our members, both active and associate, and unless some of our contributors fail us, we shall cover a wide field of information, both theoretical and practical, and I trust that the discussion of the papers presented will be active and searching, as it is in these discussions that the true value of the papers presented is to be found; therefore, do not let your modesty hold you back in these discussions, but add each your mite to the value of these proceedings by bringing forward any point which may suggest itself to you.

It is held by some that the better way to get at the "meat" of a paper is by the prearranged discussion of the papers by those who may perhaps be thought the most competent, but I am of the opinion that where this method is in vogue, the membership generally does not get sufficiently interested to bring forward many points that might suggest themselves, and the "cut-and-dried" method of discussion gradually undermines the active interest of the members generally and destroys in great measure the usefulness of such associations as ours, and interest in the proceedings wanes.

I am further of the opinion that we have within our ranks men and minds, which, if not stifled by an air of prearrangement, are competent enough and bright enough to discuss any paper offered by men who are technical in their respective lines and to bring out many obscure points, and thus make the papers of the more value to all of us; again, therefore, let me urge upon all the necessity of discussion if we are to get full values, and let each contribute his share.

It is unnecessary to add that the commercial side of every proposition is the one which most appeals to the central-station man, and it is to be expected therefore that those side lights will be thrown on the papers to be read, and it is right and proper that it should be so. It is, of course, from the technical side that the papers are written, and it is from the operative side that they are in measure discussed.

During the year which has just passed over into history there has been much done which is of interest to our profession, though no startling discoveries or innovations have been brought forward, if possibly we may except the mercury-vapor lamp; but still the year has witnessed better development of many appliances, and it is now more than probable that each future year will add to this general betterment, though with less of novel ideas to attract and, possibly, as in the past, to discard. The general principles of our business seem to be better settled and more fully grounded and the lines of machine building seem to have reached their ultimate for a considerable time at least, and therefore the central-station man is very much nearer a standard than ever before. This is a hopeful sign for our chosen business, and it is probable that our depreciation accounts will be the gainer from the fact that the various apparatus used will not be found, as in the past, to be obsolete almost as soon as installed.

The twin subjects of taxation and municipal ownership are and always will be with us. I am, however, very much of the opinion that both are more likely to be met more in the spirit of fairness than in the past. I have no recommendations in the nature of a cure at all to make upon these important subjects, and can only say that as the nature and hazards of our business are more understood by the general public we will be better treated by the same public through their chosen representatives. Let us at all times treat them with fairness and strive, by our good treatment of the public, from whom we receive our franchises, to merit their good will, give them the best possible service for the least possible cost to them and we will make friends instead of enemies, or, at best, doubtful friends, as many seem to think us. The standardization, of which I have spoken, will ultimately be the means of enabling central stations to manufacture their output commodity at a cost which will enable them to supply the public on terms that will, while selling their output at a non-restrictive price, yet realize a fair and equitable profit on their sales, which, from the very fact that they are selling standard goods, will increase by the application of their product to many new uses by the consumer.

This, then, will still further operate to make friends of the general public, and thus in a measure silence the popular clamor for high and still higher taxes upon our industry and for the establishment of municipal lighting and power plants.

I shall not here inflict upon you my personal views as to the rights of the municipal authorities to enter upon a commercial venture in competition with their fellow citizens, but in some occult or obscure way our business seems to be a target, though why other lines, such as provisions, fuel and other public necessities escape such proposal on their part does not make itself entirely clear to me.

I find that I have already exceeded the limit of time which I had proposed, and which is of more value if used for other purposes of this convention, and will, therefore, again welcome you and thank you for your kind attention and forbearance, and we will now take up the regular business before this assembly.

Committees Appointed.

The next item of business was the appointment by the president of a nominating committee, consisting of R. N. Kimball of Kenosha, Wis., H. W. Frund of Vincennes, Ind., and P. H. Korst of Janesville, Wis. Following this, J. H. Harding of Laporte, Ind., W. H. Schott of Chicago and Irving P. Lord of Waupaca, Wis., were appointed as a committee on membership.

Uniform Advertising.

H. J. Gille of St. Paul, Minn., chairman of the committee on uniform advertising, was unable to be present, but wrote as follows:

"I had fully intended to be present at the annual meeting of the Northwestern Electrical Association this week, but find that it will be impossible for me to leave here. However, I am with you in spirit and hope that you will have a profitable meeting.

"In regard to the report of the committee, I had fully intended to make a verbal report and explain in detail what has been done during the year, and finding at the last moment that it will be impossible for me to be there, I have written a brief progress report.

"As you know, this work [illegible] completed, but there is no question but what good progress has been made, and if it is the wish of the association to continue this committee, I would suggest the addition of Mr. H. Almert of Oak Park, Ill., Mr. Frank G. Bolles, New York, and Professor Philip B. Woodworth, Lewis Institute, Chicago. These gentlemen have been hard workers during

the last year, and I feel that it is very desirable, in order to properly continue this work, to have a larger committee of active men who are interested in this matter.

"Your committee reappointed at the last annual meeting of this association to continue the work it had begun the previous year was very much gratified with the hearty support and indorsement of the electrical press generally of our last annual report. The comment editorially in the electrical papers, certainly indicates that the press is alive to the fact that the present method of distributing advertising matter and literature is not all that could be desired, and that this movement is in the right direction.

"Your committee has, during the last year, taken this matter up with quite a number of associations and societies in various parts of this country, and has, without exception, received their hearty support and co-operation. In much of this work your committee was very ably assisted by Messrs. Almert, Bolles and Woodworth.

"We have also taken this matter up with quite a number of prominent manufacturers, who have indorsed this plan, as is indicated by the literature and advertising matter sent out by them. There is no question that there is quite an improvement in the literature sent out to-day as compared with two years ago. Many companies are availing themselves of the bulletin form and the sizes of our last report, although there is considerable advertising matter sent out which is more of 'brass band' advertising, which contains very little information regarding the apparatus or supplies advertised. This literature undoubtedly finds its way to the waste basket, as it is of no value in the files.

"There is, however, considerable work to be done, especially with several of the large associations, with which we are working at the present time."

President Bowen, as a member of the committee, supplemented the report with a few words, saying, in brief, that he had taken the matter up with the National Electric Light Association at its last meeting, and got such action as committed that association to a consideration of the question. It was a little too sudden to bring it before the association for positive action, because it would need time to think about it, but the matter is before that association for its consideration. Mr. Bowen also added that at the last meeting of the Wisconsin Gas Association it adopted this report as the report of its committee, just as it stands, and committed itself to exactly the same line that this association has committed itself to, on the subject of advertising matter.

Later a motion to the effect that Mr. Almert, who is a member of the association, be added to the committee and that the committee avail itself of the co-operation of Mr. Bolles and Professor Woodworth was carried.

New Members.

Secretary Mercein read letters from the legislative committee and sub-committees, which contained little except the fact that no adverse legislation had been passed in Wisconsin, Illinois or Indiana.

Several new members, recommended by the committee on membership, were admitted. Following is the list:

Active: George W. Colles, [illegible] electrical engineer, Milwaukee.

Associate: J. Ritchie Kimball, Walker Electric Company, Chicago; American Radiator Company, Chicago; F. F. Skeel, Western manager Crane Works Company, Chicago; James N. Harris, Chicago manager Heine Safety Boiler Company; H. W. Johns-Manville Company, New York city; V. R. [illegible] Company, Chicago; Edward H. Fox, Chicago.

Reading of Papers.

W. H. Schott of Chicago then read his paper on "Central-station Heating," it being deemed advisable to introduce the paper at that time instead of on Thursday afternoon, as originally intended. The subject was ably treated by Mr. Schott, who, as is well known, is authority on heating from central-station plants, and his paper brought out many points of interest, as was evinced by the long discussion which was participated in by H. Almert, R. N. Kimball, J. H. Harding, George H. Lukes, George C. Keech and President Bowen. An abstract of paper and discussion will be given in the Western Electrician of a later date.

"Coil Windings for Electrical Purposes," by Richard Varley and Charles R. Underhill of Providence, R. I., was the subject of next paper, read by Mr. Underhill. Mr. Underhill is chief engineer of the Varley Duplex Magnet Company and came from Providence to present the paper. His courtesy was appreciated by the association. The next paper on the programme was by W. Scheidel of Chicago on "The Electrolytic Rectifier and Interrupter." Mr. Scheidel was unable to be present and the paper was read by the secretary. In view of Mr. Scheidel's absence no discussion followed. Following this paper was one read by George C. Keech of Chicago, the subject being "Incandescent Lamps in General; Their Smashing Point in Particular." This is a live subject, and Mr. Keech was assailed with a volume of questions by George H. Lukes, W. H. Schott, President Bowen, H. W. Frund, George Cutter, J. Bradshaw, J. H. Harding, P. H. Korst and H. Almert. An abstract of this paper and discussion is given elsewhere in this issue.

Theater Party.

On Wednesday evening a large majority of those attending the convention went in a body to the Alhambra Theater, Secretary Mercein having reserved a large section of seats, so that all were seated together.

Thursday Morning Session.

"Double-current Generators in Their Connection with Double-current Supply," by W. L. Waters, was the first paper of Thursday morning's session. Mr. Waters did not read his paper word for word, but gave a talk bringing out all the points embodied in the paper. Considerable interest was manifested in the discussion which followed, and Mr. Waters was kept busy answering questions and defending his position. An abstract of Mr. Waters' talk and the discussion following appears on another page.

Prof. C. F. Burgess of Madison, Wis., read his paper on "Rectifiers." This excited considerable discussion, and anabstract of the paper and discussion is reserved for a future issue of the Western Electrician.

Election of Officers.

The nominating committee having decided upon a list of officers for the coming year, the following-named gentlemen were chosen for the several offices:

President—T. F. Grover of Fond du Lac, Wis.

First vice-president—George H. Lukes, Evanston, Ill.

Second vice-president—E. A. Daniell, Menominee, Mich.

Secretary and treasurer—Thomas R. Mercein, Milwaukee.

Directors—W. H. Schott, Chicago; D. C. Jackson, Madison, Wis., and H. Almert, Oak Park, Ill.

The gentlemen named were unanimously elected.

The new president was escorted to the chair, and with a few well-chosen words Mr. Bowen welcomed him to his position. President Grover then replied:

"It is unecessary for me to say that I am not a speaker, but I wish to thank you sincerely. It was a great surprise to me. I did not expect it, and at the same time I feel greatly complimented in being made president of this association, as I think it is one of the best in the United States to-day, if not the largest."

As is customary, the former president retained the chair.

Summer Meeting.

The secretary then said: "I wish to speak of a reference in my report to the action taken last January as to the summer meeting. At the instance of Mr. Doherty, our former president, who advised the taking of some action as to meeting with the National Electric Light Association at St. Louis, and after some discussion, this convention decided to hold a summer meeting in conjunction with the National association at St. Louis, preferably in June. But I have been informed that the National association will hold its regular meeting in May or June at Boston, and that it will hold another meeting at St. Louis in September. That may make a difference in the arrangements of this association in the matter of holding a convention this summer at St. Louis, and I think this point ought to be acted upon at this convention."

After some discussion, participated in by George Cutter, Irving P. Lord and President Grover, a motion to the effect that the summer meeting of the association be held in September at St. Louis, to meet with other electrical associations and electrical people, the date to be left to the executive committee, was unanimously carried.

Thursday Afternoon Session.

The paper on "Standard Practice in the Use of Alternating-current Electrical Apparatus," by John J. Gibson, was read by J. R. Kimball of Chicago. Although Mr. Gibson was not present, the paper was freely discussed.

The association, acting on the suggestion of President Grover, then voted to send Secretary Mercein as its representative to the annual meeting of the National Electric Light Association, to be held in Boston next May.

J. M. S. Waring of Chicago read his paper on "Storage Batteries for Small Central Stations," which will appear in a later number of the Western Electrician.

Following Mr. Waring's paper was the paper by James Lyman of Chicago on "The Curtis Steam Turbine." Lantern slides were used throughout the discussion, which helped very materially to an understanding of the operation of the steam turbines representing the latest developments in that form of motive power.

The last and one of the most interesting features of Thursday's programme was the illustrated lecture on radium, by Professor Robert A. Millikan of the University of Chicago. The lecture was illustrated by experiments with radium, showing some of the phenomena connected with it; also its seeming relation to the phenomena attending X-rays and the many other kinds of rays which have so interested scientists during the last five or six years. A similar lecture was given by Professor Millikan recently before the Chicago Electrical Association, and was given in brief in the Western Electrician of October 31, 1903.

The Banquet.

The banquet on Thursday evening was well attended, although many delegates were obliged to leave before that event. Covers were laid for about 100. As usual, Secretary Thomas R. Mercein presided, and after coffee and cigars had been served called on the members to do their part to amuse the assembled banqueters. This time there were no formal toasts, and after addresses by the incoming and retiring presidents, each man called upon was supposed to contribute, as the toastmaster put it, with "either a speech, a song or a story." Under the tactful guidance of Toastmaster Mercein few escaped doing their part to amuse the guests. The function was brought to a close with all the banqueters arising and singing "Auld Lang Syne." During the evening telegrams were received from Governor La Follette of Wisconsin, Mayor Rose of Milwaukee, Mayor Harrison of Chicago and James Wolff of Chicago.

Friday Morning.

The convention was called to order by the president at 10 a. m. There being no business before the association, the convention was declared adjourned sine die.

President Grover.

T. F. Grover, the new president of the Northwestern Electrical Association, was born at Blairstown, N. J., March 5, 1865. It was there that he received his public-school education and later learned the machinists' trade, which he followed until 1885. In that year he became connected with the old Edison United Manufacturing Company, with which concern he remained three years. After leaving the Edison company he acted as one of the electricians employed to install the plant of the Metropolitan Museum of Art in New York city. After the completion of this plant Mr. Grover became the engineer-in-charge. It may be mentioned that this was one of the largest isolated plants of its time, and here also one of the first large successful storage-battery plants was installed.

Ill health brought Mr. Grover to the Northwest in 1892, and for a few months he was engaged in the installation of small lighting plants. In the spring of 1893 he was made superintendent of the Milwaukee and Wauwatosa Electric Company, which position he held until the company was sold to the Milwaukee Electric Railway and Light Company in 1896. In October of that year Mr. Grover was elected vice-president and superintendent of the Fond du Lac (Wis.) Electric Company. In that capacity he was instrumental in securing a new franchise in that city relating to street railways and gas lighting, resulting in the formation of the Fond du Lac Street Railway and Light Company. The new company took on the property of the Gas Light Company of Fond du Lac and in 1899 built a street-railway system.

The year 1902 saw the formation of the Fond du Lac and Oshkosh Electric Railway Company, which recently built an interurban line from Fond du Lac to Oshkosh, a distance of about 19 miles. Mr. Grover was made manager and later president of this company, which position he held until October 1, 1903, when the Eastern Wisconsin Railway and Light Company was incorporated, and he was made vice-president and manager of the new concern.

The new president of the Northwestern Electrical Association has thoroughly at heart the interests of the organization, and this, together with his pleasing personality, will make him a popular and efficient executive. He is a strong believer in the benefits of association meetings and is himself a member of the National Electric Light Association, the American Gas Light Association, the Northwestern Electrical Association, and the American Street Railway Association. In January, 1899, Mr. Grover was married to Ida I. Heber.

Convention Notes.

The Nernst lamps were diligently pushed by Mr. Andrae.

J. R. Kimball came up from Chicago in the interest of the Walker Electric Company.

Charles Gregory of the Guarantee Electric Company proved himself a witty after-dinner talker.

President Charles Messer of the Dearborn Electric Company, as usual, came early and stayed late.

Paul A. Westburg was most energetic in looking after the interests of F. B. Badt & Co. of Chicago.

George Searing, as usual, came handsomely to the front in behalf of Hart switches and Peru porcelain.

The American Steel and Wire Company appeared in the persons of Wayne C. Bogue and Walter Gains.

George Cutter again distinguished himself as an orator by a most dignified and forcible after-dinner speech.

Frederick L. Merrill of the Standard Railway Materials Company, Chicago, put in an appearance on Thursday.

The only "Burch" of Madison, was, as usual, one of the indispensables at the banquet. Burch is "one of the best."

L. G. Kallock did the honors for the Benjamin Electric Manufacturing Company of Chicago, manufacturer of wireless clusters.

Among the latecomers was Joseph L. Barnhard, assistant manager of the Minneapolis district office of the Bryan-Marsh Company.

Secretary and Treasurer Frederick W. Insull and General Superintendent Lukes of the North Shore Electric Company of Evanston, Ill., were two of

the most welcome central-station men at the convention.

Professor C. F. Burgess' paper on "Rectifiers" was one of the most highly appreciated additions to the scientific literature of the convention.

Sales Manager V. C. Gilpin of the DeVeau Telephone Manufacturing Company dropped into the Pfister from New York during the convention.

The Buckeye Electric Company and the Jandus Electric Company were, as usual, represented most thoroughly by W. R. Bonham of the Chicago office.

M. B. Austin of the M. B. Austin Company was among those to arrive on Wednesday. Mr. Austin, however, did not remain throughout the convention.

President W. W. Low of the Electric Appliance Company of Chicago was on hand the first day of the convention, but did not remain for the banquet.

F. J. Alderson of the Chicago office of the Stanley Instrument Company made an interesting exhibit of Stanley specialties in one of the parlors of the Pfister.

The ever-welcome and popular P. F. Lyons appeared from Bristol, R. I., to remind the gathering of the National India Rubber Company's rubber-covered wires.

Edward H. Fox, so well known through his excellent work in the interests of the Phœnix Glass Company of Chicago, was at the convention looking for 1904 business.

The Central Electric Company, Chicago, was energetically represented by those two indefatigable workers, John Wesley Mason and W. W. Geisse. No exhibit was made.

Of course, Thomas G. Grier was on hand, and this time, to express it in Mr. Grier's own words, he came simply "as the hired man of the American Circular Loom Company."

District Manager T. F. Whitfield of the Milwaukee office of the Northern Electrical Manufacturing Company was in constant attendance during the convention at the Pfister.

The Standard Underground Cable Company made no attempt at an exhibit, but, as usual, sent its indefatigable representative, E. J. Pietzcker, who "did it" in his usual pleasing manner.

The western office of the General Electric Company was represented by F. N. Boyer, S. F. Dibble, W. J. Ferris, James Lyman, Jesse Scribner and Thomas Ferris. No exhibit was made.

Vice-president and Chief Engineer H. H. Cutler of the Cutler-Hammer Manufacturing Company found time to drop in on Wednesday to inspect the exhibit and listen to the lecture on radium.

C. D. Goss dropped in in the interests of the Sterling Electrical Manufacturing Company of Warren, Ohio. Mr. Goss made no exhibit, as until the last moment he did not expect to go to the convention.

The Westinghouse Electric and Manufacturing Company made no exhibit at Milwaukee, but was nevertheless efficiently represented in the persons of W. R. Pinckard, R. L. Millard, W. D. McDonaid and Norman Stewart.

Western Sales Manager William M. Porter appeared at the convention to look after the interests of the Alphaduct Manufacturing Company. Mr. Porter was constantly on hand and kept his company well to the front.

Professor R. A. Millikan won the hearts and excited the greatest enthusiasm among the listeners to his lecture on radium by his clear-headed and enthusiastic presentation of a most technical and interesting scientific subject.

The theater party at the Alhambra on Wednesday night was attended by in the neighborhood of 100 of the convention people. A number of ladies were included among the electrical people, and the whole function proved itself to be a most enjoyable one.

Among the prominent electrical Milwaukeeans who were at the convention were Vice-president and Manager T. S. Watson and Engineer Frederick L. Ford of the Mechanical Appliance Company. Both these gentlemen attended the banquet Thursday evening.

Of course, Western Agent Francis E. Donohoe of the American Electrical Works was on hand. As a rule, Mr. Donohoe has delegated Representative Hammond of the western office to do the honors, but this time he appeared in person and was warmly welcomed.

Among the unlooked-for arrivals was President I. J. Kusel of the Eureka Electric Company, telephone switchboard manufacturer. Mr. Kusel, however, has a host of friends in the general electrical business, and he seized the opportunity to "mingle with the boys."

The Chloride accumulator, or, more strictly speaking, the Electric Storage Battery Company of Philadelphia, was ably represented in the persons of Manager Godfrey H. Atkin of the company's Chicago office and Electrical Engineer J. M. S. Waring; no exhibit was made.

Engineer and Contractor W. H. Schott came nobly to the front with a handsome line of representatives. Assisting W. H. Schott were Benjamin Kauffman, J. C. Hornung and M. O. Payne. Mr. Schott has made an excellent name for himself through his satisfactory work in the designing and constructing of central stations, steam, hot-water plants and also electric-light, gas and street-railway plants.

President Kuhlman of the Kuhlman Electric Company came up from Elkhart, Ind., in the interest of his well-known transformers. Mr. Kuhlman recently brought out a new type of polyphase transformer, that has already made its mark among the central stations of the United States.

The Fort Wayne Electric Works were represented by Western Manager W. S. Goll, J. H. Raymond and C. E. Sedgwick. An exhibit was made, the company presenting type-K wattmeters, type-A oil transformers, form-C enclosed-arc lamps, revolving-fan motors, and other Fort Wayne specialties.

Among the most welcome of the prominent central-station men of the Northwest at the convention was Past-president Irving Lord of Waupaca. Mr. Lord was accompanied this time by Mrs. Lord, whose kindness and hospitality to the members of the association at the Waupaca convention will long be remembered.

R. H. Watson of the sales department of the Gregory Electric Company was one of the most welcome guests at the Milwaukee convention. Mr. Watson has earned for himself a popularity among the electrical fraternity of the West second to none, and his work for his company has proved itself productive of the highest results.

Rudolph Miehling, electrical engineer, announced at the Milwaukee convention the severance of his connection with the Walker Electric Company of Philadelphia, to accept a responsible position with the Northern Electric Company of Duluth, Minn. This latter concern does a large northwestern business as contractor and supply dealer.

The many friends, in Milwaukee and throughout the West, of Harry Byrne will be interested to know that he appeared at the Milwaukee convention for the first time as district manager at Indianapolis, Ind., for the Wagner Electric Manufacturing Company of St. Louis. Mr. Byrne will also look after the Bullock interests in Indianapolis and vicinity.

Francis Raymond III. appeared, of course, in the interests of the General Incandescent Arc Light Company. Mr. Raymond was dignified and energetic in his efforts in behalf of his company, and it is safe to say there was no more popular man at the convention than "Raymond III." Mr. Raymond was accompanied by Arc-lamp Expert Lewis Friedmann of the G. I. Company.

The Cutler-Hammer Manufacturing Company of Milwaukee made no attempt at an exhibit, but Secretary and Superintendent Arthur W. Beresford and General Sales Agent A. P. Munning of the company's New York office represented it. Mr. Munning, however, was compelled to leave for the East on Wednesday night, leaving Mr. Beresford to do the honors alone.

The Triumph Electric Company of Cincinnati appeared, as usual, in the person of Manager W. H. Jacob. Mr. Jacob was joined in Milwaukee by R. L. Thayer of the Triumph company's Chicago office. No exhibit was made, owing to the heavy nature of the company's product, but Messrs. Jacob and Thayer were in constant attendance at all the sessions and other functions.

Vice-president Phelps of the Phelps Company of Detroit, manufacturer of the well-known Hylo lamps and other devices, as usual, aroused attention. Mr. Phelps presented an exhibit of the Hylo self-flashing sign lamp, and his "skedoodle" plug, the addition of which latter specialty to a common lamp turns it into a flashing sign lamp. He also showed a Hylo pull-string and long-distance lamp.

Manager A. L. Severance of the Hotel Pfister was, as usual, most indefatigable, as was the entire staff of the Pfister Hotel, in his efforts to see that every delegate and exhibitor was taken care of in that hospitable manner through which the Pfister has won so many friends among the traveling public. The appearance of the banquet hall on Thursday night and the service were a credit to Milwaukee.

The Kester Electric Manufacturing Company, Chicago, made quite an extensive exhibit of self-fluxing stick solder, soldering paste, salts and the "auto-tipper." Looking after the interests of this company were President A. J. Witherall, Manager F. G. Dickerson and Representative J. E. Goodwin. The Kester company's strongest claim is, that it simply makes good salts, and such as are used by the largest electrical manufacturers in the world.

Indefatigable was Irving B. Cary in presenting the exhibit of the Milwaukee Electric Company. There were also on hand during the convention, representing this company, Vice-president Walter Cary and Secretary and Assistant Treasurer Thomas G. Whaling. The Milwaukee Electric Company exhibited a fine line of motors, ranging from one-eighth horsepower up to 20 horsepower. The exhibit also included an interesting type of crane motor.

Western Manager Skeel of the Chicago office of the Crouse-Hinds Company of Syracuse, N. Y., came up with the Chicago delegation on Wednesday morning. Last year Mr. Skeel made his first appearance at the Northwestern convention, and this year finds him a full-fledged member of the association. At the banquet on Thursday evening Mr. Skeel "did himself proud" in a graceful response to a toast. Mr. Skeel made a very complete exhibit of the Crouse-Hinds goods, displaying a full line of switches, switchboards and panel boards. He also presented the company's new guy anchor and a new arc headlight for steamboats and trolley cars. He showed, too, an interesting and full line of Norbitt porcelain goods.

Among those who made their initial bow at the Northwestern convention was President A. J. Pardridge of the Pardridge Shade and Reflector Company, Chicago. Mr. Pardridge made an interesting exhibit of what is practically a new invention in reflectors for electric lights. The Pardridge reflector, however, has to be personally inspected to be fully appreciated. Mr. Pardridge was one of the most welcome guests at the banquet on Thursday evening.

Hans J. Meyer was indefatigable in his efforts in behalf of the Wagner Electric Manufacturing Company and the Bullock Electric Manufacturing Company. Later, during the convention, Mr. Meyer was joined by Assistant Manager of Sales G. E. Bissell of the St. Louis office of the Wagner company and L. G. Bassett. Single-phase alternating-current motors, from one-fourth to one-half horsepower, were exhibited and a full line of circulars and bulletins were distributed.

Sales Agent G. H. Ryder attended most energetically to the interests of the Chicago Insulated Wire Company. This institution reports a most excellent business. The factory at Sycamore, Ill., is running full blast. The Chicago Insulated Wire Company is now reckoned as one of the most prosperous wire-winding plants in the United States, and the product of the company is eagerly sought after, especially in the western market, where a large stock and quick shipments are highly appreciated.

Arthur Jones of the Arthur Jones Company, Chicago, dealer in electrical machinery, arrived on Thursday and was most active in representing the business of the Mechanical Appliance Company of Milwaukee and the National Electric Company of the same city. Incidentally, it may be said that Mr. Jones' many Chicago friends were glad to know that the "Arthur Jones" mentioned in the list of injured at the recent Chicago theater holocaust was not the Arthur Jones so well known and highly thought of by the electrical fraternity of Chicago.

Secretary Thomas R. Mercein again distinguished himself as a most gifted toastmaster and after-dinner raconteur. His thoughtful and kindly remembrance of those who were not present at the banquet, as embodied in his toast, "To the absent friends, Wolff, Low and White," was received with much enthusiasm. The association made a well-deserved acknowledgment of Mr. Mercein's ability in his work for the association by delegating him to represent the Northwestern association at the coming Boston convention of the National Electric Light Association.

Western Manager George C. Keech of the Bryan-Marsh Company, accompanied by his energetic lieutenant, Manager Sawyer of the Minneapolis office, did the honors for Bryan-Marsh lamps. Mr. Keech's paper on "The Smashing Point of Incandescent Lamps" incited much comment and discussion, in that it was one of the first public expositions of the curious property of the latest type of the Bryan-Marsh lamp, through which the lamp literally commits suicide when it has reached the limit of its highest efficiency. Accompanying Messrs. Keech and Sawyer was J. S. Corby.

Manager of Sales John W. Brooks of Pass & Seymour of Solvay, N. Y., came West on Saturday of last week in order to reach Milwaukee in time to attend the Northwestern convention. Mr. Brooks made no exhibit, but covered the Northwestern convention as a portion of the trip which he is making to the coast. He will make a tour to California, thence East to Solvay again by the southern route, thus covering the western portion of the company's territory now under his jurisdiction. The Northwestern convention was the occasion of additional congratulations on Mr. Brooks' recent appointment as general manager of sales of Pass & Seymour.

Electrical Engineer E. R. Underhill of the Varley Duplex Magnet Company came on from Providence to represent President Richard Varley of the company and read a most interesting and scientific paper on "Coil Windings for Electrical Purposes." There has been of late years much curiosity among electrical people as to the Varley windings and scientific methods of constructing all sorts of electrical solenoids. The Varley-Underhill paper gave much information of value to the more scientific element of the convention. Mr. Underhill presented to the delegates each a copy of Varley's book on the electromagnet, a most valuable source of practical information.

The exhibit of the Duncan Electric Manufacturing Company of Lafayette, Ind., comprised a number of the latest types of direct-current meters. These new meters possess many novel features, which are much praised by those who have them in use. Particular attention was drawn to the new method of compensating for friction, which consists of a very neat and small multipoint switch placed within the meter and having its contact connected with various turns of the compensating coil. By the mere movement of the switch lever any desired compensation for friction or vibration can be obtained in an instant. Another commendable feature is the new visual bearing, which permits of an inspection of the bearings while the meter is in operation, besides al-

lowing the spindle point to be removed for renewals or examination with a special tool. The company was represented by Thomas Duncan, vice-president and manager; Marshall F. Holmes, president, Secretary Goltz and William F. Cothran of the testing department.

The National Electric Company of Milwaukee made quite an interesting exhibit at the Pfister. There were shown photographic enlargements of different types of alternating-current and direct-current generators of both engine and belted types. Quite a variety of portions of machines were presented to illustrate the details of construction embodied in National apparatus. Among those present were F. C. Randall, vice-president and general manager; C. P. Tolman, manager electrical department; C. G. Burton, general sales manager; Arthur Jones, Cook County sales agent; C. D. Knight, A. P. Peck, W. L. Richards, W. S. May, W. L. Waters and Advertising Manager H. Klingenfeld. The National Electric Company's invitation to visit its factory was accepted by a large number of the exhibitors.

The Browning Company of Milwaukee came to the front with a fine exhibit of high-grade dynamos and motors. The display was in charge of Mechanical Designer Franklin Sweet, Electrical Designer F. W. Ells and Ray Holden of the testing department. There was represented a 22-horsepower, 500-volt machine and a new five-horsepower, 220-volt motor. The latter machine is designed with vertical arms on one end and three arms on the other, thus making a much more open frame than was formerly the case in the design of this motor. This new type of design will hereafter be employed for all machines from three to 50 horsepower. In addition to the above machines, the Browning Company presented small dynamos—a one-horsepower, 220-volt, and a one-half-horsepower, 200-volt; also a polishing motor. Explanations were also given of the various details of the new Browning brush holder. There were presented likewise for inspection a number of the company's form-wound coils. The Browning Company has of late been making a great specialty of equipping special machinery with Browning motors, and can now point to a fine list of factories thus equipped to fulfill peculiar conditions.

The Holophane Glass Company, through its western distributer, the V. R. Lansingh Company of Chicago, made one of the most striking and popular exhibits of the convention. The company gave free to all of its visitors one of its most popular closed stalactites, and also one of its new pagoda reflectors. The large signs, reading "$1.58½ cents for nothing," which were placed in the different parts of the hotel, kept the rooms of this company crowded at all times. The dark room gave ocular demonstrations of the value of scientific prismatic glass, some of the forms showing a multiplication of the end candlepower as high as 15 times the value of the bare lamp. The room was lighted by one of the new six-light clusters put out by this company, using a special Benjamin body and six of the new style of pagodas; so marked were the effects of this new cluster, that the management of the Pfister Hotel, where the convention was held, immediately placed a large order for the same. The method of obtaining beautiful color effects for decorating purposes by the use of holophanes and pagodas was shown by a large board containing different color lamps and shades, which was attached to a Reynolds flasher, giving a beautiful effect. The best example of illumination was in the lobby and first floor of the Pfister, which was equipped with holophane globes over a year ago, every 16-candlepower lamp being replaced by a 10-candlepower, giving at the same time a very decided increase in the illumination. So pleased was the management of the hotel that it has just placed an order for equipping its dining rooms and banquet halls with the same kind of globes. This company reports that its business had grown so rapidly that the factory is now working three shifts day and night, and that its western office alone reports a business of over $100,000 yearly. The company was represented by V. R. Lansingh and H. M. Lauritzen.

Boston Electric-light Convention.

Far enough ahead to get it well fixed in the mind of everybody interested, the date of the twenty-seventh convention of the National Electric Light Association has been fixed. It is May 24, 25 and 26, 1904. The place of meeting is Boston, as selected at the Chicago meeting of last year. That city is the residence of President Charles L. Edgar, and that gentleman, with other officers, the local central-station people, Secretary Davis, Assistant Secretary Billings and many committeemen and editors of departments, is working hard to make the convention a success. Chicago had a very successful meeting last year, and Boston is determined to do at least as well and better if possible.

It was decided at a recent meeting of the electrical supply men, electrical workers and contractors of Memphis, Tenn., that hereafter all electrical work in that city must be done according to the rules and requirements of the National Board of Underwriters. The meeting was well attended and was presided over by City Electrician Robert Moran.

Incandescent Lamps and Their Smashing Point.[1]

By George C. Keech.

It is my desire to present to you to-day a paper on incandescent lamps which will clearly describe the results of considerable effort along new lines long desired but never before accomplished.

Carl Hering 10 years ago coined the phrase "smashing point," which has been part of the electrical nomenclature since that date. This expression had the excuse which gives all slang a place in our language. It filled a want. The leading minds in the industry had long appreciated that incandescent lamps were kept upon circuits long after they had outlived their usefulness. This half-descriptive phrase invited explanation and discussion. In an incredibly short time the idea that 80 per cent. of the initial candlepower of a lamp was the limit of its useful life was universally adopted. From the very birth of this expression came the thought that the next step toward the ideal lamp was to make a lamp which would automatically die when it had lived out its usefulness.

Every station is troubled with poor lamps, and to obviate this many companies go to the expense of periodical renewals. Although this expense is apparently heavy, there are cases on record of eight per cent. dividends being paid by companies who have renewed all the lamps on their lines as many as four times a year, and their customers have always had bright light.

Alex Dow, of the Detroit Edison Illuminating Company, has stated that 90 per cent. of customers' complaints could be traced to dim lamps. Dim lamps do one of two things, and sometimes both. They disgust the user by their pale-yellow glimmer, or increase his bills because he uses more than he ought; either way the reaction is against electric light and the lighting company. This dissatisfaction arising from poor illumination makes renewals a necessity.

For those who are interested in the proposition of free renewals I would refer to a paper read at the National Electric Light Association meeting in Cincinnati in 1902 by a central-station manager, wherein he stated that since adopting free renewals he had passed beyond the point of complaint of service. Another stated that he had retained a number of dissatisfied customers by giving them a few new lamps to prove that the trouble was there instead of in the system, and by doing this he unwittingly converted himself to the free-renewal plan.

Some recent improvements in the manufacture of incandescent lamps have created such extensive comments that it seems necessary to explain before this convention for the first time the reasons and results of these experiments. It has been said that the filament is the heart of the lamp and the vacuum its lungs. As to the vacuum, it is now produced by a process of chemical exhaustion which is considered the only perfect one. It is well, however, to go into some of the details of the development of the filament which will best lead up to the points in question.

The years 1878 to 1880 saw the inception of what approached nearest to the present incandescent lamp, and since that time the composition of the filament itself has claimed a large share of the experimenter's attention. Various materials have been used. The paper filament of Maxim, the cotton thread of Swan, and the bamboo of Edison were all, however, of cellulose, so that cellulose has been the basis of all lamp filaments since the beginning.

The present cotton fiber is mixed with certain ingredients formed into a pasty mass and squirted under a high pressure through small apertures into threads whose original diameter before carbonizing is about four times greater than when it is ready to put into the lamp. The exact composition and exact processes are in a great measure secret, but a general idea may be had from these statements.

Speaking of possible improvements along this line, Dr. Lewis Bell, in his work on the "Art of Illumination," states: "It may be that we must look to the chemist rather than to the electrician for the final word as to illumination." I may add that the combined knowledge of chemistry and electricity has brought about the results which I shall mention shortly.

It is in the engineer's laboratory that the regulation of the life of the filament has been worked out and the automatic smashing point assured.

To refer again to the process of developing the filament from the original cellulose thread: After squirting it is shaped and packed in a crucible with powdered graphite and baked until thoroughly carbonized. Considerable effort is required to make this thread of an even diameter for its entire length. The process of treating consists in passing a gradually increasing current through the filament in a bath of hydro-carbon vapor. The hot filament decomposes this vapor from which the carbon is deposited upon it. This process is continued until the thread has received a complete coating of hard pure graphitic carbon, which gives it greater mechanical and electrical stability when operated in the lamp, and also makes it of the proper diameter and resistance for the voltage and efficiency for which it is intended. Although the treating is valuable, yet a proper foundation is necessary, and it is to this foundation that great efforts have been given.

All of the above has been explained to show the possibility of changing the value of lamps by skillfully manipulating the filament in its manufacture.

Now to summarize. Customers should have bright light every hour and every ounce of coal should produce good value in light. Complaints should be stopped by getting dim lights off the circuits. A consumer should get an average of 90 per cent. of the lamp's initial candlepower.

It is agreed that a lamp is useless after it has depreciated 20 per cent. As everyone realizes that it is economy to remove a lamp at this point and as but few practice it the only really economical lamp to use is one which will burn out at or near its smashing point. If, then, it were possible to have lamps automatically extinguish themselves when they had fallen to this point where they were no longer economical, say at 20 per cent. below their initial candlepower, one great step toward the final popularization of electric lighting would be accomplished.

Discussion (in abstract).

W. H. Schott, Chicago: I did not quite understand what point Mr. Keech considered the proper smashing point.

Mr. Keech: Twenty per cent. below the initial candlepower.

President F. W. Bowen, Kenosha: That is at 12.8 candlepower practically?

Mr. Keech: The ordinary performance of an electric lamp is something like this: Starting at 16 candlepower it will rise slightly for the first 75 or 100 hours, and then it will continue to drop. Now, this 12.8 candlepower is 80 per cent. of 16 candlepower, and that point has been determined by authorities as the point at which a lamp is no longer economical.

Mr. Schott: The frequent changing of lamps is a good thing to maintain candlepower, but the tendency of cities is to force companies into lower rates, and it is an open question whether they can go into too great expense to maintain that.

Mr. Keech: The average burning of a lamp is, say, two hours per night, and one lamp at half a cent would bring you in revenue of one cent per night, 50 lamps 50 cents; and in 365 nights those 50 lamps would bring in about $180, so that 50 dead lamps on your line, if they had been burning, would have given you $180 worth of current, and you expect to make your money out of the sale of the current.

J. H. Harding, La Porte, Ind.: I do not quite understand. Is it not a fact that as your lamp grows dim you find a complaint from your customer very often, due to the size of his bill, which is due to the fact that his lamps are dull and he has to burn two lamps where he would otherwise burn one?

Mr. Keech: That is the idea.

Mr. Harding: If you want to avoid the complaint you must get rid of those lamps.

Mr. Schott: I find, according to my report, that the average renewals are about a lamp per year for your connected load. For instance, with about 7,000 lamps connected with your station, about 7,000 would be the average number of renewals. That will vary somewhat when you take into consideration the character of the business to which you are furnishing current, and that statement applies particularly to a residence territory, but if you have a commercial plant the percentage of renewals will materially increase. In the Indianapolis plant we have strictly a commercial business; we have a load line running 10 hours a day and the renewals run up; but in the ordinary country plant where anywhere from 30 to 60 per cent. of the connected load is for resident use, about one lamp per year for each lamp connected would be a fair average to consider. In a town of 10,000 or 12,000 inhabitants, 7,000 lamp renewals would cost about $1,400; and you can readily arrive at a percentage basis from those figures.

President Bowen: No stated percentage of the cost of renewals can be given. To my mind the question is, What does it cost you per kilowatt-hour of current sold per lamp renewals? That is the whole story.

Mr. Schott: I use a 52 to 57-watt lamp (55 on an average). If you run your voltage a little high you will increase your candlepower. If you increase the voltage on your lamp one per cent., you increase its candlepower 6.2 and decrease its life 25 per cent.

President Bowen: But that involves the use of a higher voltage current during all the hours of the burning of that lamp. Now, if you succeed in burning a lamp which presumably has anywhere from 600 to 800 hours of useful life at one per cent. above its voltage for 100 hours you decrease the light of that lamp quite materially.

Mr. Keech: If you burn a lamp three per cent. high you will cut its life right in two, no matter what the efficiency is. The curve is not exactly straight. A 3.5-watt lamp burning three per cent. high will last about 54 per cent., and a 3.1-watt lamp on the same circuit will last about 50 per cent. of its life on the average, because the 3.1-watt lamp is more delicate. With a 3.5-watt lamp run two per cent. high, you will cut its life in two. So far as the light is concerned it will be the same as a 3.1-watt lamp.

P. H. Korst, Janesville, Wis.: Mr. Schott says it is his practice to use a 56-watt lamp and force

1. Abstract of paper read before the Northwestern Electrical Association at Milwaukee on January 20, 1904.

it up, and he gets more candlepower and shorter life. Now, is it not better practice if you want to accomplish the shorter life to buy a lamp built for that—the higher-efficiency lamp for, say, 20-candlepower at three watts per candle, instead of using a 16-candlepower lamp 56 watts and crowding it and increasing your watts' consumption?

Mr. Keech: I should judge it would, because from the manufacturer's standpoint you can get a closer selection on a 3.1-watt lamp than on a 3.5. Strictly you get the best service by operating the lamp at exactly the voltage for which it is built. You shorten the life, but the lamp is going out at that point anyhow, whether you burn it high or low; so, why not burn it at normal voltage and let it go out? The very low-efficiency lamp is more liable to burn for 2,000 or 3,000 hours at very low candlepower than the 3.5-watt lamp.

Mr. Harding: For a number of years I have obtained a good deal better results by following out this plan: During the heavy part of the evening—the important lighting hours of the evening—I am in the habit of running my lamps two volts high, that is, 108-volt lamps at 110, cutting off along about 10:30 to the 108-volt, and maintaining it there for the balance of the 24 hours, or until the lighting load comes on the next afternoon. In doing that I have materially reduced the lamp renewals on our plant, and I know that I am giving better satisfaction to my customers than I did when I undertook to hold my voltage right at the point at which the lamp was built to run. It is a well-known fact that you take a lamp and put it out on the circuit and go to any plant operating it at the required voltage and they complain that the lamps are dead, and we find in order to hold up business that it is necessary to force the lamps up during those hours. The balance of the time it is all right.

Mr. Keech: That is something that is regulated, I presume, a great deal by local conditions. There is no doubt that when you force your lamp a couple of volts high you are cutting its life a little. You could not force it up one night and not the next night, because your customers would notice the difference right away. Does this complaint ever arise during the first part of the evening, that the light is very brilliant, but later in the evening it drops down?

Mr. Harding: No. That is due to the fact that later in the evening in a town of our size the general consumption of light is cut off on the street, so that a 14-candlepower lamp shows up much better after 12 o'clock than a 20-candlepower light would at 8 o'clock when everybody is lit up.

President Bowen: Mr. Harding thinks it good practice to raise his voltage. There has been some question whether his lines were of ample capacity, his transformers the same, and whether there was any relation between his transformer losses at full-connected load, so far as voltage losses are concerned, and at a partly connected load. Of course all of those things enter into this calculation. It is a fact that almost every small station is a little overcrowded after it has been operating for a time, and it must necessarily buy 108-volt lamps in order to do a business that is as satisfactory to the consumer as it used to be in the years gone by when 110-volt lamps would produce the same result. A careful calculation will show the manager in some of the stations: If there is a pressure wire running back to the switchline, the wire does not tell the truth; also, that the transformers are losing in their efficiency through the raising of their temperature, and there is a loss that perhaps has not even been thought about; so he finds he is really overloaded and did not know it. That is the general condition of stations that have been operated for a number of years, unless they get at the root of those things and put up the copper necessary and put their transformer system into such shape that it can be in the closer district networks. I do not know but that Mr. Harding does this thing. It may be his standard practice, but if any central-station man will go to work in his closer crowded districts and put his transformers on a network he will find that he can get along with from 25 to 33 per cent. in transformer-rated capacity of what he could if he relied on individual transformers—that is, not for each individual consumer, but I mean the block system—if he connects his blocks by network he will find a great many of his voltage troubles disappear.

Alternating-current Motors for Indianapolis-Cincinnati Road.

The Indiana correspondent of the Western Electrician makes the following interesting announcement: "The City Council of Rushville, Ind., has extended the franchise of the Indianapolis-Cincinnati electric traction line. This is necessary from the fact the directors have decided to equip the cars with alternating-current motors which will require six months time to complete. President C. L. Henry says each car will have a capacity of 475 horsepower with an almost limitless speed. He explains that the company first decided to build a third-rail system, but later decided to use the trolley system, with alternating current, which will give much better speed, and which, when completed, will be one of the finest in the country and perhaps the only one operated by the alternating-current system. Mr. Henry and his engineer are now in Pittsburg to let the contract to the Westinghouse company for 15 motors."

Double-current Generators and Double-current Supply.[1]

By W. L. Waters.

It is the old question of alternating currents vs. direct. The advantage of alternating currents, of course, is the ease with which they can be generated and handled at high voltage, and the ease with which they can be transformed by means of stationary transformers. The direct current, on the other hand, is not suitable for use at high voltages, but is suitable for all classes of motor work, and while it is very difficult to use alternating currents, or they are very unsuitable for street-railway work, or in variable-speed motors or elevator motors, that is just the case in which the direct current is most suitable; so that you can see that alternating and direct currents are to a certain extent complementary; the advantages of the one correspond to the disadvantages of the other, and vice versa.

So in a case in which these advantages and disadvantages are both important, the natural question comes up, Why not have a double-current set; that is, both alternating currents and direct currents? In a number of instances this plan has been adopted. That usually means that in a small town you have direct currents for the street-railway work and alternating currents for lighting, and in large cities you have direct currents for downtown, where motor loads are important, and alternating for uptown districts, where the load is almost entirely for lighting.

The usual method of arranging your central station has been to have both alternating and direct-current sets, each set having its own engine, and while, of course, that is extremely simple and very flexible and answers all requirements, yet the disadvantages are obvious. Your alternating-current load and direct-curent load are never at a maximum at the same time. The direct-current load will be at a maximum in the daytime and the alternating current will be at a maximum in the evening, so that you have only practically one-half your sets in use at one time, the alternating sets at night and direct-current sets in the daytime, and you have almost double the outlay in station machines running on light load. You have extra cost of attendance and maintenance. So it has naturally occurred to all operating engineers, that it ought to be possible, in some way to tie the two systems together, so that they can help out one another at the times of the peak of the load. This, of course, has been done by having both a direct and alternating-current generator coupled to the same engine. This is an extremely flexible arrangement and quite frequently used, the only trouble is that it is a compromise in the question of cost. You have two machines on one engine, instead of two generators and two engines. The efficiency remains about the same, because you still have your alternator running on load part of the time. This combination takes up a certain amount of extra floor space, and you have two machines to keep up instead of one, as you would have if you employed a double-current generator.

A motor-generator set is extremely flexible for tying the two systems together, but it is fairly expensive and inefficient. The rotary converter is more efficient, less expensive and occupies less floor space; but the volts on the two sides have a practically fixed ratio, which takes away from the flexibility of the system. So, on the face of it, it looks as if the double-current generator has great advantages and gives good efficiency, because you may have a light load on the alternating-current side and a light load on the direct-current side, which, combined, will make a thoroughly reasonable load for a double-current machine. It occupies little floor space, but it has the advantage that the volts on the two sides have a fixed ratio, just as in the rotary converter, and it has also another slight disadvantage, that the load coming on the one side affects the volts on the other. But in a well-designed machine the volts are only affected to a slight extent, and generally that can be neglected.

From the manufacturer's point of view, the great disadvantage of double-current generators (and that is the main reason why so few are being installed) is that double-current generators are usually special machines. They usually mean special designs, patterns and dies for the manufacturer, and he might have to use those designs and patterns just on that one machine. If that is so, of course, the central-station man has to pay for that. You can take any direct-current generator and put collector rings on the back end and make an alternating-current machine out of it. The reason that it cannot be used as a double-current generator, is because the frequency is usually unsuitable. The frequencies in use for alternating-current generators are pretty well standardized at 25, 40 and 60. The ordinary engine-type, slow-speed generator, will not often fit in with that frequency. You can take an alternator and design it for almost any frequency, voltage or speed, you like, without extra cost; but if you come to a direct-current machine the question is different; the voltage and output of the machine practically decide the number of poles that are going on that machine, and that, with the speed, decides the frequency. If that number of poles has to be altered in order to get another frequency, to make it suitable for our direct-current generator, that may increase the cost of the machine very considerably.

And so the question comes down to one of cost, and I give a list of the standard frequencies of ordinary direct-current generators, or the frequencies which you will obtain by putting collector rings on the back. If you want to buy a direct-current generator in any case, if you can choose one of these whose frequency nearly fits in, or is nearly the same as the one you want, you will be able to get that machine much cheaper than a machine that has to be made specially.

List of Frequencies.

	Engine Type.		Belt Driven.		Steam Turbine Driven.	
Kilowatt	250 V.	500 V.	250 V.	500 V.	250 V.	500 V.
25	15	15	10	10		
50	14	14				
100	13	13				
250	12	8	25	25	60	60
500	12	8	25	25	60	60
750	14	10				
1,000	15	11				
1,500	20	16				
2,500	22	18				

If we take the standard frequency at 25, 40, or 60, you see there are quite a number of machines in that list that will fit in very well with that frequency. For instance, take a 2,500-kilowatt, 250-volt engine-type generator, the frequency on the list is 22. That can very easily be speeded up 10 per cent. and make it 25, and you have a first-class double-current generator, which is a standard machine.

Suppose, on the other hand, we took a 500-volt traction machine. The nearest frequency on the list is eight—that is nothing like 25, and if you wanted a 25-cycle double-current generator of that voltage and speed and number of poles, it would have to be specially built, and would probably cost double the price of a standard machine.

Speaking generally of double-current generators, as regards the difficulty of manufacture and operation, they are much the same as rotary converters. Twenty-five and 40-cycle machines can be built quite easily, but when you get a 60-cycle machine, you begin to get difficulties on the commutator on account of the high peripheral speed, which, on a 500-volt machine, is quite serious. To get 60 cycles you must have a certain number of poles, and to have a reasonable number of volts for a commutator bar, you cannot go too high; that gives you a certain number of segments on the commutator, and that, with the speed, gives you the design of the commutator, and that gives extremely high peripheral speed on the commutator, a large number of segments, and the commutators are very difficult to build.

With an ordinary standard machine, for instance, 2,500 kilowatts, the only change required to make it an alternating-current generator, is to put collector rings on the back, slightly increase the air gap and put more copper on to obtain good regulation when running on the alternating-current side. The extra copper at the collector rings ought not to increase the cost of any standard machine more than 15 to 20 per cent.

Looking down the list (see table), you see that 25-cycle machines, if of large output, can be made engine type, but if they are of small output, that is, up to 500 kilowatts, the engine-type machine has not high enough frequency, and the machines ought to be belt-driven.

The 40-cycle machines have to be all belt-driven if they are to be standard. None of the engine-type of machine on the list has a frequency as high as 40, so if you wanted it to be an engine-type of machine, you would have to have it built special. Of the 60-cycle machines, the only ones that look promising are the steam-turbine-driven sets, but there are no direct-current-system turbine machines on the market at present. However, there will be probably shortly, so that they can be regarded as a possibility for the future.

Discussion (in abstract).

George W. Colles, Milwaukee: I understand from Mr. Waters that his plan is more practicable on high-output, large-capacity machines than on small-capacity machines; and I understand him also to say his plan is almost impracticable on the engine-type of slow-speed machines, on account of the frequency being too low. On the other hand, these generators are rather difficult to apply to the steam-turbine type, on account of the speed being too high to run the direct-current end of it. In other words, the limit of speed at which the commutator can be successfully applied is below that at which the steam turbines can be driven.

Two things have occurred to me—one for and the other against these machines. One is that the current losses may be double that of two machines, each having the same capacity in alternating and direct current, respectively. You are still saved your cost of separate engines in cases where these machines are direct-driven, but, on the other hand, in all cases, as I understand it, it will be practically [illegible] these machines are used; whereas, with a separate [illegible] use any such step-up transformer.

Mr. Waters: Standard direct-current machines, when used, have both advantages and disadvantages.

1. Address before the Northwestern Electrical Association, January 21, 1904.

Vertical engine types are not suitable for direct-current generators, even if they are built [illegible] if you can pay anything you wish, the manufacturers will build anything you like; but if you use the standard machines, you will only pay 15 to 20 per cent. more, and that is an offset against the step-up transformer. If you want 20,000 volts, say, you would have to have step-up transformers in any case.

J. W. Shuster, Madison: Mr. Waters has confined his remarks mainly to the 500-volt, direct-current machine, and I think he said it was a practical impossibility to design a 500-volt machine for 60 cycles, without getting into a good deal of difficulty in the way of commutation. Now he has mentioned a number of the advantages that have come from the use of the direct-current generator for a lighting load in the center of the city, and perhaps the motor load also, and then transmitting an alternating current to another part of the city and using it for lighting or alternating-current motors. I would like to ask if it is found that the direct-current generators work perfectly satisfactory, generating 220 volts direct current, and then taking the alternating current, which would be something smaller, and using that to transmit to the more distant load. It seems to me that if the standard direct-current machine could be speeded up to give this higher frequency, and the commutation should be perfectly satisfactory on a 220-volt machine, a machine of that kind might be made perfectly satisfactory, and by the use of the system of choke coils, you might get a double-voltage direct current, both 220 and 110, and get the alternating current for transforming. If that is perfectly possible from the designer's standpoint, and with all these advantages, I would like to inquire whether the manufacturer cannot design a standard double-current generator and put it on the market and show its superiority, so that the manufacturer will get customers enough for that machine to make it a standard machine, so that it can be sold at practically the same price as a direct-current machine. Or, perhaps, if the standard direct-current machine has to be treated to get this 60 cycles, then, of course, questions come in which tend to reduce the price of the machine, so that the double-current generator, it seems to me, might be put on the market as the standard generator, for what the direct-current machine costs, or perhaps less.

Mr. Waters: As regards the question of putting a standard line of double-current generators on the market, that is more a business question than anything else. If we can get you to buy standard machines, we will do it, and we will not get out a line of special machines, which will not be bought for years perhaps. It is the same question as in alternating-current traction work—it can be used, but all companies have standard patterns and dies, which have been in use for some time on direct-current work, and they will not switch over unless they are made to; so that if any suggestion such as this is ever taken up, as regards getting out a standard line of double-current generators, it will not be done without the manufacturers are forced to it, because it is not a commercial proposition to waste three or four years trying to get somebody to take up a machine which you cannot guarantee and have a quick return from. There are no patents covering such a machine, and if one firm took it up, as soon as they had brought it out on the market and it was successful, it would be copied by other firms, and the firm bringing it out would not be repaid for the trouble it had had.

V. R. Lansingh, Chicago: Where the load is so large that the central station will have to run a direct-current generator for a railroad system and a very large load for an alternating system, as it would be in a large city, it does not seem to me that it would be any advantage.

Mr. Waters: It seems to me that is partially true, because what decides the size of your station, whether alternating current and direct current, is the peak of your load.

Mr. Schuster: In regard to the last question, it seems to me the double-current generator would only be applicable where the load would not vary rapidly, as in railroad work, so that, from the standpoint of regulation, I think the answer to Mr. Lansingh's question is that they would not be applicable under any circumstances, because of the difficulty in regulating voltage for a railroad system, which would affect the entire system, and would not be desirable from the standpoint of regulation.

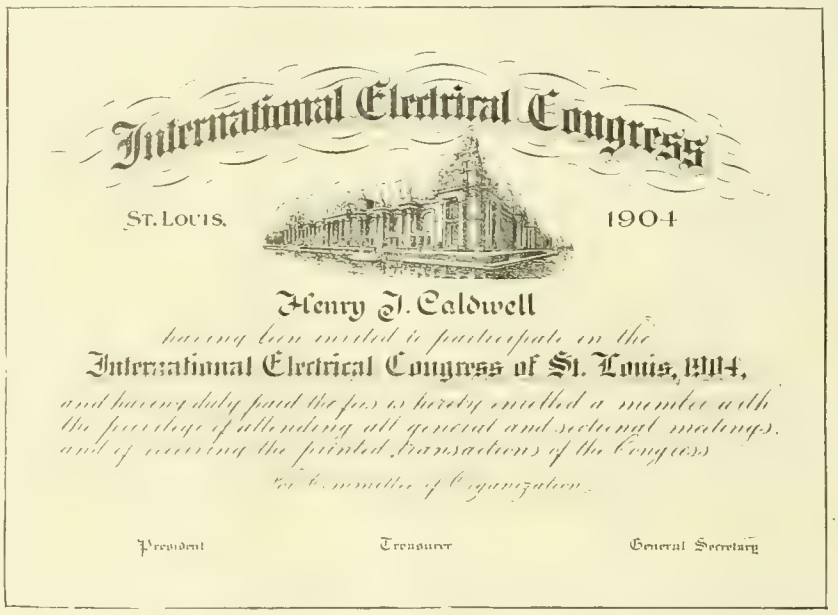
President Bowen: It looks to me as though perhaps the whole matter was one of expediency with each of your individual stations. It seldom is good practice to run an engine underload to, say, 50 per cent., and that is practically where you would stand with any double-current piece of apparatus. I doubt very much whether it is good policy to run a 500-horsepower engine at less than 250 horsepower, or, possibly, 200, which would frequently be the case, so that always this question of double-current generators is up against your prime power, in my opinion. If it is good practice to run your prime power underload at certain times of your 24 hours, well and good, but we have got to have the prime power there to cover the peak of the load anyway, whatever it may be, and your peak seldom lasts more than one or two hours at the outside.

Preparations for International Congress.

Up to January 19th about 3,550 circular letters of invitation to join the International Electrical Congress had been issued to persons or associations in North America. From these, 875 postcard acceptances of membership have been received. About 350 similar circular letters of invitation have been recently sent to other countries. It is intended to issue in all about 5,000 invitation circular letters in American and about 6,000 in foreign countries. It is expected that many persons will join the congress, both in America and abroad, who do not expect to attend the sessions in St. Louis, in order to secure a copy of the Transactions, which will form one and perhaps two, large octavo volumes. Collection of fees has commenced, and upon receipt of a fee the member will be forwarded a certificate of membership, a reproduction of which is shown herewith. The certificate is 8½ inches by 11 inches in size and printed on heavy paper of excellent quality.

Recently 280 special letters of invitation have been issued, on behalf of the committee of organization, to prominent electricians and electrical engineers, signed by the president and the general secretary of the committee, requesting papers for the congress in the various sections. Of these, 146 have been sent to foreign authors and 134 to American authors. There has not been time to receive replies from more than a few foreign authors, but 21 acceptances have, up to date, been received from abroad and 46 acceptances from North America. Sixty-seven papers have thus already been promised for the congress, and the number is steadily increasing. A considerable further number of invitations to contribute papers have yet to be issued. It is hoped that the congress will convene with a full programme in each section, and that at least half of the papers may be from foreign countries. According to the plans of the committee, papers for the congress programme are specially invited, but papers voluntarily offered will be submitted to the officers of the sections to which the papers belong, and may be included in the programme by invitation at their request, if the subjects are desirable, and if the schedule allotted to each section will permit, it being the desire of the section officers to secure and offer the best possible programme and presentation.

All communications should be addressed to the general secretary, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass.



FACSIMILE OF CERTIFICATE OF MEMBERSHIP IN INTERNATIONAL ELECTRICAL CONGRESS.

Mr. Garrison's Death.

Additional details in relation to the lamented death of William O. Garrison, president of the Columbia Incandescent Lamp Company, which occurred in St. Louis on January 17th, as noted in the Western Electrician last week, are now at hand. Mr. Garrison had been in poor health for a number of months, being confined to his bed early in September, owing to trouble with his leg and hip, which at first appeared to be sciatic rheumatism, but which afterward developed into inflammation, the result of the grip. It was not supposed, however, until a short time before his death that he was in a dangerous condition, as he had been able to conduct his business in his usual vigorous way while confined to his bed. But not long before the end he gave evidence of a decided weakness of the heart, and this was the direct cause of death.

Mr. W. O. Garrison was born in St. Louis, December 14, 1851, and had been officially identified with the Columbia company since 1891. Since the death of the former president, J. S. Rhotehamel, he had given all of his time to the company. Mr. Garrison was for many years a member of the firm of D. E. Garrison & Co., western agents of the Illinois Steel Company, and dealers in general railway supplies. Early in the '90's he assisted in organizing the St. Louis Radiator Manufacturing Company, and was president and general manager of that company until 1898, when it was consolidated with the American Radiator Company.

Mr. A. C. Garrison, brother of Mr. W. O. Garrison, has succeeded to the presidency of the Columbia Incandescent Lamp Company. He will give his entire time to the business.

Verdict of Coroner's Jury in Iroquois Theater Inquest.

The verdict of the coroner's jury in the case of the 571 victims of the Iroquois Theater fire was rendered on January 25th. Following is the full text of this momentous verdict:

An inquisition was taken for the people of the state of Illinois at the council chamber, City Hall, in the city of Chicago, in the county of Cook, on the 31st day of December, A. D. 1903, and the 1st, 2d, 4th, 5th, 6th, 7th, 8th, 9th, 11th, 12th, 13th, 14th, 15th, 16th, 18th, 19th, 20th, 21st, 22d, 23d and 25th days of January, A. D. 1904, before me, John J. Traeger, coroner in and for said county, upon viewing the body of Mary Edna Torney, then and there lying dead, upon the oaths of six good and lawful men of the said county, who being duly sworn to inquire on the part of the people of the state of Illinois into all circumstances attending the death of the aforesaid that the said Mary Edna Torney, now lying in 168 East Eighteenth street, in said city of Chicago, county of Cook, state of Illinois, came to her death on the 30th day of December, A. D. 1903, in the building known as the Iroquois, Randolph and Dearborn Streets, from asphyxiation, shock and injuries caused by the drapery over the stage at the proscenium arch in said theater taking fire from an electric arc light used in the production of the play known as "Mr. Bluebeard, Jr.," on December 30, A. D. 1903, at which the said Mary Edna Torney was one of the audience in the said theater, and from the testimony presented to us we, the jury, find the following were the causes of said fire:

Grand drapery coming in contact with electric flood or arc light situated on iron platform on the right hand of stage, facing the auditorium.

City laws were not complied with relating to building ordinances, regulating fire-alarm boxes, fire apparatus, damper or flues on and over the stage and fly galleries.

We also find a distinct violation of ordinance governing fireproofing of scenery and all woodwork on or about the stage.

Asbestos curtain totally destroyed, wholly inadequate considering the highly inflammable nature of all stage fittings, and owing to the fact that the same was hung on wooden battens.

Building ordinances violated in closing aisles on each side of lower boxes and not having any fire apparatus, dampers or signs designating exits on orchestra floor.

Building ordinances violated regulating fire apparatus and signs designating exits on dress circle.

Building ordinances violated regulating fire apparatus and signs designating exits on balcony.

Generally, the building is constructed of the best material and well planned, with the exception of the top balcony, which was built too steep, and therefore difficult for people to get out of, especially in case of an emergency. We also note a serious defect in the wide stairs, in extreme top east entrance leading to the ladies' lavatory and gallery promenade, same being misleading, as many people mistook this for a regular exit and, going as far as they could, were confronted with a locked door, which led to a private stairway, preventing many from escape and causing the loss of 50 to 60 lives.

We hold Will J. Davis, as president and general manager, principally responsible for the foregoing violations in the failure to see that the Iroquois Theater was properly equipped as required by city ordinances, and that his employes were not sufficiently instructed and drilled for any and all emergencies, and we, the jury, recommend that the said Will J. Davis be held to the grand jury until discharged by due course of law.

We hold Carter H. Harrison, as mayor of the city of Chicago, responsible, as he has shown a lamentable lack of force, in his efforts to shirk responsibility, evidenced by testimony of Building Commissioner George Williams and Fire Marshal William H. Musham. As heads of departments under the said Carter H. Harrison, following this weak course, have given Chicago inefficient service, which makes such calamities as the Iroquois Theater horror a menace until the public service is purged of incompetents, and we,

the jury, recommend that the said Carter H. Harrison be held to the grand jury until discharged by due course of law.

We hold George Williams, as building commissioner, responsible for great neglect of his duty in allowing the Iroquois Theater to open its doors to the public when the said theater was incomplete and did not comply with the requirements of the building ordinances of the city of Chicago, and we, the jury, recommend that the said George Williams be held to the grand jury until discharged by due process of law.

We hold Edward Laughlin, as building inspector, responsible for gross neglect of duty and glaring incompetency in reporting the Iroquois Theater "O. K." on a most superficial inspection, and we, the jury, recommend that the said Edward Laughlin be held to the grand jury until discharged by due course of law.

We hold William H. Musham, fire marshal, responsible for gross neglect of duty in not enforcing the city ordinances as they relate to his department and failure to have his subordinate, William Sallers, fireman at Iroquois Theater, report the lack of fire apparatus and appliances, as required by law, and we, the jury, recommend that the said William H. Musham be held to the grand jury until discharged by due course of law.

We hold William Sallers, as fireman of the Iroquois Theater, for gross neglect of duty in not reporting the lack of proper fire apparatus and appliances, and we, the jury, recommend that the said William Sallers be held to the grand jury until discharged by due course of law.

We hold William McMullen, electric light operator, for gross neglect and carelessness in performance of duty, and we, the jury, recommend that the said William McMullen be held to the grand jury until discharged by due process of law.

We hold James E. Cummings, as stage carpenter and general superintendent of the stage, responsible for gross carelessness and neglect of duty in not equipping the stage with proper fire apparatus and appliances, and we, the jury, recommend that the said James E. Cummings be held to the grand jury until discharged by due course of law.

From testimony presented to this jury, same shows a laxity and carelessness in city officials and their routine in transacting business which calls for revision by the mayor and City Council, and we, the jury, demand immediate action on the following:

Should have classified printed lists, to be filled out by an inspector, then signed by the head of the department,

Fig. 1. Box letter Sign

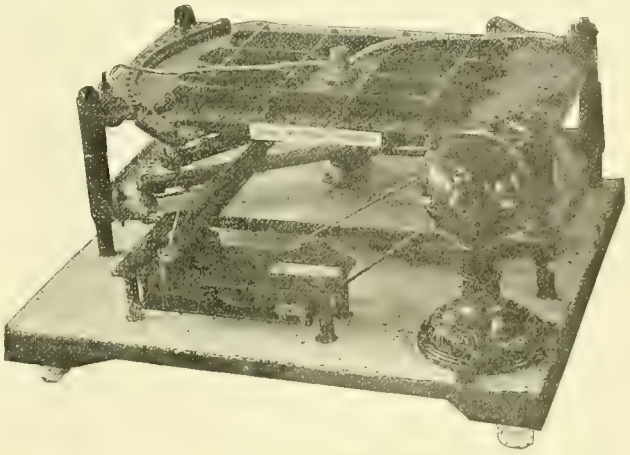


Fig. 2. Dimmer Apparatus

HALLER ELECTRIC SIGN AND DIMMER.

before any public building can secure permanent license and record kept thereof in duplicate carbon book.

All fire escapes should have separate passageways to the ground, without passing any openings in the walls. All scenery and paraphernalia of any kind kept on the stage should be absolutely fireproof.

Asbestos curtains should be reinforced by steel curtains and held by steel cables. There should be two electric mains entering all places of amusement, one from the front with switchboard in box office controlling entire auditorium and exits and one on the stage, to be used for theatrical purposes.

All city officials and employes should familiarize themselves with city ordinances as they relate to their respective departments, and pass a rigid and signed examination on same before they are given positions. This same rule should be made to apply to those holding office.

All theaters and public places should be supplied with at least two city firemen, who shall be under direction of the fire department and paid for by the proprietors of said places.

We recommend that the office and detail work of the fire department, as imposed on the fire marshal, be made a separate and distinct work from fire fighting, as it is hardly to be expected of any fire marshal to give good and efficient service in both of these branches; also a police officer in full uniform detailed in and about said place at each and every performance.

Electrical men will note with great interest that the only recommendation of an electrical nature is that there should be two sources of current supply and two switchboards, one for the auditorium and front of the house, to be located in the box office, and the other on and for the stage.

The testimony before the coroner's jury consisted of the evidence of 180 witnesses.

A new theater-building and fire-protection ordinance was passed by the Chicago City Council January 18th. Later the City Council voted to give the theaters until September 1st to make some of the more extensive alterations, such as the installation of automatic sprinklers, etc. The following provisions, however, must be complied with before opening.

Brick proscenium walls and steel curtains.

Fire apparatus and fire-alarm equipment.

Two or more firemen.

One or more vents or flue pipes over the stage.

Fireproof scenery and stage settings.

Entrances, exits, stairways and aisles sufficient, in the judgment of the mayor, commissioner of buildings and the special aldermanic committee, to render the theater safe.

Fire-alarm boxes shall be installed on all floors, on the stage and in the ticket office.

All lights in the lobby, corridors, ticket office and every part of the building, except the auditorium and stage, shall be controlled by separate switches located in the lobby.

The use of calcium lights is forbidden and all arc lights used shall be subject to the approval of the city electrician.

All stairways and corridors shall be supplied with a supplementary lighting system of electricity, gas or sperm oil, and shall be in operation during the whole period the theater is open to the public.

Only enough persons shall be allowed to enter the building to fill the seats.

Haller Electric Sign and Dimmer.

Great progress has lately been made in the manufacture of electrically illuminated advertising signs in order to meet the requirements not only of the customers but also of the various electrical inspection departments. A type that is receiving recognition to-day is the all-metal sign made by the Haller Machine Company of Chicago. In Fig. 1 is shown an all-metal autograph sign made of box letters, which is fire and water proof. The sign is handsomely decorated in colors and gold leaf and is of attractive appearance in the daytime as well as at night.

This sign is operated by a novel current-saving device (Fig. 2) made by the Haller company, which consists of a theater dimmer automatically operated by an electric motor, with a result that the sign is gradually lighted up from total darkness to full candlepower, and after retaining its full brilliancy for several seconds is gradually dimmed to total darkness. This has the same effect as that secured by the use of a flasher in drawing the attention of the public toward the signs; at the same time it effects a considerable saving of current. This device, while higher in first cost than a flasher, is exceedingly simple and cannot readily get out of order. The sign "Manicini's" shown is a double sign connected on a three-wire system and is operated by a double dimmer in such a manner that while one side is lighted brilliantly the other one is in total darkness. Less current is consumed in this manner than if the sign was in continuous operation.

High-pressure Gas Distribution.

A gas-power installation of exceptional interest is now under construction by the Laclede Gas Light Company of St. Louis, Mo. The system has for its object more efficient distribution of gas over larger areas than may be economically covered by the simple method of running large low-pressure mains from a centrally located gas-generating plant to supply all parts of the city. The system under construction is intended to supply the entire city of St. Louis, embracing an area of approximately 65 square miles.

It is evident that in order to serve the outlying districts of such an area one of three methods must be employed—first, large low-pressure feeder from central holder to center of district to be covered; second, medium-sized feeders from main holder to auxiliary holder in center of district, or, third, high-pressure feeder to distributing center, using pressure-reducing valves at this point for obtaining proper pressure upon the service lines. The expense for construction entailed by the first two methods has practically prohibited their use in St. Louis, and the high-pressure system is being installed. With this system the size of the feeder pipes is greatly reduced and the necessity of auxiliary district holders is entirely done away with.

For serving suburban communities lying far beyond the city limits this method may be extended and the pressure of the gas raised to any desirable extent for transmission through small pipes, this pressure being reduced at the suburban distributing center by pressure regulators as in the medium-pressure system above mentioned.

This gas-distribution system as a whole presents a striking similarity to the ordinary alternating-current distribution system with primary high-pressure feeders, reducing transformers and secondary low-pressure distributing lines, the theory of high-pressure transmission being in both cases identical.

The pressures to be employed in the system under construction at St. Louis are approximately five pounds per square inch for the medium-pressure feeders and from 20 to 80 pounds per square inch for the high-pressure suburban feeders. On account of the use of cast-iron mains the five-pound limit was chosen for the medium-pressure system, but for the high-pressure system iron pipe with screwed fittings will be used. With this construction any desirable pressure may be carried with entire safety and the radius of distribution extended to 100 miles if necessary.

In the medium-pressure system the gas pressure will be supplied by a blowing unit, consisting of a standard Connersville blower direct-driven by a 300-horsepower Westinghouse horizontal gas engine. The engine is of the type recently brought out for high-power work and embodies a number of newly developed features which distinguish the construction of the horizontal type. The engine has two double-acting cylinders, 16½ inches in diameter and 24 stroke, arranged in tandem with a single crank. It uses for fuel the ordinary illuminating gas such as is distributed to customers and draws its supply directly from the gas main. The engine operates upon the four-stroke cycle and the method of governing is said to secure a constant quality of explosive mixture at all loads. Electric ignition is employed.

In this particular installation the engine is controlled by an automatic-pressure governor, which adjusts the speed of the unit in direct proportion to the demand for gas, the speed thus being in inverse proportion to the pressure in the distribution main. So sensitive is this control that the variation in pressure will not exceed eight ounces for a 50 per cent. range in gas output.

The regular centrifugal-speed governor is, however, also used in order to prevent, under any conditions, the engine running at excessive speed.

The St. Louis installation is one of the first of its kind in the illuminating gas field and presents many interesting features. The system has, however, long been in successful use in the distribution of natural gas over large districts adjacent to natural gas fields. The St. Louis system is in charge of W. A. Baehr, engineer of the Laclede Gas Light Company.

Electric Power for Factories.

One of the most important lines of work undertaken lately by the National Electric Light Association deals with the sale of current for power purposes by central stations. Of late years the day-circuit and the motor-load have become vital features of progressive development in the industry, and now on every hand there is inquiry for fuller information on all branches of the subject. Having this in mind, President C. L. Edgar of Boston has appointed on behalf of the association a committee to obtain and present data in regard to "Purchased Electric Power in Factories," and W. H. Atkins, chairman of the committee, is now issuing a circular of inquiry which is well calculated to elicit valuable data. Mr. Atkins can be addressed at 3 Head Place, Boston. The other members of his committee are S. M. Bushnell of the Chicago Edison Company and G. W. Brine of Atlanta, Ga. It is hoped and believed that responses will be copious and numerous, so that the report will give a further stimulus to the sale of current for power as well as extend the application of motors on central-station circuits. The useful work that the association thus attempts and carries out so well is highly beneficial to the art and should have a reflex action in increasing the association's influence and membership.

In the British navy [illegible] a curious way of killing sharks. They seal up a dynamite cartridge in [illegible] can inside of a lump of pork. The pork is thrown overboard on a wire-circuit which has been connected with an electric battery. When the shark takes the bait the [illegible] explodes the cartridge and kills the fish.

Chicago Telephone Company's Annual Meeting.

The Chicago Telephone Company held its annual meeting on January 20th, at which the first annual report of Arthur D. Wheeler as president of the company was presented. The stockholders authorized an increase of $5,000,000 to the present capital stock of $15,000,000. Mr. Wheeler's report is as follows:

"The development of the company's business and plant in 1903, within the 10 counties occupied by it, has been satisfactory. The net increase in the telephone stations installed was 22,144, making a grand total on December 31, 1903, of 101,187. The increase in the smaller towns and in the homes of the farmers is especially gratifying because it evidences a growing appreciation of the value of telephone service by means of a comprehensive, properly constructed and operated telephone system.

"As in the past, the various forms of message-rate contracts offered by the company have permitted subscribers to secure the quantity of service suited to the needs of any individual case. Fifty-six thousand and seventy-seven telephones are now installed under such contracts.

"The high degree of efficiency of the operating force has been demonstrated by a series of most searching and exhaustive inspections and tests, for some of which specially devised apparatus for securing records has been employed. Several thousand tests taken each month have shown that calls in the Chicago exchange have been answered in an average of about 5.1 seconds, ranging from 5.6 seconds in the month of January to 4.9 seconds in December.

"The development of the art of telephony gives constant opportunity for improvement in one or another particular. Between the time of ordering the switchboards for Douglas exchange, opened in October, and their completion, new devices justified alterations in the plans and in the partially completed switchboards, so that when put into service they represented the latest advance.

"The comparative showing as to revenue and expenditure is as follows:

	[illegible]	[illegible]
Gross revenue	[illegible]	[illegible]
Gross expenses (operation, taxes, maintenance and reserve for deferred maintenance	[illegible]	[illegible]
Net earnings	[illegible]	[illegible]
Dividends	[illegible]	[illegible]
Surplus for year	[illegible]	[illegible]

"The comparative balance sheets as of December 31st are as follows:

RESOURCES.

	[illegible]	[illegible]
Invested in plant	[illegible]	[illegible]
Invested in real estate and buildings	1,111,644.96	1,273,735.59
Other investments	14,500.00	125,036.75
Balance of bills and accounts payable and receivable	[illegible]	[illegible]
Material on hand	[illegible]	[illegible]
Cash	134,706.52	547,640.00
	[illegible]	[illegible]

LIABILITIES.

	[illegible]	[illegible]
Capital stock	[illegible]	[illegible]
Reserve for taxes, 1902, payable in 1903.	94,622.92	90,377.07
Reserve for deferred maintenance (to provide for renewal of switchboards and apparatus and for continually accruing depreciation of cables and plant)	346,551.32	646,551.32
Reserve for unearned rentals	36,591.38	46,336.56
Reserve for outstanding toll tickets and coal tickets	[illegible]	[illegible]
Surplus	427,382.67	464,767.20
	[illegible]	[illegible]

"In addition to the foregoing statements and the accompanying table showing details of the company's growth during the past 10 years the following incidental statistics of 1903 may be of interest:

"Payments to employes for services amounted to $2,248,025.[illegible]

"The purchases made through our purchasing and supply department amounted to $1,816,008.55.

"In addition to service and facilities of a large aggregate money value furnished to municipalities, $214,709.30 was paid in 1903 to the city of Chicago and for general taxes for 1902.

"The order department issued 26,182 in-orders, 12,032 out-orders and 37,291 moving or diverse forms of local orders, making a total of 75,505 for the Chicago exchange alone, or over 250 each working day, which were performed by the proper employes.

"Twenty thousand shares of stock were issued in 1903 for which $2,000,000 in cash was paid by the stockholders. We enter 1904 free from debt and with sufficient cash and material in hand to continue necessary new construction. The policy of permanency in all forms of construction where possible is being continued, so that 13 substantial fireproof exchange buildings in the city of Chicago and 10 such buildings at suburban points are now occupied by the company. A lot has been purchased at Waukegan and a building there will be completed during this year. A creditable building in Austin is nearly ready for occupancy. Exchange buildings were opened in 1903 in Chicago on Nineteenth Street (known as Canal exchange) and on Thirty-fifth Street (known as Douglas exchange); and in Joliet, Chicago Heights, Hammond and Lake Forest. During the year two 99-year leases without revaluation clauses have been entered upon. One covers a piece of property 80 feet front by 160 feet in depth adjoining the main office building on Washington Street, permitting enlargement of the general offices and the housing of the purchasing and supply department. The other covers a piece of ground 80 feet front upon Calhoun Place by 72 feet in depth adjoining Central exchange, and affords opportunity to meet the existing demand for growth there. Buildings will be necessary in due course at each of these locations.

"In the report to the stockholders for the year 1899 it was stated: 'It is understood that the term of the Chicago ordinance expires in about 10 years, but your directors assume that if in good faith the company proceeds in the making of the large additional investment required to meet the growing needs of the public the City Council of Chicago will in due time grant an extension of the ordinance upon equitable terms.'

"The capital stock was then $5,000,000. Since that time $9,000,000 additional have been issued, representing cash invested. It is believed that normal growth in the company's business during the next few years will justify the investment of at least $6,000,000 additional capital. Still assuming that continuing just relations with the city of Chicago will be established, the board of directors submit for your consideration a proposition to increase the authorized capital of the company by $5,000,000, which would make a total authorized capital of $20,000,000, of which $14,000,000 is now outstanding. If this meets your approval this new capital will be called in from time to time during the next few years as the enlargement of the plant may require."

The figures in the first table were taken from President Wheeler's report showing the growth of the Chicago Telephone Company's plant during the last 10 years, only four years being here given.

GROWTH OF THE CHICAGO TELEPHONE COMPANY.

	[illegible]	1898.	[illegible]	[illegible]	Increase 1903.	Per Cent. Increase.
Number of exchanges	[illegible]	[illegible]	112	114	2	[illegible]
Toll stations	[illegible]	86	[illegible]	[illegible]		
Number of exchange telephones	12,049	21,188	[illegible]	[illegible]	[illegible]	28.0
Underground conduit, street, miles	[illegible]	61	197	235	[illegible]	[illegible]
Underground duct, miles	[illegible]	[illegible]	[illegible]	[illegible]	180	[illegible]
Miles of wire underground	[illegible]	30,259	[illegible]	[illegible]	[illegible]	[illegible]
Miles of wire aerial cables	5,802	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Miles of wire on poles	11,900	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total miles of wire	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Capital stock	[illegible]	$4,336,500	[illegible]	[illegible]		

*Fourteen exchanges in Chicago are counted as one exchange.

Central Union Company's Annual Report.

The annual meeting of the Central Union Telephone Company was held on January 20th. L. G. Richardson, concluding his first year as president of the company, presented the following report:

"On the first day of May, 1903, Mr. John I. Sabin resigned as president of this company and the undersigned was elected by the board of directors to that position.

"On the first day of July the general operating offices of the company were removed from Chicago to Indianapolis, Ind., under the belief that, as the last-named city was the largest in the company's territory and was geographically located in the center of that territory, the business of the company would be more economically administered and with closer supervision of the force. We believe that the results have proved the wisdom of this move.

"The necessity for reorganization of the force—both at the general headquarters and in the field—has made impracticable any large amount of new construction during the year 1903, and only about $775,000 was added to construction. A large amount of extensions in the way of new exchanges, new toll lines and additional circuits upon existing pole lines is imperatively needed to place the company in a position to supply the demands for telephone service within its territory and to supply the immediate toll requirements of its sub-licensees.

"The company now has, including its sub-licensees, 577 exchanges, with a total of 153,791 stations.

"We give you below a comparative statement of the revenue and expenses for the years 1902 and 1903, the figures for 1902 being those given in a report made to you at our last annual meeting. It will be understood, of course, that the figures for 1903 given below include December estimated, as has heretofore been the custom, owing to the fact that actual figures for the last month in the year can never be made in time for the annual meeting as fixed by the by-laws of the company:

REVENUE.

	Year Ending December 31, 1902	Year Ending December 31, 1903
Exchange service	[illegible]	[illegible]
Toll service	800,784	802,467
Miscellaneous revenue, including sub-license	[illegible]	[illegible]
Total	[illegible]	[illegible]

EXPENSES.

For administration, taxes, operating and maintenance	[illegible]	$2,426,172
Operating profits	$ 661,728	$ 754,948
Less interest, including interest on bonds	[illegible]	[illegible]
	[illegible]	[illegible]

"Your directors, as stated in last year's report, charged the net shown for 1902 to line repair and maintenance. In 1903, following the same line of conservative management, an amount was appropriated for maintenance which covers the net shown on this report in addition to the amount actually expended.

"Conditions generally throughout the states operated by this company are improving. The service the company renders to the public has been much improved by the betterment of exchanges and toll lines, and a vigorous policy, backed up by the stockholders, will, it is believed, bring about the desired result."

Indiana Telephone Items.

The Denver Co-operative Telephone Company, capitalized at $13,000, will establish telephone lines and exchanges in Miami County, the principal exchange being at Denver. I. L. Eikenberg heads the list of directors.

The Cherryvale Telephone Company proposes, in its articles of incorporation, to establish telephone exchanges in Clay and Vigo Counties. The principal office and exchange will be in Cherryvale. O. N. Hamilton is president.

Oliver Spencer is the secretary of the New Home Telephone Company, organized by the citizens of Hollandsburg last week. This company will establish an exchange in Hollandsburg and stretch lines in Wayne and Randolph Counties and will make connection with Independent companies in Ohio.

The Citizens' Telephone Company of Zionsville filed notice of an increase in capital stock of $15,000 for the purpose of equipping the plant with modern apparatus and extending the line. James O. Hurst is president.

The annual meeting of the stockholders and directors of the Brownsburg Telephone Company was held last week. The directors were instructed to make extensive improvements and extend the lines. The company is figuring with both the Bell and the New Long-distance Telephone Company relative to getting a direct line to Indianapolis. J. S. Tharp was re-elected president and J. R. Flinn, superintendent of construction.

The Carroll Telephone Company of Delphi and all the co-operative companies operating in Carroll County have effected a consolidation, and all the lines are connected now for business. The fee for connection by patrons is 10 cents. This arrangement is on trial for three months, and if it proves satisfactory a permanent contract will be made. The new arrangement gives service all over the county and connects nearly 2,000 rural telephones with the county-seat exchange.

The Mutual Telephone Company of Shelbyville is putting in a new section of switchboard which will increase the capacity to 1,200 telephones. A third line will be strung between Shelbyville and Indianapolis, as the two lines which are now in use are not sufficient to carry the business of the company.

The officials of the Delaware and Madison Counties Telephone Company announce that the December earnings amounted to $6,550 gross; expenses were $2,802 for operating, taxes, etc., and $1,441 for interest, leaving $2,307 for surplus to be applied to stock. This company operates the Muncie, Elwood, Anderson and Alexandria exchanges. The company will put in a new section of board, cable and other equipment to accommodate about 300 more telephones at Alexandria.

The Citizens' Telephone Company at Fairmount has decided to install a new switchboard in order to accommodate a hundred or more additional new subscribers, which are now on the waiting list.

Judge Anderson of the United States District Court has refused the petition of the Cumberland Telephone Company of Evansville for a rehearing of its suit against the city to restrain the authorities from ousting it from the streets on the ground of having no franchise. The company will now perfect its appeal to the Federal Court of Appeals at Chicago.

The Lake Shore and Michigan Southern Railway Company is preparing to adopt the telephone system. The apparatus has arrived at Mishawaka and will be put in position at once. A telegraph wire will be used and no extra wire will be strung. Key messages and oral dispatches will be transmitted over the same wire by the use of the improved system.

Senator Fairbanks has advsied Indiana telephone men that he has introduced an amendment which he intends to propose to the postoffice appropriation

bill, when that measure reaches the Senate, providing for an appropriation of $20,000 for experimental telephone delivery of rural mail matter. The senator's plan for making use of the telephone in delivering special letters in rural districts has attracted wide attention. Postmaster-general Payne, in his annual report, submitted last week, heartily indorses Senator Fairbanks' proposition. The House committee will consider the subject and will most likely provide for the experiment. F.

Telephone News from the Northwest.

The Interstate Telegraph and Telephone Company of Austin, Minn., had 467 instruments in use January 1st. Long-distance connection with the Twin Cities will be completed at once.

The Montevideo (Minn.) telephone exchange will build and equip about 25 miles of country lines during the coming year. The company now has 267 telephones in operation. The cost per month per telephone was 79 cents, as compared with 82 for last year.

It is rumored at Brainerd, Minn., that the Northwestern Telephone Exchange Company will build a telephone line from that city north to Walker, Minn., in the spring.

The Minnesota Rural Telephone Company of Princeton, Minn., has declared its first dividend of eight per cent. on $13,500. The company has many improvements under way.

The patrons of the telephone line at White Rock, near Cannon Falls, Minn., presented G. O. Miller, the founder of the line, a handsome gold watch and chain in appreciation of his good work.

The Duluth Telephone Company has practically all its wires off the poles on Superior Street, the principal street of that city, and would be able to remove the poles but for the city's wires, which are on them.

The Howard Lake (Minn.) Telephone Company will build a rural line of 13 miles in the spring.

The Tri-State Telephone and Telegraph Company is working toward Rochester, Minn., with its long-distance lines.

All the Independent telephone lines of Hamilton County, Iowa, will unite as the Hamilton County Independent Telephone Company. An exchange will be put in at Webster City. The Stratford Independent Telephone Company has assumed the franchise of the Chamberlain Telephone Company and is the principal factor in the new merger.

The farmers' mutual telephone companies around Centerville, Iowa, will ask for a franchise to establish an exchange in that city.

The Johnson County Telephone Company will put in an automatic switchboard at Iowa City, Iowa.

The Hancock County Rural Telephone Company will extend its line east from Garner, Iowa.

A telephone line will be built from Coatsville, Iowa, to Coal City.

The Nebraska Telephone Company will remodel its exchange building at Lincoln at a cost of about $80,000.

The Adams Telephone Company of Adams, Wis., has incorporated with a capital of $2,000. R.

Ohio Telephone Notes.

The Home Telephone Company of Plain City, Ohio, has been incorporated with a capital stock of $50,000. The incorporators are Calvin Liggett, C. M. White, L. H. Elliott, F. M. Mattoon, L. S. Lane and L. W. Worthington.

The Hollansburg Home Telephone Company of Hollansburg, Ohio, was incorporated a few days ago with a capital stock of $10,000. G. W. Harley, S. V. McKesel, G. U. Wolf, W. A. Chenoweth, C. H. Brown and J. E. Irelan are the incorporators.

The Farmers' Mutual Telephone Company, without capital stock, has been organized at Liberty Center, Ohio, by C. A. Clifton, J. E. Liest and others. C.

Bell Output for 1903.

The instrument-output record of the American Telephone and Telegraph Company for December and the year 1903 makes a showing which is relatively good, as far as the year's total is concerned, although the month of December, like the month of August, contributed nothing to the aggregate gain. The number of instruments returned was unusually large last month, and the output was less than in the corresponding period of 1902. The figures in detail are appended:

Month of December:	1903.	1902.	Inc.
Gross output	88,94[illegible]	92,732	*3,788
Returned	[illegible]9,678	34,688	4,990
Net output	[illegible]	58,044	[illegible]
Year, since December 20, 1902:			
Gross output	1,109,888	960,055	149,833
Returned	480,691	386,861	93,830
Net output	629,197	[illegible]	[illegible]
Total outstanding	2,770,517	2,526,010	[illegible]

*Decrease.

Many improvements will be made in the street-car system of Nashville, Tenn., this year. The work of converting the old tracks, which were, in many cases, in bad repair, into new ones, laid with heavy rails and with curves of the most exact radius, will be carried on until every foot of track in Nashville will be in perfect condition.

Ohio Independent Telephone Meeting.

The Ohio Independent Telephone Association will meet in Cincinnati on February 17th for a three-day convention. All Independent telephone companies, manufacturers, dealers and supply houses are invited to send representatives. The sessions will be held in the Grand Hotel, where arrangements have been made also for the accommodation of exhibitors. As Cincinnati has no Independent exchange, it is the desire of the officers of the association to make this convention an impressive one with a large attendance. To this end an effort is being made to make the meeting one of special value to all who attend. Considerable time will be given up to the reading of papers on practical subjects. Those who expect to attend, and especially those who will have exhibits, should notify the secretary at once. The officers of the association are: President, W. Gilbert Thompson of Lebanon; secretary, Eugene E. Knox of Portsmouth; chairman committee of arrangements, Jerome Penn of Washington Court House.

Industrial Outlook in Manila.

Former Governor William H. Taft of the Philippine Islands arrived at San Francisco last week en route from Manila to assume his new post at Washington, D. C. Judge Taft spoke encouragingly of the industrial outlook in the Philippines. He stated that conditions indicate a period of great activity in railroad building and, while English and Belgian capitalists have so far controlled the field, the people of the islands are anxious for the introduction of American capital. Speaking of the progress in electric-railway building he is thus reported:

"One American syndicate headed by a Mr. Swift of Detroit is engaged in the construction of electric railroads, gridironing the streets of Manila, with the object in view of extensions which will connect the suburban points. Two new branch lines have just been authorized by the government, one of 35 miles and another of 351 miles, on the line of the road now running out for a distance of 120 miles from Manila to Dagupan. This road was originally built by the Spanish. English capitalists are now seeking franchises in other directions, and Secretary Root has had surveys made for two or three trunk lines, which have already been published, and for which estimates have been made."

Cleveland's Three-cent Fare Ordinance.

Upon the application of the Cleveland Electric Railway Company of Cleveland, Ohio, Judge Wing of the United States Circuit Court has issued a temporary injunction restraining the city officials from enforcing the reduced-fare ordinance recently adopted by the City Council, providing for three-cent street-car fares within a certain zone, as stated in last week's issue of the Western Electrician. The ordinance fixed January 24th as the date for the first operation of the new fare schedule, but under the injunction this is deferred at least until February 13th. The company alleged in its application that the reduction in fare would jeopard its capital and security for its bonds.

GENERAL TELEPHONE NEWS.

C. P. Latta was elected manager of the Jones County Telephone Company of Washington, Iowa, to succeed H. F. Camp, resigned.

J. C. Marsh, owner of the local telephone exchange at Marshfield, Wis., has engaged W. J. Reik of La Crosse, Wis., to act as manager.

The Texas and Pacific Telephone Company has increased its capital stock from $30,000 to $40,000 and has changed its headquarters from Abilene to Colorado City, Texas.

The engineering headquarters of the Stromberg-Carlson Telephone Manufacturing Company have been moved from Chicago to the Rochester (N. Y.) offices of the company.

A telephone system will be established at McDonald's Mill, Va., by the recently incorporated North Fork Telephone Company. The company is capitalized at $5,000. A. P. Bennett is president.

The Hopkinsville Home Telephone Company of Hopkinsville, Ky., has been organized by the election of the following-named officers: President, R. E. Cooper; vice-president, George H. Metheaney of Lima, Ohio; treasurer, Joseph F. Garnett; secretary, F. G. Hoge; general counsel, J. T. Edmunds. The Ideal Construction Company of Lima, Ohio, has secured the contract for building the plant. The cost will be about $100,000.

The Fall River (Mass.) Automatic Telephone Company has paid its fourth quarterly dividend at the rate of five per cent. per annum. It now has 1,160 stations, an increase of about 100 for the quarter. Although its toll rate to the New Bedford automatic exchange is 10 cents and the New England (Bell) company has reduced its rates from 15 cents to five cents between these points, the earnings of the Automatic company's toll lines show a steady increase.

CORRESPONDENCE.

Great Britain.

London, January 16.—The discussion concerning the purchase by the Marylebone (London) Borough Council of the portion of the Metropolitan Electric Supply Company's undertaking within its area, has taken another turn. As I have frequently mentioned in these notes, the Borough Council has encountered a difficulty in raising the necessary amount of money to carry out the purchase, and after over 12 months' delay, a bill has had to be promoted in Parliament. This, however, has yet to receive the assent of the taxpayers. At the last meeting of the Borough Council a communication from the Metropolitan Electric Supply Company was read. This contained an offer that the company should, instead of requiring the immediate payment of £1,212,000 in cash, accept it as stock having a charge as revenue upon the rates of the borough, the stock to be redeemed at par at 42 years. Then in 1932 the council should purchase, at an agreed price, a portion of one of the company's largest stations and compensate the company for the capital expended upon the borough during the lease of 42 years. The proposal of the company, which was tantamount to asking for a lease of the undertaking for 42 years, was not too favorably received, and another meeting is to be held.

The London County Council has put into service another section of its conduit-tramway system in the south of London. The line runs from the center of the town to Greenwich, some miles southeast, and terminates near the site of the permanent generating station which is being erected there. At present, however, power for this section of the lines will be taken from a temporary plant erected in one of the London supply companies' works at Deptford in a similar manner to the plant erected at Larghborough Junction for the remaining lines. Upon the day of the opening of the Greenwich lines the inspecting car ran completely over the whole of the "electrified" lines of the council by a circuitous route without a hitch and greatly impressed the Board of Trade inspector.

A provisional date, viz., February 1st, has been fixed for the opening of the Great Northern and City electric railway. Although nominally a "tube" railway, this line, as a matter of fact, is contained in a 16-foot tunnel, with the idea of running the ordinary railway rolling stock upon it. But since its promotion several years ago some change in the relationship with the other companies has taken place, and at present it would be unwise to say what will be done. The line is only some five or six miles long, but it will give a much-needed extra communication between the city and the northern suburbs. The multiple-unit system will be employed, and an interesting engineering fact is that for some distance of its route the two tunnels are in the same street as the City and South London tube railway.

The adoption of a surface-contact system of electric tramways in Musselburgh, a large suburb of Edinburgh, has been suggested. The Town Council has engaged an expert to report upon the proposals. The name of the system is not mentioned.

A set of rules governing the manufacture of electric accumulators has been issued by the Home Office. They have reference to the protection of the work people, and took effect January 1, 1904.

Some time ago a big dispute arose between the Hull corporation and the National Telephone Company with regard to the question of rights-of-way. The matter went to the law courts, and eventually the corporation secured a license from the postmaster-general and commenced the construction of a municipal exchange. Later on the question of intercommunication between the two systems was considered in return for the corporation allowing the company to retain its underground wires, but before the matter could be settled trouble again arose between the parties as to extensions of the company's system. The dispute is now being argued out.

The Birmingham corporation has opened its first electric-tramway route. Birmingham has hitherto been much in the hands of companies in the matter of tramways, but its recent policy has been to acquire the lines as the leases lapse. Mr. Baker, late tramways manager of the London County Council, has been appointed to a similar position at Birmingham, and he is to be congratulated upon the speed with which he has opened the first section of the municipal lines. G.

New York.

New York, January 23.—By far the most representative in all branches of the motor-vehicle industry that has ever been held in this country—and in the opinion of many foreign visitors it equals the notable exhibits held in Paris—is the automobile show held in Madison Square Garden this week. Automobiles of every conceivable design, color and make were on exhibition, there being 185 exhibits, ranging from improved motor cycles to large tonneau touring cars, trucks and delivery wagons. The fact that automobiling is [illegible] is illustrated in the larger number of moderate-priced cars and their superior condition over cars of equal value a year ago. One popular make is a light tonneau of eight horsepower, which can be bought for $950. Gasoline remains the popular motive power. Electric machines are more numerous, while the steam vehicles are [illegible]

The largest electric automobile exhibit shows 12 different cars, including vehicles for every use, from light park living to delivery wagons and trucks. A run of 40 miles on one charge is the usual guaranty. A new model is presented in the runabout class, seating two persons, capable of a speed of 15 miles an hour, with three speeds forward and two backward. An electric phaeton shows several improvements over the old models and possesses a speed of 14½ miles an hour. Electric machines received a notable triumph, however, when it was announced that not a few American electric automobiles had been sold for export. Among them was a handsome victoria, sold to Percival W. Roberts for use in Paris. Mr. Roberts declared that the carriage was superior to anything in France in the electric line. Most of the electric automobiles in Paris are light vehicles, without much power for climbing fairly steep grades, the great care that has been paid to the perfection of the gasoline machines having left the electric somewhat in the background. Many conventions and dinners marked the week. The convention of the American Motor League was particularly interesting and was attended by prominent men in the motor-vehicle business. Technical subjects were treated by the ablest and most competent authorities, including professors from the leading colleges.

At the annual convention of the United Electrical Contractors' Association of New York State, held in the Buildings Trades Club rooms, this city, on January 19th, the following-named officers were elected: President, Marshall L. Burns of Troy; vice-president, James R. Strong of New York; secretary, Frederick Fish of Rochester; treasurer, J. C. Stearns of Buffalo.

Nearly 1,000 members of the American Society of Civil Engineers were present at the annual meeting, when it was decided to submit to a letter ballot of the members of the society the question of accepting the offer of Andrew Carnegie of $1,000,000 toward a union engineering building in New York. New officers were elected as follows: President, Charles Hermany of Louisville, Ky.; vice-presidents, A. S. Curtis of Boston and S. L. F. Deyo of New York; treasurer, James M. Knapp of New York; directors, Charles F. Gowen of Ossining, N. Y., H. P. Lewis of New York City, James W. Ellis of Poughkeepsie, N. Y., George S. Webster of Philadelphia, Ralph Modjeski of Chicago, and Charles D. Marx of Leland Stanford University, California.

About 30 notable financiers were treated to a handcar trip through the rapid-transit subway the other day by August Belmont. It was an unusual gathering in that it is estimated that the combined personal wealth of the coterie is easily $300,000,000. At the conclusion there was a luncheon served, at which all expressed astonishment at the magnitude of the undertaking and the way it has been carried out. Some significance is attached to the presence of so many men representing Pennsylvania railroad interests, and it has been "in the air" in financial circles several days that a deal of great magnitude, involving at least a "community of interests" between the Interborough Rapid Transit Company and the Pennsylvania Railroad interests, and perhaps including Gould interests, was in process of organization.

John C. McDonald, wire chief of a Harlem telephone company, has an invention for rendering safe the third rail on electric railways. He does not give details, as he is trying to secure a patent. "My invention," he said, "makes it impossible for a person to receive a shock from the third rail unless he falls under a train. It will also be possible by the use of my contrivance to avoid collisions, as by regulation with my invention the power on the rail for 500 feet or one mile behind each train may be rendered inert. The Interborough company has promised me space for a trial of my invention, and I shall hold it as soon as I learn whether my application for a patent has been successful." O.

Ohio.

Cleveland, January 23.—High waters have damaged electric-railway property in Northern Ohio to a considerable extent the last week. In Cleveland but little trouble was experienced, but about Akron and Massillon tracks were submerged to such an extent that cars could not run for a time. Water gave much trouble about Delaware and some other points also.

The capital stock of the Dayton and Western Traction Company has been increased from $800,000 to $1,300,000.

The Western Union Telegraph Company has leased three floors in the Davis Building on Vine Street in Cincinnati, in the rear of the Ingalls Building, where its offices and other departments are located. It was found that the space in the new building would not be sufficient for its purposes, but with the additional space in an adjoining building, convenient quarters can be made.

The Falk Construction Company has filed a mechanics' lien against the Cincinnati, Milford and Loveland Traction Company for $93,289.68, a controversy having arisen over settlement for building a section of the road between Columbia Avenue, Cincinnati, and Milford, which was turned over to the owners a few days ago. Attorneys for the road deny that the owners owe anything like the sum claimed.

It is said the trouble between the Cincinnati and Columbus Railway Company and the Cincinnati, Milford and Loveland Traction Company over claims for the franchise over the bridge at Milford, will be settled in a short time by granting each the right to use the bridge on the same terms, which are similar to the original agreement with a former company from which the Cincinnati, Milford and Loveland purchased the franchise. Both companies are said to be satisfied with the new arrangement.

Contracts will soon be awarded for the construction of the section of the Cincinnati, Georgetown and Portsmouth line between West Union and Russellville. It is understood the work will be pushed to completion as rapidly as possible. In order to secure a bonus made up by people along the line, the road must be completed by January next.

The office and plant of the Western Union Telegraph Company at Lima were destroyed by fire a few days ago. The company was compelled to use press wires for commercial purposes. O. M. C.

Indiana.

Indianapolis, January 25.—During the last week plans were made for the promotion of several new electric lines in this state. A line is projected to connect Richmond, Middlebury, Bethel, Hollandsburg, White Water and Greenville, Ohio. The citizens are so enthusiastic for the road that money was readily raised and the preliminary survey ordered at once.

Colonel A. G. Smith and other capitalists are promoting an electric line from Kingman to Covington. The headquarters of the company and the power house will be at Kingman. They expect to build the road this year.

The interurban lines centering in Indianapolis suffered no great damage from the flood, although they were inconvenienced on account of weakened bridges. The lines operating between Fort Wayne and Logansport along the Wabash River were not so fortunate. Two of these lines were put out of business by high water. The loss to interurbans in the state will be considerable. New work has been washed out and several bridges were damaged.

The Columbus, Greensburg and Richmond Traction Company has awarded the contract for the survey of its road, and the work is to begin in 10 days. C. N. Wilson of Indianapolis is secretary.

The Western Indiana Traction Company has elected officers as follows: President, Samuel Williams, Vincennes; vice-president, F. S. Robinson, Cloverland; secretary-treasurer, John LeCroix, Vincennes. The company is making plans to build a line between Vincennes and Terre Haute in the spring.

The Bedford council has awarded a franchise for an electric street railway to a company of local capitalists. The line will be extended to Oolitic, in the stone-quarry district. The total cost of the road is placed at $125,000.

Judge Anderson of the federal court has cited the officers of the Indiana Railway Company to appear before him on January 28th to show cause why a receiver should not be named for the company on the amended complaint of Dewitt Delsworth of Pittsburg, who asserts that the managers of the company are trying to "freeze out" the smaller stockholders, of whom he is one.

The Indianapolis and Northwestern Traction Company received two more new and elegant cars, which were at once put in service between Indianapolis and Lafayette. The company is now operating 10 cars and 10 more are under construction. The cars are geared to 60 miles an hour and equipped with four motors of 75 horsepower each. The company will operate a block system.

The Muncie, Hartford City and Fort Wayne Traction Company is having trouble in Bluffton for failure to stop and take on passengers at street crossings. The City Council annulled its franchise and shut it out of the city until it petitioned for a renewal of its rights. It was again admitted to the city, but under a penalty of from $5 to $50 for failure to stop at street crossings.

The flood has greatly damaged the electric-light plant at Logansport. The north wall of the building tumbled into the river. The plant was closed and the needed repairs will be costly.

The municipal electric-lighting plant of Tipton is overloaded and the service is unsatisfactory. The plant was built several years ago at a cost of $40,000. The city has outgrown its capacity. The plan is now to enlarge the plant and to replace the old dynamos with new and up-to-date machines with double the present capacity.

The first annual report of the Indianapolis Merchants' Heat and Lighting Company shows that the company during the first year earned $23,145.26 above operating expenses, interest on bonds and other charges. This is regarded an excellent showing, since the company operated only four months. Central heating and lighting plants are destined to be popular in Indianapolis.

The following-named companies have been incorporated: The American Construction Company of Indianapolis, for constructing steam and electric railroads, etc.; incorporators, James E. Greer, A. W. Moore and Josh Zimmerman. The Piedmont construction Company of Indianapolis, for promoting and operating street and interurban railroads and electric plants and for the creation and distribution of electricity; incorporators, Joseph Little, James F. Wilson and G. E. Coughlin. The Wells Manufacturing and Supply Company of Indianapolis, for the manufacture of factory supplies, including supplies for steam and electric railroads, electric lighting, telephone and telegraph companies and for contractors and builders. F.

Michigan.

Detroit, January 23.—The Common Council of Lansing has rejected the franchise asked for by John H. Chase and W. L. Haag for the establishment of a heating and electric power plant which has been pending a year. The chief objection was that the promoters of the enterprise have not formed a company.

Negaunee will spend $15,000 in repairing its municipal electric plant.

The lighting company which has been furnishing power for lights at Ithaca has decided to close its plant and go out of the business, which has not been paying expenses. The question of municipal control is being agitated.

Traffic of the electric cars on the Grand Rapids, Holland and Lake Michigan railway, between Grand Rapids and Holland, was entirely suspended on Wednesday of this week on account of the heavy fall of snow. This is said to be the most severe winter in that part of the state for 20 years.

The Schwarge Electric Company of Adrian, with a capital of $2,500, has filed articles of incorporation.

The Owosso Common Council finally passed an ordinance granting the Ionia and Owosso Electric Railway Company a franchise through the city. One route is on West Main Street from the west to the east city limits, and the other the route asked by the company. There are, however, certain provisions in the franchise which are understood to be objectionable to the company.

The right-of-way and the necessary franchises for the West Michigan Interurban Railway Company between Muskegon and Hart have nearly all been secured. Over $7,000 has been expended thus far in the preliminary work.

At the annual meeting of the stockholders of the Detroit United Railway, held at Detroit this week, the old directors were re-elected as follows: H. A. Everett of Cleveland, Arthur Pack, George H. Russell and J. C. Hutchins of Detroit, E. W. Moore, R. A. Harman and H. R. Newcomb of Cleveland, R. B. Van Cortland of New York and H. S. Holt of Montreal. The directors re-elected as chairman, Henry A. Everett; president, J. C. Hutchins; vice-president, Arthur Pack; treasurer, George H. Russell; secretary, Edwin Henderson of New York; assistant secretary, A. E. Peters of Detroit.

The bond of L. K. Gibbs, president of the Traverse City and Peninsula railroad, for $2,500 has been accepted by the Traverse City Council. This practically assures the building of the road within one year, as the bond is forfeited if the road is not completed within that time.

The Bay City council has voted to have the city go at once into commercial lighting. In April the city will vote on a $50,000 bonding proposition to increase the capacity of the city lighting station. C. G. W.

Texas and Mexico.

Austin, Texas, January 21.—J. W. Maxey, an engineer of Houston, Texas, is preparing plans for a large electric power plant which is to be established at San Felipe Springs, adjacent to Del Rio, Texas. It is proposed to generate 375 horsepower by means of the flow of water from the springs. The electrical energy will be conducted to the town, where it will be used for lighting and power purposes. It will also be transmitted to irrigation and manufacturing plants in that section. G. Bedell Moore of San Antonio, who owns the San Felipe Springs, is back of the project.

It is announced by Ed. Kennedy of Houston, who is promoting the building of the Houston, Liberty and Batson electric railway, that the contract for grading a portion of the line has been let to J. E. Smith of Houston. A construction company will be organized, to have full charge of the construction work. The right-of-way for the whole distance between Houston and Sour Lake is said to have been secured.

The Ballinger Light and Ice Company has been organized at Ballinger, Texas, for the purpose of constructing and operating an electric-light and power plant. It has a capital stock of $10,000. The incorporators are W. A. Norman, R. B. Creasey, E. J. Hardgrave and Lewis Alexander.

The Cleburne Gas and Electric Light Company has been organized at Cleburne, Texas, with a capital stock of $150,000 for the purpose of manufacturing gas and to furnish electric light and power for public use. The incorporators are R. B. Sticher, J. F. Strickland, Osce Goodwin and M. B. Templeton, all of Waxahachie, and R. Vickery of Fort Worth.

The contract for installing the new electric-light and power plant at Monclova, Mexico, has been let to Victor M. Braschi & Bro. of the City of Mexico. The plant will cost about $40,000. Jose M. Tejada of Monclova is president of the company.

Good progress is being made in the preliminary steps looking to the construction of an interurban electric railway between Puebla, Mexico, and San Francisco Tectihuacan. The distance is nine miles. It is stated that all necessary financial arrangements for building the road have been made. The equip-

ment and much of the material will be purchased in the United States.

It is stated that the electric plant which has been installed by the Penoles Mining Company at its mines situated near Mapini, Mexico, is the most complete plant to be found at any mine in Mexico. The plant cost, including its installation, $400,000. It furnishes power for the hoists, pumps and compressors of the mines. The electric power is transmitted more than five miles. Upward of 5,000 men are employed in these mines.

The Mexican government has granted a concession to Colonel Fernando Gonzalez of the City of Mexico to utilize the waters of the Amacusac River for generating electricity and for irrigation purposes. Mr. Gonzalez will construct a large dam across the river to form a storage reservoir. An electric power plant will be erected and transmission lines established. It is also planned to establish an extensive system of irrigation in the valleys, which are situated at a lower level than the reservoir. Conduits will be constructed to convey the water to the lands that are to be placed under irrigation.

The City Council of the City of Mexico has appropriated $348,000 for providing the city with electric lights during the year 1904.

Jesus Avalos will soon commence the construction of a large electric power plant on the Lorma River, near La Piedad, Mexico. He proposes to provide electric lights and power for several towns in that section and to furnish power for the operation of manufacturing concerns. H.

Kentucky.

Louisville, January 23.—Judgment for $82,217 has been entered in Judge Miller's court against the Louisville Railway Company, as a result of the suit for back-franchise taxes. The city attorney computed the amount at $258,000. Later a credit of $125,000 was allowed for license taxes paid within the period named by the city. Still other credits were made, until the amount was reduced to the figures for which the court finally signed judgment. It is not known whether the suit will be appealed or not. The litigation has covered a period of several years.

A flywheel at the electric-light plant in Jackson burst a few days ago and the machinery was badly damaged. The engineer, John A. Bailey, had gone to supper and left Thomas Marcum, his boy assistant in charge. In some way the engine became unmanageable. Its speed frightened Marcum, and he made his escape just in time to save his life. The plant had been closed down since the first of the year, until a few days ago.

A bond issue of $700,000 has been placed by the Bluegrass Traction Company of Lexington, which controls the lines between that city and Georgetown and Paris. The bonds were taken principally by Cleveland and Cincinnati trust companies, although $100,000 of the amount was placed in Lexington. The company will probably build a number of lines the coming summer. C.

Northwestern States.

Minneapolis, Minn., January 23.—The Amery (Wis.) Electric Company has made extensive improvements to its electric-light plant.

Grundy Center, Iowa, voted a franchise to the proposed Marshalltown Electric Street and Interurban Railway Company.

Minneapolis capital is interested in a project to construct an electric interurban line from Gladstone, Mich., to Rapid River.

The representatives of the proposed line from Fond du Lac to Manitowoc, Wis., are buying the right-of-way.

The Lamartine Heat, Light and Power Company has incorporated with a capital of $150,000 at Fond du Lac, Wis. Dr. C. A. Beebe is president and D. O. Williams secretary. The company has applied for a lighting and heating franchise.

The council at Council Bluffs, Iowa, has voted a franchise to the Council Bluffs, Tabor and Southern Electric Railway Company.

The Great Northern Power Company of Duluth, Minn., is asking for bids for three 12,500-horsepower turbines on vertical shafts to operate under a head of 365 feet at 250 revolutions per minute. These are the largest waterwheel units ever installed. It is expected 35,000 horsepower will be available by 1905.

The Electrical Workers' Union has ordered that no apprentices be employed on buildings at Milwaukee, Wis.

The Albert Lea (Minn.) Electric Light and Power Company and the Citizens' Gas Company have merged into one company.

A test case will be made at LaCrosse, Wis., regarding the law compelling the employment of conductors on all street cars. R.

Pacific Slope.

San Francisco, Cal., January 21.—C. T. Tulloch of Oakdale, Cal., president of the Stanislaus Milling and Power Company, has been in San Francisco for several days purchasing electrical apparatus for the extensions of the electric transmission plant at Knights Ferry. A contract has been closed for the purchase of a 750-kilowatt, two-phase, Westinghouse generator, which is to be direct-connected to a Stilwell-Bierce waterwheel. At present about 1,200 horsepower is being transmitted, the Alta mine using about 300 horsepower and the Royal Consolidated mine about 500 horsepower. The distance from the generating plant to Oakdale, where electric lights and a flour mill are operated, is about 14 miles. The power line will be extended from Oakdale, a distance of 16 miles, to Modesto, where about 400 horsepower will be taken on. The town has its own public-lighting system. The total cost of the plant will be about $25,000.

The Roberts Manufacturing Company of this city is making the gas and electric fixtures for the new Iroquois apartment house on Ellis Street. The Sanitary Compressed Air and Suction Dust Removing Company has installed its automatic air sweepers driven by electric motors. The Otis Elevator Company has the contract for putting in two Otis magnet-control passenger elevators of the most approved type.

Eleven of the new electric cars ordered by the United Railroads have arrived from St. Louis, and are being equipped with motors at the Geneva Avenue car house. The cars are of the vestibule pattern of the latest design and are a part of an order of 50, the rest being expected shortly. They will be used on the Ellis, Fillmore and Turk, and Fulton Street lines.

The Ecco Battery Company has been incorporated with a capital stock of $25,000 by G. W. Emmons, I. H. Andrew, E. C. Bartlett and others. San Francisco is the principal place of business.

The common report of new activity in the Mutual Electric Light Company caused the stock of the San Francisco Gas and Electric Company to take a sharp drop last week. Ten carloads of machinery have just been received by the Mutual company, and the generators are now stored on the power-house site. There is talk of securing electric power from a waterpower plant until the company's own plant is ready for operation.

The Oakland Electrical Company has been formed at Oakland, Cal., by J. O. Larabee, J. M. Cox and others, with a capital stock of $35,000.

The steamer Mineola is now at the Union Iron Works, being overhauled and fitted with electric lights.

The Yamhill Milling Company of Yamhill, Ore., contemplates putting in an electric-light plant to light the town.

Electric lights were recently turned on at Kilarc, Cal., and for the first time the new power plant of the Northern California Power Company, on North Cow Creek, was in commercial operation. The electric current for the lights was transmitted from the Shingletown plant of the company at Volta. From Volta to Palo Cedro the distance by the main power line is 20 miles; from Palo Cedro to De La Mar by the cross line it is 18 miles, and thence by the new line to Kilarc, which has just been completed, it is 20 miles more.

The Adams County Electric Transit Company of Spokane, Wash., expects to start construction work at the Spokane end of the line this spring. The company has located a water right on the rapids in Columbia River near the mouth of Spokane River, and is planning to develop 30,000 horsepower for the new enterprise. The company proposes to run a branch from Davenport to the Columbia.

Dr. J. J. O'Brien of Los Angeles has been in the vicinity of Hanford, Cal., for several days for the purpose of looking into the matter of establishing an electric power plant at Coalinga, to be run by steam generated by crude oil as fuel. The plan contemplated by Dr. O'Brien is to erect a power station at Coalinga and run lines for the distribution of electricity for light and power to Lemoore, Armona, Laton, Guernsey, Dallas, Corcoran, Angiola, Wasco and throughout the Sunset and Kern oil fields. The plan is to distribute electric power for pumping, lighting and oil-development purposes. Dr. O'Brien promises to commence active work as soon as he can contract for 1,000 horsepower.

Surveyor D. Wishon of Porterville, Cal., has gone to the Tule River region to see about clearing the right-of-way recently obtained from the government, in the forest reserve, for the Huntington electric power plant. It is expected that work on the road will commence about the end of January. The water for power will come from the Nelson and Doyle branches of Tule River, and will flow through pipe lines to a reservoir at the top of the hill about a mile above the forks. The head will be 2,200 feet, developing 6,000 horsepower.

The trustees of San Pedro, Cal., are considering the calling of a special election to vote bonds to erect a municipal lighting plant. The trustees believe that this will be cheaper than to accept the Edison company's offer to install 200 more lights at a cost to the city of $1,200 a year, with the proviso that if a contract is made for three years light will be furnished at 66⅔ cents each a month.

The San Pedro Electric Construction and Fixture Manufacturing Company proposes to establish a factory in San Pedro for the manufacturing of electrical fixtures of different kinds, especially switchboards.

The first 1,500-kilowatt generator of the American River Electric Company's new plant at the mouth of Rock Creek, six miles from Placerville, Cal., is in successful operation. The principal load for the first few days has been the lighting of Placerville, although the Hammon dredge at Jenny Lind has been tested and will be in steady operation later.

The Arlington and Riverside Electric Company is extending its line through North Orange Street, Riverside, Cal., to reach a new base of supply at Highgrove.

Plans for developing power to operate an electric-light and power plant for Walla Walla, Wash., and Pendleton, Ore., will be selected this week and construction work will follow immediately, according to I. W. Anderson, general manager of the Northwestern Gas and Electric Company, which has recently purchased the plants at these two cities. On the Walla Walla River it is proposed to develop 2,500 horsepower.

The Citizens' Light and Traction Company of Salem, Ore., will furnish the city with electric light and power from Silverton after February 1st. The Union Light and Power Company, which owns and controls the Silverton power, is putting up poles and stringing wires. About two-thirds of the distance between Salem and Silverton has been covered. A.

PERSONAL.

Professor F. E. Turneaure, who has been acting dean of the college of engineering, University of Wisconsin, since the death of the late Dean Johnson, was appointed to the position permanently on January 19th. Professor Turneaure is a man greatly respected and liked by the student body, and this fact, together with his long experience in the university and his knowledge of the affairs of the college of engineering, will make him an able administrator.

T. H. Bailey Whipple has returned to the Sawyer-Man Electric Company to the position which he left last summer in order to take a part in the reorganization of the sales department of the Nernst Lamp Company of Pittsburg. Mr. Whipple is an old hand in the commercial end of the electric-lighting field. He was general sales agent with the Buckeye Electric Company of Cleveland, O., and held a similar position with the Jandus Electric Company, which was an offshoot of the Buckeye Electric Company.

ELECTRIC LIGHTING.

The city of Conyers, Ga., has issued bonds to the amount of $10,000 for the erection of an electric-light plant.

White & Kyler propose to put in an electric-light plant and heating system at Kirkwood, Ill., at a cost of $8,000.

The Brookfield Gas, Electric and Heating Company of Macomb, Ill., has increased its stock from $25,000 to $50,000.

Important improvements in the Warren (R. I.) power station of the New York, New Haven and Hartford Railroad will be made this year.

W. H. Thompson, manager of the Illinois Hydraulic Press Brick Yard, is having an electric-light plant installed at the works east of Edwardsville, Ill.

The Eldorado Industrial Company of Eldorado, Ark., has been incorporated with a capital of $80,000 to distribute electricity for light, heat and power purposes.

A franchise has been granted to F. F. Taylor and W. B. Merrill by the city of Heflin, Ala., for the construction of an electric-light plant and system of waterworks.

J. T. Smith of Quincy, Ill., and Edward Ryan of Chicago will establish an electric-light plant and other public utilities at Cotter, Ark. About $75,000 will be expended.

The electric-light and power plant at Chickasha, I. T., has been purchased by J. W. Hackaday of Itasca, Tex., and will be operated by him as the Chickasha Light and Power Company.

President Douglas of the Commercial Association of Eau Claire, Wis., has appointed a committee composed of W. K. Coffin, John S. Owen and others to investigate the feasibility of establishing a municipal lighting plant.

The Weather Bureau is about to establish a new signal station on Governors Island at which an electric current will supply the signal lights. A skeleton tower 50 feet high will be erected and topped by a staff 25 feet high. The signals will be set according to indications received from the New York office.

At the last annual meeting of the stockholders of the De Witt (Iowa) Electric Light and Power Company it was decided by unanimous vote to expend a few thousand dollars in improving and increasing the capacity of the plant. As the business has outgrown the plant, it will be necessary to install some new and larger machinery.

It is stated that Eduardo J. Chibas, who is the engineer and concessionaire for the proposed electric plant and street railway at Santiago, Cuba, will let the contracts in about two months for the electric light plant. There will be 8,000 16-candlepower incandescent and 100 1,200-candlepower arc lights, and the plant will cost about $200,000. The commencement of work depends upon the city awarding to Mr. Chibas a contract for the lighting of the city, terms for which are now being considered.

Electric lighting of trains on the West Australian government railways has been in vogue for several

years and the results are satisfactory. The report of the acting manager of the government railways indicates that as the system is extended the annual cost of maintenance is decreased proportionately. About 70 cars have been equipped with electric light at an average maintenance cost per car of about $91 a year. Investigations are now being made as to the economy of employing ordinary mechanics to attend to the apparatus.

ELECTRIC RAILWAYS.

The Whitman Railway and Power Company has been incorporated at Colfax, Wash., with a capital of $500,000. The company will build an electric road from Palous to Colfax.

Postmaster Sharp of Chattanooga, Tenn., is still at work on the proposition to gain the government's consent to a free mail delivery on the cars of the Chattanooga electric railway. Major Warner, it will be remembered, recently offered the free use of his cars for transporting the mail, and the only thing now to be considered is the government's consent to the boxes going back on the cars.

A number of cars operating on the electric line between Racine, Kenosha and Milwaukee, Wis., were snowbound in the drifts of the storm in that section last week. One car with three men and two women passengers left Racine at 8:30 Monday night and did not reach Kenosha until 9:30 Tuesday morning. The passengers failed in an attempt to reach a farmhouse and were nearly frozen before they got back to the car. Snowplows and men were sent to the rescue.

Ground has been broken for the big new central elevated depot of the Metropolitan Elevated railway at the corner of Jackson Boulevard and Fifth Avenue, Chicago, for the eventual accommodation of all the West Side suburban trains. The depot site and the right-of-way east of the river have already been purchased, and the first consignment of structural steel has already arrived in Chicago. Work on the structure will be pushed forward with all possible speed, as it is intended to run the first train out of the new depot on June 1st.

The Lake Street Elevated Railway Company of Chicago has been notified that unless the license fee which the city asserts it owes is soon paid, all cars operating without a license will be stopped. The same methods, it is intimated, will be employed against other transportation lines. Some time ago Corporation Counsel Tolman advised that the companies be required to take out a license for each car, which shall be posted in the car, like a saloon license. So far the companies have failed to comply. The fee is $50 a year a car for every car owned by the companies.

An important item of electric-railway news last week was the issuing of a trust deed to secure a second-mortgage bond issue of $500,000 for the Aurora, Elgin and Chicago Railway Company. United States Senator Albert J. Hopkins is made trustee in the instrument. The bonds are a second incumbrance on all the property of the company, including the main line of electric third-rail road from Aurora, through Kane, DuPage and Cook Counties to Chicago and the branches to Elgin and Batavia. The original lien on the property is a trust deed executed by the railway to the American Trust and Savings Bank, securing a first-mortgage bond issue of $3,000,000.

SOCIETIES AND SCHOOLS.

The next meeting of the Chicago branch of the American Institute of Electrical Engineers will be held on the evening of February 2d at the rooms of the Western Society of Engineers in the Monadnock Building. Manual versus automatic telephony will be discussed.

A lecture was given by Herman A. Poppenhusen before the Chicago Association of Stationary Engineers, January 20th, the subject being "Automatic Mechanical Stokers." Incidentally the questions of handling of coals, firing of boilers and smokeless combustion were discussed.

PUBLICATIONS.

"Volume Blowers and Exhausters" and "Mechanical Induced Draught" are the titles of two neat little pamphlets issued by the Buffalo Forge Company of Buffalo, N. Y. The former contains illustrations and descriptions of the Buffalo "B" blowers, which have a large range of sizes and forms, adapting the fans to an extensive variety of uses. The exhausters are built with an overhung wheel and a single unobstructed inlet. The advantages of the mechanical induced-draft apparatus are that it enables the burning of low-priced fuel, the automatic control of fan speed, and smokeless operation, and the apparatus is independent of atmospheric conditions, considering the exit temperature of the gases.

MISCELLANEOUS.

Jose de la Horga of Texcoco, Mexico, has purchased a modern flour-mill plant of a capacity of 150 barrels a day. Electric power will be used in operating the plant. This will be developed from a waterfall four miles distant, where 180 horsepower can be generated. The power will also be utilized for lighting the town of Texcoco.

The body of James Smithson, founder of the Smithsonian Institution at Washington, has been brought to this country and was transferred from the steamship Prinzessin Irene to the dispatch boat Dolphin with appropriate formalities January 20th. The remains were received with simple ceremony on board the Dolphin and taken to Washington for interment. The body has rested in a cemetery in Genoa since 1829.

TRADE NEWS.

The office of E. Stütz, who is the agent for "Thermit" in this country, will be changed from 54 Front Street to 43-47 Exchange Place, New York city, after February 1st. The date of the lecture to be given by Mr. Stütz before the American Chemical Society on the subject of "Thermit" has been changed to February 25th.

The calendar year 1903 and the month of December, 1903, showed, respectively, the highest record of annual and monthly exports from the United States. The year's export figures, as presented by the Department of Commerce and Labor, through its Bureau of Statistics, were $1,484,658,127, and those of the month of December, $174,734,368. The highest preceding record for any calendar year was that of 1900, when the total exports were $1,477,946,113, and the highest preceding record for a single month was that of October, 1900, when the total was $163,389,680.

Reports from Berlin are to the effect that the Allgemeine Company has acquired from the General Electric Company of New York the patent rights to the Curtis steam turbine, and that these two companies are to unite to supply capital for the Berlin Steam Turbine Company, the capital of which is to be $1,250,000. Further, the Thomson-Houston Electric Company, the General and the Allgemeine companies are to establish an Italian turbine company with a capital of $1,200,000. German electricians expect an enormous increase in the German electrical industry as the result of the application of turbine engines to the iron, coal and other leading industries.

E. G. Chamberlin, formerly vice-president of the Standard Pole and Tie Company, has associated himself with A. J. McKinnon of Maxton, N. C., in the incorporation of the Southern Exchange Company, with offices at 97-99 and 101 Warren Street, New York. The latter company will conduct a general sales agency, making a specialty of construction material for steam railroads, trolley lines, electric-light and telephone plants. Their pole specialties are the southern white-cedar and long-leaf octagonals. Mr. Chamberlin has been favorably known by the trade for several years, and his connection with Mr. McKinnon, who has an extended acquaintance among the millmen in the South, should be a fortunate one.

Russia, with its 141,000,000 people and an area nearly three times as large as the United States, offers an inviting market for American manufacturers. The industries of that country are as yet in their infancy, and among other things the advantages of 20 per cent. reduction in import duties on all direct shipments to Russian ports of entry offer opportunities for favorable competition. M. Gradstone & Co. of 2 and 4 Stone Street, New York city, represent exclusively the interests of American manufacturers for export to Russia and are endeavoring to promote direct trade relations, on a cash basis, between American manufacturers and Russian importers. They are represented in large Russian cities and contend that they are better equipped for trade in the czar's dominions than concerns whose attention is divided among several countries. Catalogues of manufacturers are solicited.

The Sprague Electric Company's New York office and Watsessing factory forces held their annual bowling tournament and banquet at Smith's Hotel, Roseville, N. J., on January 16th. That it was a success goes without saying. Besides the "boys" several of the officers of the company and many heads of the departments were present. Four bowling matches arranged on a "sliding-scale basis" were rolled. The representatives of the office force came out victorious in all of the matches after hard-fought battles with their opponents, the representatives of the factory, who acted as hosts on this occasion. It may be noted that, although they were beaten in the matches, it was the consensus of opinion of all present that as hosts Mr. Charles Noll and his confreres were without equals. After the bowling matches everybody sat down to a banquet. After the coffee had been served and the last "fuse" had been "blown" the toasts were "thrown into circuit." The voltage of the themes of these toasts was very high, and the "circuit-breakers" of laughter were continually being "tripped." Mr. Issertel of the New York office acted as toastmaster.

BUSINESS.

The Jeffrey Manufacturing Company of Columbus, Ohio, through its connection with the Ohio Malleable Iron Company, also of Columbus, is now in the field soliciting orders for high-grade malleable castings.

The B. F. Sturtevant Company says: "The maximum boiler horsepower in central power stations is only attained during a few hours of the day. During the greater part of the day the capacity required is much less than this maximum. On this account it has been found economical and practical to design the boilers and chimneys of ample capacity for this load and to force them above and up to the maximum by means of mechanical draft. This is applied with equal success to old and new plants. In the new power station of the Denver Tramway Power Company, Denver, Colo., mechanical draft is used as an auxiliary, to the natural draft provided by a chimney 240 feet high. Artificial draft is furnished by three Sturtevant electrically driven steel plate fans. The boiler capacity of the plant is approximately 6,000 horsepower."

Among cedar companies in Michigan it is the custom to ship the poles which are bought from small producers and also those lumbered off their own lands into different convenient storage yards. There the poles are assorted into their different sizes, receiving usually a second careful inspection, the first being made in the woods. Of course some companies still endeavor to ship the greater portion of their stock direct from the woods, but this is so apt to cause delay in getting cars and confusion in filling "straight" carloads of some one size from a small stock that the more experienced companies have abandoned it almost entirely. The small margin in poles and the fierce competition among the buyers of the different companies in the woods have led to the adoption of every economy possible, but this yard expense is something that must be borne if orders are to be filled promptly and accurately, especially the larger orders. However far this reform, if it may be called such, has gone in the pole business, it has not as yet been very extensively introduced in the cedar-tie business. The Maltby Lumber Company of Bay City, Mich., is one of the few concerns that has applied the reasoning and experience of the pole business to ties. Nevertheless, it has proved a very attractive feature in securing orders and will doubtless be followed by other tie companies as time goes on. A railway company is apt to find itself short a few thousand ties, or possibly but a carload or two. Then the advantage of calling on a section of the country where ties can be and are shipped every month in the year is readily appreciated. High water, poor roads, lack of water, have no effect on the shipment of ties that are concentrated in lots of 10,000 to 15,000, especially when piled in yards located in the same favorable position as regards competing railroads, as the best pole yards.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) January 19, 1904

749,716. Rail Contact Shoe. George W. Brady and Lawrence R. Jones, Wheaton, Ill. Application filed January 26, 1903.

The device consists of a body portion of inverted U-shape in cross-section, provided with depending sides adapted to partially embrace the rail-head. Sectional removable contact strips are secured to the inner surfaces of the sides for contact with the corners of the rail, and a removable contact block is secured to the body intermediate the strips and adapted for contact with the top of the rail.

749,743. Speed Indicator. Thomas H. McQuown, Biggsville, Ill. Application filed September 26, 1902.

An advancing mechanism for the indicating device is actuated by an electric magnet. Within an electric circuit is a circuit closer and breaker controlled by a movable part of the machine to which the indicator is applied. A holding and releasing device for the advancing mechanism is actuated by another electric magnet having an electric circuit and a clock-controlled circuit closer and breaker.

749,769. Electric Sanitary Closet. James H. Wilson, Lowell, Mass. Application filed October 23, 1902.

Combined in the closet are a bowl, a seat, an electric circuit, means for closing the circuit by the weight of a person, a burner arranged in the circuit and forming the pan of the closet, and a suitable receptacle in which the burner is pivoted.

749,775. Electrostatic Relay. Dan la Cour, Copenhagen, Denmark. Application filed February 7, 1903.

The combination, with an electroscope, comprises a fixed and a movable electrode. There is a local source of electricity for charging the electrodes and circuit connections between the source and the electrodes whereby the latter may be charged with the same potential, causing them to repel each other, or with different potentials, causing them to attract each other. A device or instrument responds to electrical influences independent of the local circuit for changing the status

of the circuit connections and correspondingly the potentials of the electrodes.

749,785. Battery Plate. Oskar Frank, Detroit, Mich., assignor to Levi J. Lennox and the Michigan Storage Battery Company, Detroit, Mich. Application filed May 2, 1903.

A grid for a secondary-battery plate is cast in one piece with an outer frame forming a border. Vertical bars are spaced at intervals apart and horizontal cross-bars of triangular cross-section connect the vertical bars at intervals apart and with the base of the triangles, flush alternately with the opposite faces of the plate. (See cut.)

741,791. Means for Reproducing Electrical Variations. Peter C. Hewitt, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed May 16, 1902.

As a means for reproducing the variations of current in an electric circuit an electromagnet is subjected to the influence of the variations and a gas or vapor apparatus is located in the field of the magnet.

741,792. Means for Reproducing Electrical Variations. Peter C. Hewitt, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed May 16, 1902.

The method of reproducing current variations in an electrical circuit consists in transforming these variations into a varying field of force, causing the field of force to act magnetically upon an inclosed gas or vapor so as to produce variations of electrical resistance in another circuit.

749,793. Regulator for Gas or Vapor Electric Apparatus. Peter C. Hewitt, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed May 16, 1902.

In an electric-vapor apparatus in which a path is provided for the electric current between a positive and a negative electrode, and in whose normal operations a negative flame is developed at the negative electrode are magnetic means for projecting the flame in such a direction with relation to the path of the current between the electrodes as to produce a definite normal resistance in the apparatus.

749,795. Trolley Stand. James Kermath, Detroit, Mich., assignor to the Eclipse Manufacturing Company. Application filed October 9, 1903.

With a trolley stand is combined a base provided with a socket having grooves in its side walls and divided transversely into two parts upon a line extending through the grooves at one side of the socket. A pivot post is provided with grooves to coincide with the grooves in the socket. Balls are adapted to be inserted in the grooves through the openings formed by dividing the base, and bolts extend through openings in each part of the base to secure the parts together.

749,798. Central-energy Telephone System. Kempster B. Miller, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed December 19, 1900.

A combination with a pair of telephone lines consists of a cord-circuit to loop the lines together for conversation and having a connecting plug at each end and a source of electricity for each line of the connected pair; also a relay associated with each end of the cord-circuit and operated over the telephone line during conversation from the corresponding source of current but de-energized when the subscriber's telephone is not in use, and a plug-seat switch for each of the connecting plugs. A supervisory signal for each end of the cord-circuit is controlled by the conjoint action of the relay and plug-seat switch associated with the corresponding end of the cord-circuit.

749,813. Portable X-ray Apparatus. Eugene W. Caldwell, New York, N. Y. Application filed January 16, 1903.

In an X-ray apparatus are combined a coil box, a slotted arm adjustably secured to the coil box, a rod slidingly mounted at the outer end of the arm and having a universal motion with respect thereto, and means to secure the rod in position with respect to the arm. A tube clamp at the outer end of the rod adjustably supports a tube from the coil box.

749,814. Relay Device. John P. Downs, Cleveland, Ohio, assignor to the North Electric Company, Cleveland, Ohio. Application filed May 7, 1902.

A relay device with a helix-wound core consists of a polar extension, an armature engaging therewith and disposed before the core, an interposed actuating part, a plurality of contact springs adapted to be actuated into and out of engagement with each other, and adjusting means interposed between the armature and the actuating part.

749,824. Telephone Exchange. Nils E. Norstrom, Chicago, Ill., assignor of two-thirds to John Anderson, Salina, Kan., and M. E. Richardson, Sterling, Kan. Application filed November 23, 1900.

The switching mechanism of a telephone station comprises a series of contact points, a contact arm therefor, and a magnet for moving the contact arm; also a battery and connections for operating the magnet, a circuit-breaking device in the connection, a receiver hook arranged to close the device when in one position and to open it when in another position, and a branch connection around the circuit-breaking device arranged to permit of a single movement of the contact arm. A central office, connections from the central office to the station, and means whereby the magnet may be operated from the central office are provided.

749,835. Electromechanical Switching Mechanism. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, Los Angeles, Cal. Application filed May 29, 1903.

In a switching mechanism are combined a motor-operated member, a switch element, a member connected with the switch element, to move the latter, a clutch between the members, an electromagnet, and an armature connected with the clutch and arranged to be moved by the magnet. (See cut.)

749,841. Portable Electrically Driven Drilling Apparatus. George F. Campbell and Stanley T. Isherwood, Bootle, near Liverpool, England. Application filed November 26, 1901.

Electrical features of the device are described.

749,842. Burglar Alarm for Safes. Henry R. Cassel, London, England. Application filed May 3, 1902.

The alarm is in connection with the combination of an air-tight safe, which is provided with means for altering the pressure of the enclosed air. A main circuit has a contact influenced by the air pressure.

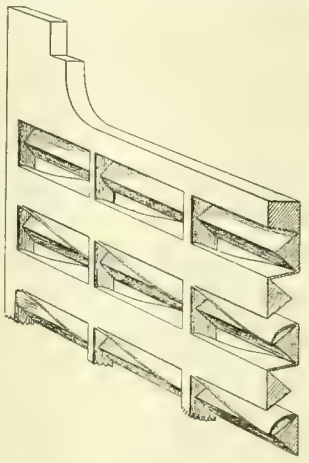
749,843. Process of Extracting Precious Metals by Electrolysis. Henry R. Cassel, New York, N. Y. Application filed October 25, 1902.

A step in this process of extracting precious metals by electrolysis consists in lifting the pulp by an air jet, distributing the same between the electrodes, and simultaneously amalgamating the cathodes.

749,844. Apparatus for Extracting Precious Metals by Electrolysis. Henry R. Cassel, New York, N. Y. Application filed October 25, 1902.

Included in the apparatus are a tank, vertical electrodes, an elevated pulp box, and a perforated launder above each anode that communicates with the box. A perforated mercury trough extends over the cathode, provided with means for imparting a reciprocal movement to the trough.

749,854. Means for Converting Faint Vibrations into Electrical Energy. William H. Fahrney, Chicago, Ill. Application filed January 10, 1903.



NO. 749,785.—BATTERY PLATE.

A plunger, an adjustable gauge or support through which the plunger passes, a variable resistance operatively related to the plunger, an electric circuit including the resistance, and means included in the circuit for indicating undulations in the strength thereof, are included in the device.

749,855. Process of Producing Electrodes for Storage Batteries and Electrode. Frederick A. Feldkamp, Newark, N. J., assignor to the Electra Manufacturing Company. Application filed May 19, 1903.

The process consists in enclosing a perforated metal plate or grid in an open-mesh fabric, and securing the fabric on opposite sides of the plate or grid, and forcing an active material in a plastic or semi-plastic state from the outer surface of the fabric on the one side of the plate or grid into and through the interstices of the fabric and directly upon the surface of the plate or grid and into and through the preparation in the plate or grid and into and through the fabric upon the opposite side of the plate or grid. The active material is then dried to produce a hard mass of active material in which the threads of the fabric are incorporated.

749,860. Means for Loading or Unloading Vessels. Henry M. Harding, New York, N. Y. Application filed January 16, 1902.

It is designed to provide a series of barges or floats with a section of overhead electric railway on each barge or float, flexible connections between the sections, and electrically operated carriers traveling on the railway.

749,867. Method of Securing Electric Wires. Alexander Kline, Jersey City, N. J. Application filed March 31, 1902.

A tie wire has a flattened middle part for winding around the line.

749,868. Power-transmission Device. John F. Krcma, Chicago, Ill. Application filed July 23, 1903.

In combination with a motor and its driving shaft are frictional rollers in peripheral engagement therewith, and a rotatable friction disk engaging one on each side of the pair of friction rollers. A rotative shaft with a non-rotative nut on each end thereof is adapted when the shaft is rotated to move the disks oppositely, and a shaft operatively connected with the friction disks is driven thereby.

749,916. Trolley for Overhead Electrical-conductor Systems. Eugenio Cantono, Rome, Italy. Application filed August 3, 1903.

A trolley, in the working of which springs are largely employed, is described.

749,919. Handle for Snap Switches. Charles A. Clark, Hartford, Conn. Application filed January 3, 1903.

The handle consists of a body of molded insulating material, and a sleeve that is angular in cross-section and has an expanded portion between its ends embedded within the body. A plunger has a head with an angular cross-section movable within the sleeve, and a washer is secured to the end of the sleeve. A spring surrounds the plunger and thrusts against the head and against the washer.

749,939. Railway Signaling Apparatus. John F. Mickey, Frank T. Bailey and Joseph J. Noppenberger, Baltimore, Md. Application filed August 1, 1903.

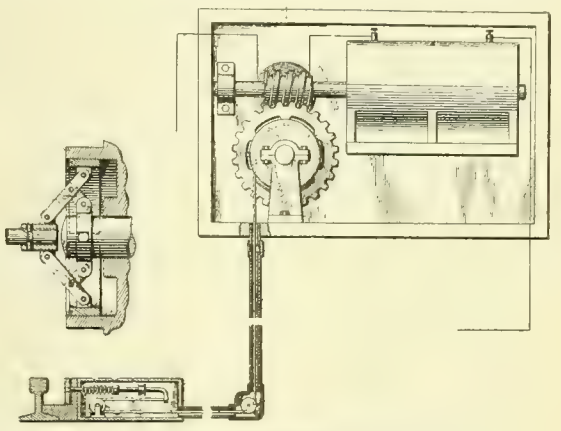
The apparatus is for third-rail block systems, and comprises the following: A trolley arm, a contact roller mounted thereon, a brush connected to the roller, a danger signal, electrical connections between the signal and the brush, an anti-friction roller carried by the trolley arm, a rail and a projection thereon adapted to contact with the roller to raise the trolley arm, means for holding the trolley arm raised, and a mechanism for releasing the trolley arm, and allowing the same to fall by gravity, so that the contact roller carried thereby will engage the third rail.

749,949. Indicating Dial for Snap Electric Switches. Charles G. Perkins, Hartford, Conn. Application filed October 29, 1903.

An indicating dial has a locking plate movably attached to one face and provided with an opening that when moved to one position is eccentric with the opening through the dial, and that when moved to another position is concentric with the opening through the dial.

749,977. Telephone-hook Switch. Ernest E. Yaxley, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed June 12, 1901. Renewed December 23, 1903.

The features are a supporting plate having a standard thereon, a hook lever pivoted to the standard, and switch springs insulatingly mounted upon the plate. A leaf-lifting spring upon which the hook lever bears has its free end interposed between the springs to operate them.



NO. 749,835.—SWITCHING MECHANISM.

749,982. Electrical Signaling System. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed December 19, 1901.

An electric lamp, a source of current supply, a normally open circuit including the lamp and source of current supply are described. The circuit and source of current supply are capable of furnishing an abnormally strong current to the lamp. A normally open shunt or parallel connection extends around the lamp, and a relay for automatically closing the normally open shunt or parallel connection is arranged so as to reduce the current through the lamp. (See cut on next page.)

749,998. Electric Tube Lamp. Daniel M. Moore, Newark, N. J. Application filed January 22, 1903.

In an electric lamp wherein the illuminating agent consists of a luminous gas traversed by electric currents and contained in a sealed enclosure is an internal electrode, consisting essentially of a thin film of carbon applied to a non-conducting surface, but in union with the leading-in wire.

749,999. Electrode for Electric Tube Lamps. Daniel M. Moore, Newark, N. J. Application filed February 26, 1903.

Combined with a tube or other receptacle containing a rarefied gas or vapor is an exterior energy-transferring electrode, and means for excluding air from a junction point between the electrode and the tube or receptacle.

750,009. Electromagnetic Gearing. Eric Thordon, Pittsburg, Pa., assignor to the Westinghouse Machine Company. Application filed February 6, 1903.

The combination consists of a driving shaft having an annular set of electromagnet coils, a shaft having an annular set of electromagnet coils arranged to move in proximity to the electromagnet coils of the first set and means for conducting the magnetic flux between adjacent poles of the two sets of magnet coils.

750,010. Air Brake. George Westinghouse, Pittsburg, Pa., assignor to the Westinghouse Air Brake Company, Pittsburg, Pa. Application filed June 2, 1903.

An electrically operated release-valve device is used for controlling communication from the main reservoir to the train pipe, and there are means [illegible] the motorman for controlling the operation of the release-valve device.

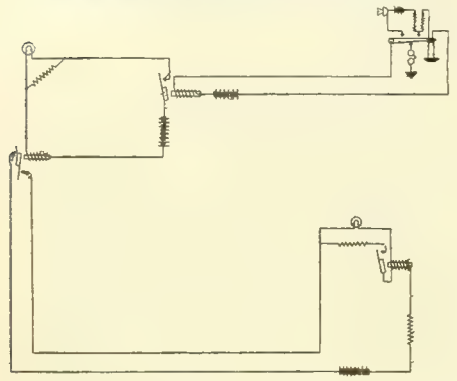
750,012. Fire-alarm Mechanism. Leonidas G. Woolley, Kenton, Ohio, assignor to Asa C. Cooney, Kenton, Ohio. Application filed April 27, 1903.

Drive mechanism for [illegible] is brought into operation by magneto-motors.

750,013. Fire-alarm System. Leonidas G. Woolley, Kenton, Ohio, assignor to Asa C. Cooney, Ken-

ton, Ohio. Original application filed April 27, 1903. Divided and this application filed July 6, 1903.

Combined with a number of electric circuits including alarm boxes is a signaling mechanism adapted to be set in operation by the turning in of an alarm, and means for cutting out all of the electric circuits immediately after the signaling mechanism is set in operation.



NO. 749,982.—SIGNALING SYSTEM.

750,038. Attemperating Device. Milton H. Shoenberg, San Francisco, Cal. Application filed March 16, 1903.

The device has a suitable support interposable in a fluid conduit, a rheostat carried by the support, and connections including a conducting plug parallel with the support and having a fluid passage through it. A solid conductor is parallel with the perforated plug, and the rheostat is in electrical connection with the conductor and plug.

750,039. Ruhmkorff Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Application filed August 21, 1903.

Included in the combination is an induction coil, an electromagnet and a vibratile circuit-controller, the circuit-controller being operated by the combined action of the coil and electromagnet.

750,040. Vibratory Circuit-controller. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Application filed October 19, 1903.

A vibratile-contact device for electric circuits consists of two members, one of which is vibratory and the other fixed; one of them carrying a number of contacts adapted to engage with the other and a circuit in which the number of contacts are connected in parallel relation.

750,041. Vibratory Circuit-controller. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Application filed October 19, 1903.

Means co-operate with the vibratile element for opening and closing the circuit successively more than once during each to-and-fro excursion of the vibratile element.

750,068. Electrically Operated Railway Gate. Max Spinrad and Hans Buechting, New York, N. Y. Application filed June 16, 1903.

An apparatus for operating railway gates consists of plates formed of insulating material and pivotally connected with the gate supports. Contact points connect with the plates and with a source of electric supply, and spring arms are attached to the supports and provided with contact points which are adapted to engage with the points upon the plates and which are also connected with the source of electric supply. Magnets are secured to the supports and connect with the source of electric supply, and armatures connect with the frame of the magnets and have projecting fingers which are adapted to engage with the plates, the armatures being operated by the aforesaid magnets and adapted to throw into and out of contact the various points to break and close the various circuits. Devices are connected with one of the rails of the track and adapted to be operated by the wheels of a car for moving the plates to throw into and out of contact the various contact points and to reverse the current which operates the motor.

750,093. Electric Resistance Furnace. Alfred H. Cowles, Cleveland, Ohio. Original application filed November 20, 1902. Divided and this application filed April 21, 1903.

The furnace comprises a resistance conductor in position to heat the charge, means for passing through the conductor an electric current the density of which increases to a maximum through a portion of the conductor in proximity to the charge, and thereby heating it uniformly, and means adjacent to the region of maximum-current density for withdrawing a product by gravity.

750,094. Process of Smelting Materials and Producing Carbide. Alfred H. Cowles, Cleveland, Ohio. Application filed October 20, 1903.

The process of producing calcium carbide consists in preheating a charge of lime and carbon by passing hot gases through it whereby its electrical conductivity is increased and electrically heating the preheated charge to the required temperature by a current passing through a resistance conductor, and increasing the heat supplied by the resistance conductor along the path of the electric current.

750,095. Process of Electrically Heating Materials. Alfred H. Cowles, Cleveland, Ohio. Application filed November 5, 1902.

The material is placed in proximity to a resistance conductor of loose, broken or granular material and an electric current is passed through the conductor. The current density is increased through a portion of the conductor in proximity to the material.

750,096. Process of Effecting Chemical Changes. Alfred H. Cowles, Cleveland, Ohio. Application filed November 5, 1902.

The terminals of a source of electric current are placed in contact with different parts of a body of carbide-forming materials, and an electric current is passed between the terminals. The current density along the path of the current is increased in the body to a point where the heat generated by the resistance of the body causes the materials to react to form carbide.

750,098. Motor. Bertram J. Delzeit, Philadelphia, Pa. Application filed October 31, 1903.

An independent series of batteries is electrically connected with one brush of the motor and contacts are connected to the series of batteries. A disk is adapted to be rotated by the motor, and means operated by the disk are provided for establishing an electrical connection between the contacts successively and the other brush of the motor. (See cut.)

150,102. Electric Automobile. Thomas A. Edison, Orange, N. J. Application filed January 9, 1903.

With the driving motor and the storage batteries is combined a separate fluid-pressure engine connected with the armature shaft of the motor for operating the latter as a generator for recharging the batteries. A flexible connection with the engine is provided for supplying fluid pressure thereto.

750,115. Automatic Electric Pump. Francis L. Orr, Thurman, Iowa, assignor of one-half to William W. Keyser, Percival, Iowa. Application filed September 9, 1903.

The invention comprises the following: A pump barrel with piston, piston rod and valves, a battery circuit, a solenoid, with reciprocating core connected in alignment with the pump piston rod, an automatic switch controlled by the solenoid core and an inclosing casing for the solenoid made tight and in open communication with the top of the pump to form an air chamber for the same.

750,117. Electrically Operated and Controlled Railway Signal. Robert D. Peters, Knox, Ind. Application filed November 21, 1902.

The various parts of the signal are operated by radially arranged electromagnets having circuits to operate the magnets independently of each other. Pivotally supported armatures for the magnets are arranged to stand normally with their free ends in the path of the stop-lug on a disk, and a lamp is provided to illumine the segmental panes.

750,118. Apparatus for Duplicating Sound-record Cylinders of Phonographs, etc. Ademor N. Petit, Waterloo, near Liverpool, England. Application filed March 25, 1903.

The device is for the manufacture of duplicate sound-record cylinders for phonographs, and among other details is provided with an electrodeposit cylindrical matrix to receive a blank celluloid cylinder.

750,119. Celluloid Phonograph-record Cylinder. Ademor N. Petit, Waterloo, near Liverpool, England. Application filed March 25, 1903.

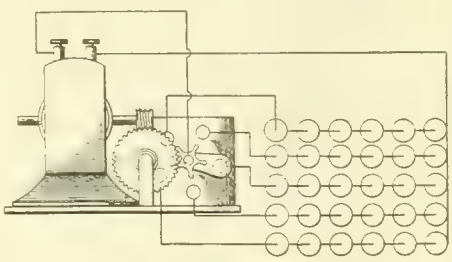
Details are described.

750,132. Electromagnet. Illius A. Timmis and Edgar W. Timmis, London, England. Application filed June 19, 1903.

A helix having a tapering central cavity and a tapering external surface is combined with a naked armature having a core and a depending rim, both tapered on lines parallel to the adjacent surfaces of the helix.

750,139. Electrical Controller for Railway Cars. Harlan P. Wellman, Ashland, Ky. Application filed November 19, 1903.

An electrical controller and casing therefor is equipped with a fluid-pressure brake system, provided with a valve. An exhaust pipe leads from the valve to the casing for discharging the exhaust from the valve into the casing in the form of spray.



NO. 750,098.—MOTOR.

750,150. Electric Fire Alarm. Joseph A. Barten and Samuel R. Sneeringer, Philadelphia, Pa. Application filed April 30, 1903.

A contact is provided with a movable member and means for closing the contact when the temperature reaches a predetermined degree. A guide rod is mounted upon the movable member, and a head is mounted adjacent to the guide rod. A spiral spring encircling the guide rod and engaging the movable member and the head has means controllable at will for securing the head at different points for the purpose of tensioning the spring to any desired degree.

750,170. Method of Electric Heating. Alfred H. Cowles, Cleveland, Ohio. Application filed November 5, 1902.

The process consists in passing an electric current through a pool of conductive material, maintaining in such pool a region of maximum-current density, feeding into contact with such pool a suitable charge, and withdrawing the product from the region of maximum-current density.

750,171. Electric Furnace. Alfred H. Cowles, Cleveland, Ohio. Application filed November 20, 1902.

An electric-resistance furnace comprises a hearth arranged to support a body of conductive material and means for passing through the body an electric current the density of which increases to a maximum along the path of the current in the body. Means are provided adjacent to the region of maximum-current density for withdrawing a product by gravity.

750,179. Electric Blanket. Charles Foglesong, St. Paul, Minn. Application filed September 14, 1903.

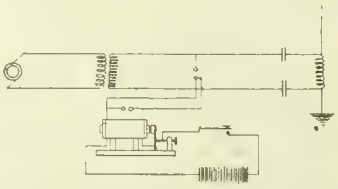
Combined in an electrotherapeutic blanket is an inner sheet of absorbent material to come in contact with the skin of the patient, an intermediate sheet having continuous wires laid closely therein, and an outer sheet formed of non-conducting material, the whole being united to form a sanitary article.

750,180. Method of Controlling Spark Production. Lee De Forest, New York, N. Y. Application filed June 17, 1903.

One claim reads: In spark telegraphy, the method of precipitating sparks between normally inoperative sparking terminals, consists in increasing at will the condition of ionization of the medium between the sparking terminals. (See cut.)

750,181. Device for Clearing Ice from Antennæ. Lee De Forest, New York, N. Y., and Walter G. Clark, Seattle, Wash. Application filed June 17, 1903.

In combination with an antenna in a wireless signaling apparatus is a generator of electromotive force of large amperage, and a conductor connected with the upper end of the antenna. Means for including the conductor and the antenna in a closed circuit with the generator are provided.



NO. 750,180.—SPARK CONTROLLER.

750,198. Socket for Incandescent Lamps. Owen E. Kenney, Toledo, Ohio, assignor to the Yost-Miller Company. Application filed June 16, 1902.

A switch-containing barrel is composed of upper and lower sections of insulating material secured together by conductor plates, having their ends curved and in parallelism with the insulator sections and secured thereto by screws. A vibrative switch is composed of a single piece of spring metal returned at one end to conform to the curve of the conductor plate, and secured in fixed relation therewith by the screw employed to attach the conductor plate to the insulator.

750,207. Electromagnetic Brake. John S. Lockwood, Kansas City, Mo. Application filed June 23, 1902.

A magnetizable drum consists of a suitable support, an electromagnet movably mounted on the support and having two cores provided each with a groove, and an armature mounted in the grooves and adapted to bear upon the drum. Two magnetic portions and a third non-magnetic connecting portion are also described.

750,223. Electric Block System. Frederick C. Robinson, Farmington, Maine. Application filed August 22, 1903.

The apparatus is in combination with a source of electricity at each end thereof, and is comprised as follows: A series of lamps electrically connected with the sources and arranged in groups, switches adjacent the ends of the series, electrical connections between the switches and the sources of electricity and the lamps, whereby when the switches are closed the lamps are included in an electric circuit, and independent means for throwing each group of lamps into circuit with the sources of electricity.

750,239. Electrically Heated Soldering Iron. William J. Bowen, Cleveland, Ohio, assignor to the Williams-Abbott Electric Company, Cleveland, Ohio. Application filed August 17, 1903.

The heating coil is mounted on a core or spool and is provided with a tapped receptacle or socket at its forward end, a removable soldering tip similarly tapped and adapted to screw into the socket, and a covering of graphite or similar substance, adapted to assist in protecting the engaging parts of the screw joint.

750,244. Fuse for Electric Circuits. Elwood C. Phillips, Chicago, Ill. Application filed January 9, 1903.

The device comprises a cylindrical insulating base having a metal sleeve on one end and having its opposite end diametrically enlarged; provided also with a central cavity open on one side and an annular cavity surrounding the same and provided in its outer wall with a recess. A cap is detachably secured on the enlarged end of the base and forms a closure therefor.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on January 25, 1904:

356,496. Electrical Elevator. Norton P. Otis, Yonkers, N. Y.
356,576. Electric Motor. Philip Diehl, Elizabeth, N. J.
356,579. Electric Locomotive. H. Erhardt, Boston, Mass.
356,580. Supporting Frame for Electric Lamps. Herbert H. Fairbanks and William H. Coughlin, Worcester, Mass., assignors to the Worcester Electric Light Company, Worcester, Mass.
356,605. Electric-Clock Alarm. Milton M. Smith and Ferdinand P. Jones, Buffalo, N. Y., said Smith assignor to Josephine R. Smith, Buffalo, N. Y.
356,632. Electric Cut-out. John Fuchs, Beardstown, Ill.
356,640. Process of Manufacturing Amalgams by Electrolysis. Arthur S. Hickley, Montreal, Quebec, Canada, assignor to the Electric Amalgam Company of Maine.
356,667. Dynamo Electric Machine. Sidney H. Short, Denver, Colo.
356,688. Telephone. Edward H. Johnson, New York, N. Y.
356,689. Telephone. Edward H. Johnson, New York, N. Y.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, FEBRUARY 6, 1904 No. 6

Power Supply at the St. Louis Exposition.

The numerous brief items that have appeared from time to time in the technical press regarding the generation and distribution of electrical energy at the St. Louis Exposition have given only a general idea of the magnitude and characteristics of perhaps the largest power plant ever erected for temporary use. Up to the present time but few details have been available, and it is the purpose of this article to present an outline of the engineering features of this installation which has occupied the attention of the electrical engineering staff of the St. Louis Exposition for more than two years.

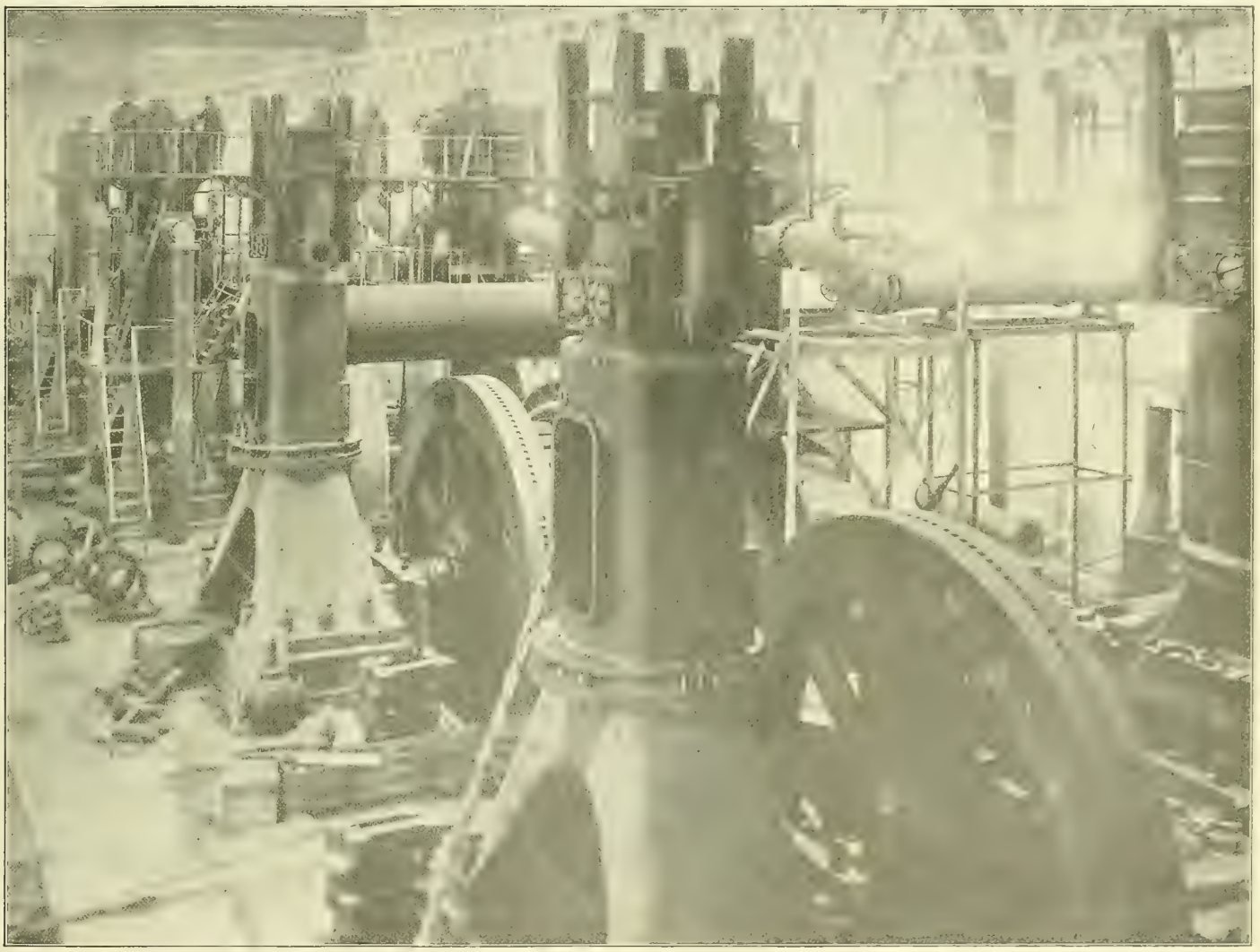


FIG. 1. POWER SUPPLY AT THE ST. LOUIS EXPOSITION—WESTINGHOUSE SERVICE PLANT IN MACHINERY HALL IN COURSE OF ERECTION.

At the Pan-American Exposition, to consider the latest American international exhibition, the proximity of Niagara Falls made it possible to obtain a large amount of electrical energy from a station already in operation and with the installation of but very little electrical apparatus. At St. Louis, however, the conditions are such that nearly all of the energy necessary to carry out the elaborate scheme of lighting, pumping and working the exhibits must be derived from a temporary exposition power plant, as none of the local companies is in a position to supply such enormous quantities of electrical energy. The chief feature of the Buffalo Exposition was the lighting effects obtained, using the Electric Tower as a centerpiece. Buffalo was essentially an electrical exposition, and yet four times the amount of electrical energy used there will be necessary successfully to carry out the plans of Mr. Henry Rustin and his successor, Mr. Edward B. Ellicott. At Buffalo, too, one-half of the electrical energy was obtained from Niagara Falls, while at St. Louis the power supplied by the Union Electric Light and Power Company will barely suffice to illuminate Festival Hall, the Cascades and the adjacent buildings.

At an early date in the development of the St. Louis Exposition it was found that the only area available for the large boiler capacity necessary was the tract just west of Machinery Hall, and accordingly plans were drawn for the Steam, Gas and Fuel Building (see Figs. 3 and 4, on next page), 200 feet by 300 feet in size.

The Palace of Electricity, one of the first buildings to be erected, had been located on an island west of the Grand Basin, and after a careful study of the situation it was deemed inadvisable to install steam-driven generators in this building, as, in order to accomplish this, live steam must be piped more than 1,400 feet and carried under a lagoon nearly 100 feet wide. For this reason it was decided to convert the west end of Machinery Hall into a model power plant, in which would be installed all direct-connected units supplying power to the exposition mains. As this scheme was developed it became apparent that the Steam, Gas and Fuel Building would be inadequate for the large installation of boilers required, and accordingly it was extended 125 feet westward, making a total area of 97,500 square feet, or nearly 2½ acres. The principal items installed in this building include:

Babcock & Wilcox boilers (contract), 15,000 square feet.

The American exhibit boilers, 17,500 square feet.

Foreign boilers, 5,000 square feet.

Fire pumps, 3,500 square feet.

Gas producers, coal-crushing machinery, etc., 30,000 square feet.

Between Machinery Hall and the Steam, Gas and Fuel Building will be located several exhibits of briquetting machinery and other apparatus for the manufacture and handling of fuel.

Fig. 2 is an exterior view of Machinery Hall, while Fig. 8 is a detail of the north main entrance of the same building, showing elaborate ornamentation. Fig. 9 is a plan of the west end of Machinery Hall, just spoken of, showing power-plant exhibits.

At the St. Louis Exposition electric energy will be available from three sources:

First—The Westinghouse plant, which consists of four 2,000-kilowatt, direct-connected generators.

Second—The exhibitors' power plant, which will be composed of engines and generators installed on exhibit basis by a score of builders.

Third—The Union Light and Power Company of St. Louis, which has a contract to furnish the exposition with 7,500 kilowatts from its new station on the Mississippi River.

The energy from all of these sources is handled from a very large switchboard installed in a gallery along the west end of Machinery Hall, and thence is distributed at 6,600 volts through a main subway and branch conduits to all of the exhibit buildings and such other locations as are required.

STEAM, GAS AND FUEL BUILDING.

The Steam, Gas and Fuel Building, 300 by 325 feet, was erected by the American Bridge Company at the contract price of $100,000. The framework of this building is entirely of steel, the walls being cinder-concrete, formed by boxing in the girders and pouring the intervening space with concrete. A large window and skylight area furnishes the daylight illumination. At night arc lamps will be used.

The interior of the building presents a striking appearance, owing to the light character of its construction and the height of the roof. Fig. 3 shows

the steel framework just before the completion of the concrete walls. The building as it now stands (Fig. 4), complete, with its heavy cornice and six 11-foot steel stacks, 95 feet high, has a very solid and permanent appearance.

Oil fuel was at first given consideration, but because of its high cost as compared with coal, and the uncertainties of delivery of the large quantity necessary daily—from 1,400 to 1,600 barrels—it was decided to use coal entirely. By the use of mechanical stokers, and utilizing briquette machinery to transform the fine screenings into coal briquettes, complete combustion is practically assured. Gas generated in producers will be used both in gas engines and under the boilers.

FIG. 2 MACHINERY HALL AT THE ST. LOUIS EXPOSITION.

During the exposition West Virginia mine-run coal will be used. The exposition company has purchased 150 50-ton Rogers ballast cars, which will bring the coal direct from the mines to the exposition grounds. Entering either of the two tracks at the extreme western side of the building, it will be dumped into one of two hoppers, passing through a crusher with a capacity of 100 tons an hour. The coal is then lifted by an elaborate system of Link Belt conveyers and distributed to hoppers over the various boilers. There are 54 five-ton pockets from which the coal is fed through tubes to the stokers of their respective boilers. Three tunnels, running from the north to the south under each line of boilers and terminating in a sort of yard in the north end of the boiler house, each contain tracks upon which the ash cars run. The large central tunnel is 15 feet six inches by eight feet, while the two on either side are eight feet eight inches by eight feet. Emerging into the above-mentioned yard, the ashes are dumped into an elevator and deposited in cars on a spur of the coal track. During the period of the exposition approximately 500 tons of coal will be required daily.

The smoke flues are carried under the floor and led to the steel stacks 11 feet in diameter and 95 feet high. The blowers (Fig. 5), installed by the Buffalo Forge Company, will be driven by steam engines.

The largest installation of boilers is that of the Babcock & Wilcox company, which is included in the contract awarded the Westinghouse company for the power plant known by that name. This installation consists of 16 400-horsepower boilers arranged in four batteries of four boilers each, in the northwest corner of the building. Immediately east of these are located the feed-water pumps, having a capacity of 1,000 gallons of water a minute. The piping of these boilers is admirable, as an accident to any boiler or pair of boilers has no effect on the rest of the battery. Duplicate piping is provided in most cases to prevent a possibility of breakdowns. Leaving the boilers at the southern end, the steam headers descend to the Westinghouse steam tunnel, which is five feet by eight feet, and carries two 12-inch and two six-inch pipes This tunnel leads direct to the four Westinghouse units in the west end of Machinery Hall. This portion of the boiler plant is entirely separate from the exhibitors' boiler plant, and is not connected with it in any way.

Just south of the Babcock & Wilcox installation, and occupying about a quarter of the entire building, is a large number of boilers of different makes installed on exhibit basis and constituting a part of the Exhibitors' Power Plant. The boilers that have been definitely located consist of:

4	Aultman-Taylor of	1,000 horsepower each.
4	Aultman-Taylor of	800 horsepower each.
8	Heine of	400 horsepower each.
1	O'Brien of	150 horsepower.
1	Climax of	300 horsepower.
1	Climax of	250 horsepower.
2	Niclausse of	400 horsepower each.
3	Belleville of	500 horsepower each.
1	Durr of	500 horsepower.

In addition to these, several other boilers have not yet been definitely located. The headers from these exhibit boilers enter a second steam tunnel connected with the Exhibitors' Power Plant in Machinery Hall. This tunnel carries one 18-inch main at 175 pounds pressure, one 16-inch main at 175 pounds pressure, one 14-inch main at 250 pounds pressure and one 12-inch main at 175 pounds pressure. While the entire plant is temporary, the boilers, piping, fittings and accessories have been put in in accordance with the best practice, and an inspection of the plant in its present condition might easily lead to the belief that the whole installation was put in for permanent use. The feed-water pumps for the exhibitors' plant will consist of several pumps by different makers, having an aggregate capacity of 2,500 gallons a minute.

In the middle of the southern part of the building are located 14 Worthington high-pressure fire pumps. These are the pumps supplying water for the fire-protection system. Running diagonally across the southwest corner of the building is a wooden waterway eight by eight feet, connecting Arrowhead Lake with the lagoons. A suction pipe supplying the fire pumps is laid beside this waterway.

The entire western portion of the building, comprising about one-third of its area, will be devoted to gas producers and various mechanisms, appliances and accessories used in modern power-producing plants.

The largest gas-producing unit will be a 3,000-horsepower size, of the Duff-Whitfield system, installed by W. F. Mason & Co. of Manchester, England. This, together with a 2,000-horsepower plant erected by R. D. Wood & Co. of Philadelphia, will deliver gas to tanks or holders. An interesting exhibit will be the producer of Julius Pintsch of Berlin, of 2,400-horsepower capacity, which requires no receiver.

FIG. 5. POWER SUPPLY AT THE ST. LOUIS EXPOSITION.—BLOWERS, STACK AND BOILERS.

EXHIBITORS' POWER PLANT.

The engines and generators constituting the two power plants—the Exhibitors' and the Westinghouse—will occupy almost the entire western end of Ma-

FIG. 3. Building in Course of Erection.

FIG. 4. Building Completed.

STEAM, GAS AND FUEL BUILDING AT ST. LOUIS EXPOSITION.

chinery Hall, making it, in fact, the Hall of Electricity and Machinery, and here the engineer will find the finest and most advanced types of foreign and American engines and generators. The Exhibitors' Power Plant is naturally heterogeneous, but the items have been well selected and will operate together in perfect harmony. The larger units are located in the main corridor, immediately beneath the crane runway, and the most conspicuous is the 3,500-kilowatt Bullock generator direct-connected to an Allis-Chalmers vertical-horizontal compound engine, rated at 5,000 horsepower, as shown in Fig. 6. This unit, known as the Manhattan type, weighs over 600 tons, and is now nearly ready for steam. It occupies a floor space 35 by 45 feet, and the low-pressure cylinder rises 34 feet into the air. A 300-horsepower Ide engine coupled to a 200-kilowatt Bullock generator furnishes exciting current for this set. Just west is a Murray engine, rated

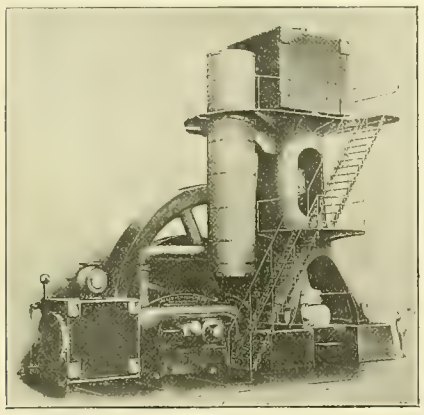
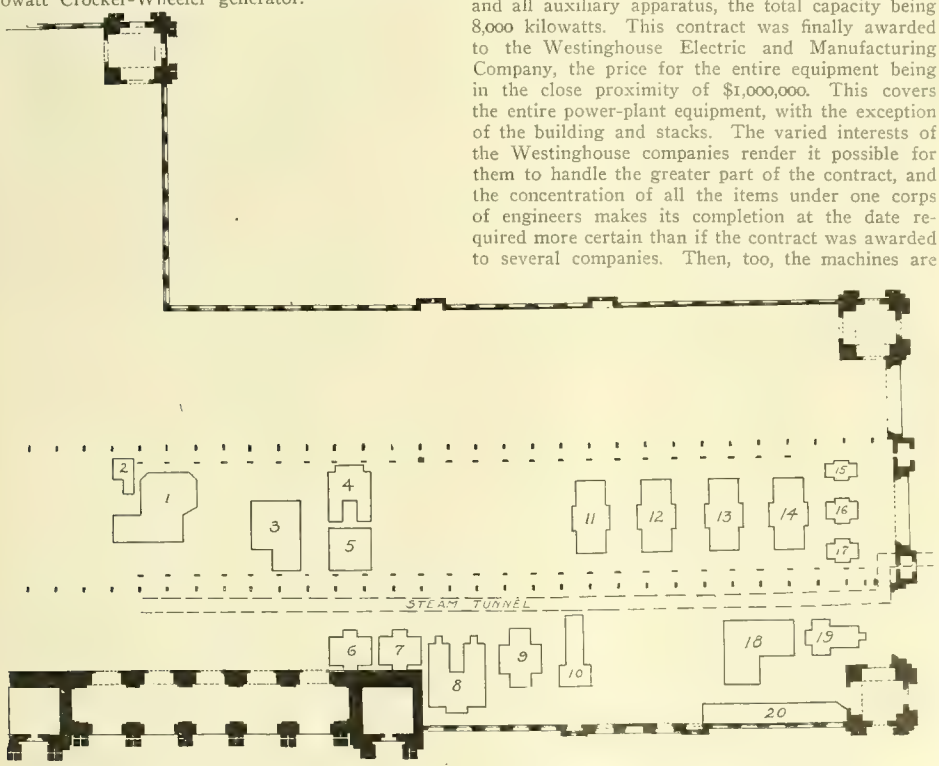


FIG. 6. ALLIS-CHALMERS VERTICAL-HORIZONTAL 5,000-HORSEPOWER ENGINE AT ST. LOUIS EXPOSITION.

at 750 horsepower, and coupled to a 500-kilowatt, 550-volt, Crocker-Wheeler railway generator.

In the same block and in the one adjoining on the north are located the following units, constituting the Intramural power plant: Lane & Bodley 900-horsepower engine, connected to a 600-kilowatt Crocker-Wheeler generator; two Brown-Corliss 750-horsepower engines, each connected to Crocker-Wheeler generators of 500-kilowatt capacity, and a Harrisburg 650-horsepower engine, driving a 400-kilowatt Crocker-Wheeler generator.



1. Allis-Chalmers 5,500-horsepower engine and Bullock 3,500-kilowatt alternating-current generator.
2. Ideal 300-horsepower engine and Bullock 200-kilowatt exciter.
3. Murray Iron Works 800-horsepower engine and Crocker-Wheeler 500-kilowatt direct-current generator.
4. Lane & Bodley 1,000-horsepower engine and Crocker-Wheeler 600-kilowatt direct current generator.
5. Harrisburg Engine Company's 650-horsepower engine and Crocker-Wheeler 400-kilowatt direct-current generator.
6, 7. Brown-Corliss 750-horsepower engine and Crocker-Wheeler 500-kilowatt direct-current generator.
8. Buckeye 1,400-horsepower engine and Crocker-Wheeler 900-kilowatt direct-current generator.
9. Hooven-Owens-Rentschler 2,250-horsepower engine and National Electric 1,500-kilowatt alternating-current generator.
10. Hooven-Owens-Rentschler steam turbine of 1,500 horsepower and Bullock 1,000-kilowatt direct-current generator.
11, 12, 13, 14. Four Westinghouse 2,800-horsepower engines, two Westinghouse 2,000-kilowatt generators and two General Electric 2,000-kilowatt generators.
15, 16, 17. Westinghouse engines, connected to 80-kilowatt Westinghouse generators (exciters).
18. Mulhausen 1,000-horsepower engine and 700-kilowatt generator.
19. Delaunay-Belleville 1,500-horsepower engine and 1,100-kilowatt Delaunay-Belleville generator.
20. Transformers.

FIG. 9. PLAN OF WEST END OF MACHINERY HALL, ST. LOUIS EXPOSITION, SHOWING POWER-PLANT EXHIBITS.

Among the alternating-current generating sets the following are noteworthy: A Hooven-Owens-Rentschler engine of the vertical type, connected to a 1,500-kilowatt National Electric generator; a 1,000-horsepower Mulhausen engine, with a 700-kilowatt generator. This is a German engine, and the generator is a French machine. A fine example of modern French practice will be found in the Delaunay-Belleville set of 1,100 kilowatts.

FIG. 7. POWER SUPPLY AT THE ST. LOUIS EXPOSITION.—INTERIOR VIEW OF MACHINERY HALL.

These machines are now being erected, and two electric cranes greatly facilitate the handling of the heavy parts. A Niles 40-ton crane, spanning the 85 feet between the middle line of posts, is used almost exclusively for the Westinghouse plant, while a Shaw crane of 60 tons capacity is now used in the erection of the Allis-Chalmers engine. (See Fig. 7.)

Westinghouse Service Plant.

The insufficient capacity of the Exhibitors' Power Plant led the exposition company to request bids for a complete power-plant installation, consisting of boilers, coal-handling machinery, engines, generators and all auxiliary apparatus, the total capacity being 8,000 kilowatts. This contract was finally awarded to the Westinghouse Electric and Manufacturing Company, the price for the entire equipment being in the close proximity of $1,000,000. This covers the entire power-plant equipment, with the exception of the building and stacks. The varied interests of the Westinghouse companies render it possible for them to handle the greater part of the contract, and the concentration of all the items under one corps of engineers makes its completion at the date required more certain than if the contract was awarded to several companies. Then, too, the machines are all of a standard type, the engines being furnished by the Westinghouse Machine Company, the generators by the Westinghouse and General Electric companies, and the construction being done under the supervision of Westinghouse, Church, Kerr & Co. The boilers, of the Babcock & Wilcox water-tube type, are located in the Steam, Gas and Fuel Building, and have already been described.

The engines and generators will occupy the central portion of the western end of Machinery Hall, about 300 feet from the boilers. (See Fig. 1.) There are four 25-cycle, three-phase, 2,000-kilowatt generators, delivering current at 6,600 volts. These are direct-connected to Westinghouse-Corliss engines, the total weight of each unit being 940,000 pounds. The engines are vertical-compound, condensing, running at 83 revolutions per minute, their rated capacity being 2,800 horsepower, with maximum overload capacity of 5,200 horsepower, this

FIG. 8. NORTH MAIN ENTRANCE OF MACHINERY HALL, ST. LOUIS EXPOSITION.

latter capacity being rated at 75 per cent. cut-off in the low-pressure cylinder. The cylinder diameters are 38 and 76 inches and stroke 54 inches. The shafts are hollow forged steel, 30 inches in diameter and weigh 40 tons. They carry, in addition to the generator field, a flywheel weighing 175,000 pounds. These engines are guaranteed to operate on 13½ pounds of steam per indicated horsepower-hour.

The generators are guaranteed to operate at 96 per cent. efficiency at full load, 95 per cent. at three-fourths load and 93 per cent. at one-half load. Exciting current is furnished from three 80-kilowatt units, any one of which is of sufficient capacity for the entire power plant. These units consist of Westinghouse 125-volt generators, direct-connected to vertical cross-compound condensing Westinghouse engines and run at 300 revolutions per minute.

The total engine capacity represented by the combined power plants approximates 45,000 horsepower,

of which 12,000 horsepower will be required for lighting alone. Three pumps for elevating the 90,000 gallons of water that will be required by the cascades every minute will absorb 6,000 horsepower, while 5,000 horsepower has been set apart for the Intramural railway system. The remainder, mainly in the form of alternating current at a pressure of 6,600 volts, will be distributed to the various substations located in the main exhibit palaces, to be used for power and lighting.

A switchboard of over 40 panels is now being erected in the switchboard gallery, which extends along the west end of Machinery Hall. This gallery consists of two floors, the upper carrying the instrument and operating panels, the lower the oil switches and bus bars. All bus bars and oil switches will be in duplicate, in order to prevent, as far as possible, even a temporary shutdown. Two load panels will register the total load, one being used for each set of bus bars. The oil switches in the high-tension circuits will be operated by solenoids, controlled in the usual manner by low-tension circuits, operated from the various generator and feed panels. Each generator panel will carry three handles operating the oil switches, one in each set of bus bars, and the third in the generator leads.

The service units were secured by Mr. Thomas M. Moore, chief of the Department of Machinery, while the power plant as a whole was developed by Mr. Rustin, chief electrical and mechanical engineer, and Mr. Ellicott, who has been in charge of this department since ill health forced Mr. Rustin to retire. Associated with Mr. Ellicott are Mr. R. H. Moore, electrical engineer, and Mr. H. F. Smith, mechanical engineer, both of whom were identified with the Pan-American Exposition.

Steam and Electric Railways in Massachusetts.

The Boston Financial News recently published an article on the comparative growth of steam and electric roads in Massachusetts in the last 10 years. From this article the following figures are obtained:

MILEAGE IN SINGLE TRACK.

Steam roads	[illegible]	[illegible]
Electric roads	[illegible]	[illegible]

NET EARNINGS FROM OPERATION.

Steam roads	$19,663,618	$25,551,068
Electric roads	[illegible]	[illegible]

PASSENGERS CARRIED.

Steam roads	[illegible]	[illegible]
Electric roads	[illegible]	[illegible]

The percentage of gain is thus shown to be greatly in favor of the electric roads. In mileage the electric roads show an increase of 187.6 per cent. as against 6.1 per cent. for the steam roads. The net earnings for electric roads increased 136 per cent. and for the steam roads 29.09 per cent., and in the number of passengers carried the former show 128.9 per cent. increase and the latter 12.5 per cent.

Doherty Gold-medal Competition.

A gold medal will be given by Henry L. Doherty, past-president of the National Electric Light Association, for the best paper, presented at the forthcoming Boston convention, on underground construction for either alternating or direct-current plants or a combination of both, the selection of the best paper to be made by a suitable committee to be appointed by the president of the association. The object of the award is to obtain for this branch of construction work more consideration than it has heretofore received. What is desired is a paper so complete and detailed that it will enable any central-station man who is obliged to put his wires underground, to undertake the work simply through the guidance of the paper. Competitors for the medal will not be confined to members of the association. Mr. Doherty's generous offer was made at the Cincinnati convention and was accepted by the association, under the condition that not less than five papers be contributed on the subject. Papers must be received at the office of the association, 136 Liberty Street, New York, not later than April 21st, three copies of each paper being requested.

Another Third-rail Line for Pennsylvania.

It is proposed to equip a portion of the Delaware and Hudson railroad system between Wilkesbarre and Carbondale, Pa., with the third-rail system, to be used exclusively for passenger service. This move is for the purpose of relieving the congested freight and coal traffic, which now crowds the road, and also, it is asserted, to compete with the Westinghouse company's third-rail system between Wilkesbarre and Scranton. (See Western Electrician of January 9, 1904.)

ALTERNATING-CURRENT RAILWAY MOTORS

An important subject was discussed at the meeting of the American Institute of Electrical Engineers in New York city on January 29th. It was "Alternating-current Railway Motors," and two papers bearing on it were read. President B. J. Arnold, who is himself a notable believer in the use of the alternating motor for railway work, occupied the chair. He introduced C. P. Steinmetz, who delivered the first paper. The second paper was read by W. I. Slichter, who, like Mr. Steinmetz, is a member of the engineering staff of the General Electric Company at Schenectady. Then followed a long discussion, in which B. G. Lamme and P. M. Lincoln of the Westinghouse Electric and Manufacturing Company, Professor A. S. McAllister of Cornell University, A. H. Armstrong of the General Electric Company, Ralph D. Mershon, Robert Lundell, O. S. Lyford, Jr., Philip Torchio and H. A. Wagner

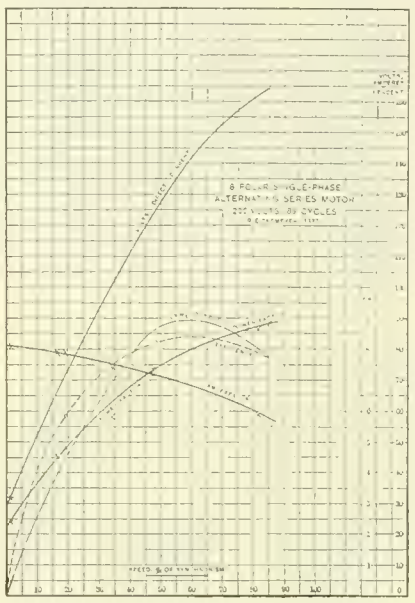


FIG. 1. ALTERNATING-CURRENT RAILWAY MOTORS.—RECORD OF EICKEMEYER MOTOR TESTED IN 1892

of New York city, and the authors of the papers, took part. An abstract of this discussion will be given in the Western Electrician of next week. The papers themselves are given in full herewith.

THE ALTERNATING-CURRENT RAILWAY MOTOR.

BY CHARLES P. STEINMETZ.

For electric railroading a motor is required which maintains a high value of efficiency over a wide range of speed. That is, the torque per ampere-input at constant impressed voltage must increase with decrease of speed, the speed increase with decrease of load.

In electric motors torque is produced by the action of a magnetic field upon currents flowing in an armature movable with regard to the field. If then the field is constantly excited—shunt motor on constant potential—the torque is approximately proportional to the current, the speed approximately constant at all loads. If the field is excited by the main current of the motor—series motor on constant potential—the field strength, and thereby the torque per ampere, varies approximately proportional to the current, and thereby the load, the whole torque approximately proportional to the square of the current and the speed inversely proportional to the current, leaving saturation out of consideration. That is, the motor has the characteristic specified above for a railway motor.

Since the direction of rotation of the direct-current motor is independent of the direction of the impressed electromotive force, with laminated field the direct-current motor can be operated with alternating currents. By the use of alternating currents it becomes possible to transfer current from circuit to circuit by induction, and instead of passing the main-line current through the armature of the alternating-current motor, the armature circuit can be closed upon itself and the current induced therein as transformer secondary by a stationary primary coil in the main circuit surrounding the armature.

The condition of operation of the direct-current motor type on alternating current is, however, that the current in field and armature reverses simultaneously. This is by necessity the case in the series motor. In the shunt motor, however, the armature current as energy current should be in phase with the impressed electromotive force, while the field current as magnetizing current lags nearly 90°. To bring it back into phase, W. Stanley tried condensers in series in the field circuit, but failed, due to the impossibility of neutralizing the self-induction of the field, which varies with the commutation and the frequency, by the negative self-induction of the condensers, which varies with the frequency in the opposite direction. The solution of the problem has been found by the use of polyphase systems, by utilizing for the field excitation the electromotive force in quadrature with the armature currents acted upon by the field magnetism. As I have shown elsewhere, the polyphase induction motor can be considered as a development of the direct-current shunt motor for alternating-current circuits, and, indeed, has all the shunt-motor characteristics regarding speed, torque, etc. As a railway motor, the induction motor has therefore not been exploited, although it has been strongly recommended in those very few cases where it appeared good engineering. Experimental work with polyphase induction-motor railways has been carried on continuously since 1893.

While in the early days of alternating-current-motor development, all other engineers were industriously developing the type with shunt-motor characteristic, only Rudolph Eickemeyer of Yonkers was far-sighted enough to realize the absolute necessity of the series-motor characteristic for railway work and undertake the development of the single-phase alternating-current series motor. I had the good fortune at that time to be associated with Mr. Eickemeyer.

As was pointed out by G. Kapp, I believe, in 1888, the power factor of the alternating-current series motor is inherently low, since the same magnetic flux which induces, proportional to the frequency of rotation, the electromotive force of useful work in the armature conductors, induces in the field coils an electromotive force of self-induction, proportional to the frequency of alternation, thereby giving the armature the same number of turns as the field (which is more than permissible in good practice, since good practice requires weak armature and strong field). Even at synchronous speed, the electromotive force of rotation of the armature would still only be equal to the electromotive force of self-induction of the field; and the power factor, allowing for an additional self-induction of the armature, would be below 70 per cent. This probably deterred the other engineers from considering the alternating-current series motor.

Eickemeyer solved the difficulty by designing the armature with a number of turns several times greater than the field [24 to seven in the first motor built] and neutralizing the armature self-induction and reaction by a stationary secondary circuit surrounding the armature at right angles electrically to the field circuit [the "cross-coil," as he called it], and either short-circuited upon itself or energized by the main current in opposite direction to the current in the armature.

In January, 1891, I tested the first motor of this type, a bipolar motor, with the following constants: Field, two coils of 14 turns No. 10 B. & S. wire connected in parallel; armature, 24 coils of four turns each of No. 12 B. & S. wire; secondary circuit, two coils of 18 turns each of No. 10 B. & S. wire connected in parallel.

At 100 cycles and 150 volts impressed electromotive force, this motor gave at three-fourths synchronous speed: Current, 45 amperes; I^2R, 400 watts; hysteresis and eddy currents, 900 watts; total

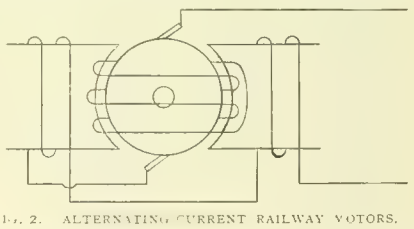


FIG. 2. ALTERNATING-CURRENT RAILWAY MOTORS. MOTOR WITH SHORT-CIRCUITED SECONDARY CIRCUIT.

output, including friction, 4,000 watts. Hence, efficiency, 75.5 per cent.; power factor, 79 per cent.

The starting current of this motor at 150 volts was 70 amperes.

As bipolar motor with the very high frequency then used, the speed, 4,500 revolutions at three-fourths synchronism, was undesirably high, so we immediately proceeded to build an eight-polar motor. In this, solid copper rings were used as secondary circuits surrounding the armature and neutralizing its self-induction, with an effective copper section more than four times that of the armature conductors. The ratio of armature-series turns to field-series turns was about four. This motor was tested in 1892. The record of tests is given in Fig. 1, the observed values being marked on the curves. For comparison, on this drawing is also given the direct-current voltage required to operate this motor at the same speed and current.

As seen, when approaching synchronous speed, the power factor is nearly 90 per cent. The commutation was fair at 85 cycles, the highest frequency at which our factory engine was able to drive the alternator, and perfect at 33 cycles.

A number of railway motors of this type were designed. The great difficulty, however, was that during these early days 125 to 133 cycles was the standard frequency in this country, 60 cycles hardly considered, and 25 cycles not yet proposed.

The efficiency of this alternating-current series

motor is slightly lower than that of the same motor on direct-current circuit, due:

(1) To the hysteresis loss in the field.

(2) The hysteresis loss in the armature core, which is of full frequency up to synchronism and of still higher frequency, the frequency of rotation, beyond synchronism.

(3) The I^2R loss in the short-circuited secondary conductors surrounding the armature.

As seen, to make the alternating-current series motor practicable, the transformer feature must be introduced, by having its armature as primary circuit closely surrounded by a short-circuited secondary circuit, as shown diagrammatically in Fig. 2.

Instead of closing the stationary circuit upon itself as secondary circuit and feeding the main current into the rotating armature as primary circuit, mechanically the same results would obviously be obtained by using the stationary circuit as primary energized by the main current and closing the armature upon itself as secondary by short-circuiting the brushes and thereby keeping the main current and the line potential away from the armature, as shown diagrammatically in Fig. 3. This introduces the great advantage of reversing the sign of the uncompensated part of the armature self-induction, so that it is subtractive, which results in an essential improvement of the power factor, especially at low speed.

This is shown in Fig. 4, where, with the speed as abscissas, in per cent. of synchronism, are plotted the power factor of the Eickemeyer compensated series motor of Fig. 1, of ratio armature to field = 4, and the power factor of one of the first railway repulsion motors, of ratio armature to field = 3.5.

The compensation of the armature self-induction in Fig. 3 is based on the feature of the transformer that primary and secondary current are in opposition to each other. The secondary current of the transformer, however, lags slightly less than 180° behind the primary current; that is, considering it in the reverse direction, is a leading current with regard to the primary current. The current in the armature in Fig. 3 is, therefore, a leading current with respect to the line current, and so not only does not add an additional lag but reduces the lag caused by the self-induction of the field-exciting coil.

This motor then consists of a short-circuited armature surrounded by two coils at right angles

FIG. 3. ALTERNATING-CURRENT RAILWAY MOTORS.—METHOD OF COMPENSATING ARMATURE SELF-INDUCTION.

with each other and connected in series, as illustrated in Fig. 5; the one (A_2), parallel with the effective armature circuit, acting as primary of a transformer to induce the secondary armature current; the other (A_1), the field-exciting coil. The ratio of turns of these coils n_2 to n_1 is the ratio of effective armature series turns to field turns, as discussed before. Obviously, these two coils can be replaced by one coil at an angle with the position of brushes, as shown in Fig. 6, and the cotangent of the angle of the axis of this coil with the position of the brushes is above ratio; that is, the smaller this angle the greater is the ratio of armature to field turns; that is, the better the power factor of the motor.

This motor, Fig. 6, is Professor Elihu Thomson's repulsion motor. In the armature an electromotive force is induced by the alternation of the magnetic field (M_2), of coil (A_2), proportional to (M_2) and to the impressed frequency and in quadrature with (M_2); and an electromotive force is induced by the rotation through the magnetic flux (M_1) of coil (A_1), proportional to (M_1) and to the frequency of rotation and in phase with (M_1). These two electromotive forces must be equal and opposite, since the armature is short-circuited (neglecting the resistance and self-inductive reactance of the armature) and at synchronism. Therefore (M_1) and (M_2) are equal and in quadrature with each other; that is, in the armature of the motor, Fig. 5, and therefore of the repulsion motor, Fig. 6. At synchronism a uniform rotating field exists and the hysteresis loss in the armature core is therefore zero at synchronism and at other speeds proportional to the difference between speed and synchronism; that is, to the slip, just as in the polyphase induction motor, while in the motor, Fig. 2, the hysteresis loss in the armature core is proportional to the impressed frequency or the frequency of rotation, whichever is the higher frequency. The hysteresis loss of the repulsion motor is therefore lower than that of the same motor as compensated series motor.

In general, if in the repulsion motor in Fig. 6 the magnetic flux in line with the brushes, which does not induce electromotive force by rotation but only by alternation, is denoted by M_2, the magnetic flux in quadrature with the brushes which induces electromotive force in the armature by its rotation but not by the alternation of the flux, by M_1, and the magnetic flux in the axis of the primary coil A, which is much nearer to M_2 than to M_1, since good power factor requires a small angle w by M, the two electromotive forces induced in the armature, by the rotation through the flux M_1 are:

$$E_1 = 2\pi N_0 M_1 n,$$

By the alternation of the flux M_2.

$$E_2 = -j\, 2\pi N M_2 n$$

Where n = number of armature turns,
N = impressed frequency;
N_0 = frequency of rotation.

Since, approximately, $E_2 = E_1$, it is

$$j\, N_0 M_1 = N M_2$$

or

$$j\, M_1 : M_2 = N : N_0 \qquad (1)$$

That is, M_1 and M_2 are in quadrature in phase and the ratio of their intensity is inversely proportional to the ratio of speed to synchronism. That is, in the repulsion motor an elliptically rotating field exists which becomes circular; in other words, a uniformly rotating field, at synchronism. Below synchronism the component M_1, which induces electromotive force by the rotation of the

FIG. 4. ALTERNATING-CURRENT RAILWAY MOTORS.—RELATION OF SPEED OF SYNCHRONISM AND POWER FACTORS IN EICKEMEYER AND REPULSION MOTORS.

aramature is greater than M_2, the more the lower the speed. The flux M interlinked with the promary coil is, however, nearer to M_2, and therefore below synchronism, especially at low speeds. The magnetic flux which induces electromotive force by the rotation of the armature and so represents the useful work, is greater than the magnetic flux which interlinks with the primary coil and so gives the lag of the primary current. This accounts for the high power factor of the repulsion motor at low speeds.

Neglecting resistance and self-inductive reactance, it is,

$$M = \text{constant},$$

corresponding to the impressed voltage.

From equation (1) it follows:

$$M_2 = j\, M_1\, (N_0/N)$$

Hence,

$$M = M_2 \cos w + M_1 \sin w$$
$$= M_1\, [\sin w + j\, (N_0/N) \cos w]$$

$$M_1 = \frac{M}{\sin w + j\, (N_0/N) \cos w}$$
$$M_2 = \frac{M}{\cos w - j\, (N/N_0) \sin w} \qquad (2)$$

or, absolute:

$$M_1 = \frac{M}{\sqrt{\sin^2 w + (N_0/N)^2 \cos^2 w}}$$
$$M_2 = \frac{M}{\sqrt{\cos^2 w + (N/N_0)^2 \sin^2 w}} \qquad (3)$$

At synchronism: $N_0 = N$, it is:

$$M_1 = M_2 = M$$

At standstill: $N_0 = 0$, it is:

$$M_1 = (M/\sin w)$$
$$M_2 = 0$$

In Fig. 7 are shown the two quadrature components (M_1) and (M_2) of the magnetic field of

FIG. 5. ALTERNATING-CURRENT RAILWAY MOTORS.—MOTOR WITH TWO COMPENSATING COILS AT RIGHT ANGLES.

the repulsion motor, for $w = 16°$ and (M) = 1.0.

In the theoretical investigation and practical calculation of the repulsion motor, just as in the polyphase and single-phase induction motor, the transformer feature is made the starting point and the motor considered as a transformer, the secondary of which is standing at a constant angle w with regard to the primary, so that motion results from the repulsive thrust existing between primary and secondary.

Let in vector denotation:

E_0 = impressed electromotive force used as zero vector e_0;

I = primary current;

I_1 = secondary current reduced to the primary by the ratio of turns (the same as customary in induction motors);

Z = primary exciting impedance that is, primary induced electromotive force, divided by primary current at open secondary circuit;

Z_0 = primary self-inductive impedance;

Z_1 = secondary self-inductive impedance reduced to the primary circuit;

w = angle between primary and secondary axis; that is, angle of shift of brushes from the position of complete transformer action;

a = (N_0/N) = ratio of speed to frequency.

The total magnetomotive force acting upon the primary coil is then: Primary current I plus component of secondary current acting in the direction of the primary, or $I_1 \cos w$.

Hence,

$$I + I_1 \cos w$$

This, then, is the primary exciting current; and the primary induced electromotive force is therefore $(I + I_1 \cos w)\, Z$.

The primary impedance voltage is $I\, Z_0$.

Hence,

$$e_0 = Z\, (I + I_1 \cos w) + I\, Z_0.$$

In the secondary circuit an electromotive force is induced by its rotation through the magnetic flux M_1 in quadrature with the secondary axis, which is in phase with this magnetic flux. This magnetic flux M_1 is due to the component of primary current acting in this direction, I sin w, since the secondary current exerts no magnetomotive force at

FIG. 6. ALTERNATING-CURRENT RAILWAY MOTORS.—COMPENSATING COIL AT AN ANGLE WITH THE BRUSHES.

right angles to the axis of the secondary coil, the electromotive force induced thereby is in phase with I.

This electromotive force, induced by flux M_1 is therefore,

$$E_1 = a\, x\, I \sin w$$

In the secondary, an electromotive force is induced also by the alternation of the magnetic flux M_2 in the axis of the secondary coil.

This magnetic flux is produced by the magnetomotive force of the secondary current I_1 and the component of primary current acting in this direction: I cos w, hence, due to

$$I_1 + I \cos w$$

and the electromotive force induced hereby is

$$E_2 = Z\, (I_1 + I \cos w)$$

The impedance electromotive force of the secondary circuit is $Z_1 I_1$, and since the secondary is short-circuited, it is

$$Z\, (I_1 + I \cos w) + Z_1 I_1 - a\, x\, I \sin w = 0$$

These are the two fundamental equations of the repulsion motor:

Primary circuit:

$$e_0 = Z\, (I + I_1 \cos w) + I\, Z_0$$

Secondary circuit: (5)

$$0 = a\, x\, I \sin w - Z\, (I_1 + I \cos w) - Z_1 I_1$$

Where we assumed the impressed electromotive force e_0 as zero vector:

From the second equation it follows:

$$I_1 = \frac{-I\, Z \cos w - a\, x \sin w}{Z + Z_1}$$

Substituting this in the first equation gives:

Primary current:

I = [illegible] $Z + Z_1$ [illegible] $Z\, Z_1$ / Z [illegible] a x sin [illegible] Z sin [illegible] Z [illegible]

Secondary current: (6)

I_1 = [illegible] Z [illegible] / Z [illegible] Z sin [illegible] Z [illegible]

Hence,

Power-factor: $\cos\phi = \frac{a_2}{\sqrt{a_1^2 + a_2^2}}$

Volt-ampere input:

$$Q = e_0 I = e_0 \sqrt{a_1^2 + a_2^2}$$

Power input:

$$P_0 = \tfrac{1}{2} e_0 I_1 = e_0^2 a_1$$

Power output:

$$P = \tfrac{1}{2} E_1 I_1 = \tfrac{1}{2} a \times I \sin w \cdot I_1 = \tfrac{1}{2} a \times \sin w \cdot I_1 I_2 = a \times e_0^2 \sin w \,(a_1 b_1 - a_2 b_2)$$

Torque:

$$T = \tfrac{1}{2} P_2 a = \tfrac{1}{2} a \times \sin w \cdot I_1 I_2 = \tfrac{1}{2} a \times e_0^2 \sin w \,(a_1 b_1 + a_2 b_2)$$

Efficiency:

$$\eta = \frac{P}{P_0} = \frac{a \times \sin w \,(a_1 b_1 - a_2 b_2)}{a_1},$$

etc.

Substituting

$Z_0 + Z_1 = Z^1 = r^1 - j\,x^1$ = total internal self-inductive impedance. Neglecting minor terms, it is approximately:

Primary current: (7)

$$I = \frac{e_0}{(a \times \sin w \cos w + r^1) - j\,(x \sin^2 w + x^1)}$$

Secondary current:

$$I_1 = -\frac{e_0 (\cos w - j\, a \sin w)}{(a \times \sin w \cos w - r^1) - j\,(x \sin^2 w + x^1)} \quad (8)$$

Angle of lag:

$$\tan\phi = \frac{x \sin^2 w + x^1}{a \times \sin w \cos w + r^1} \quad (9)$$

Torque: (10)

$$T = \frac{e_0^2 \times \sin w \cos w}{(a \times \sin w \cos w + r^1)^2 + (x \sin^2 w + x^1)^2}$$

The secondary current leads the primary current by angle

$$\tan x_1 = a \tan w$$

The secondary current comes in phase with the primary impressed electromotive force e_0, if

$$\frac{a \sin w}{\cos w} = \frac{x \sin^2 w + x^1}{a \times \sin w \cos w + r^1}$$

hence,

$$a = -\frac{r^1}{2 x \sin w \cos w} + \sqrt{\frac{x^1}{x \sin^2 w} + \frac{(r^1)^2}{4 x^2 \sin^2 w \cos^2 w}}$$

Above this speed the secondary current leads the primary impressed electromotive force e_0, hence magnetizes.

At $a = 1$, that is, at synchronism, the secondary current equals the primary current, $I_1 = I$, but leads by the angle of brush shift w.

At infinite speed, $a = \infty$

$$I = 0$$

That is, the primary current decreases with increasing speed down to zero at infinite speed. (In the ordinary induction motor the current can never fall below a certain minimum value, the exciting current.)

In this case,

$$I_1 = j\,(e_0 \times \cos w)$$

that is, lags 90° behind the primary impressed electromotive force, hence is 90° ahead of the phase of a transformer secondary current, and supplies the magnetizing current of the magnetic circuit, just as a condenser in the secondary circuit of a transformer would do.

At standstill:

$$a = 0:$$

$$I = \frac{e_0}{r^1 - j\,(x \sin^2 w + x^1)}$$

$$I_1 = \frac{e_0 \cos w}{r^1 - j\,(x \sin^2 w + x^1)}$$

$$\tan\phi = \frac{x \sin^2 w + x^1}{r^1}$$

$$T = \frac{e_0^2 \times \sin w \cos w}{(r^1)^2 + (x \sin^2 w + x^1)^2}$$

Current and torque are a maximum, the power factor a minimum at standstill.

Backward rotation:

For negative values of speed a the torque T is still positive, hence opposed to the rotation, and the repulsion motor with reversed brush angle w acts as a brake.

The primary current,

$$I = \frac{e_0}{a \times \sin w \cos w - r^1) - j\,(x \sin^2 w - x^1)}$$

for negative values of speed a becomes wattless, when

$$a \times \sin w \cos w - r^1 = 0$$

$$a = \frac{r^1}{x \sin w \cos w}$$

For higher negative values of a, or if at a speed greater than $a = (r^1/x \sin w \cos w)$ (a very low speed), the brush-angle w is reversed, the energy component of the primary current becomes negative; that is, the motor returns power into the line.

Unlike the plain series motor, which can never return power into the line, the repulsion motor when reversed becomes a generator, consumes mechanical power as brake and returns electric power into the line, even at low speeds. Experiment verifies this feature.

Discussion of Theory.

In the preceding outline of the theory of the single-phase alternating-current repulsion motor, the impedances Z, Z_0, Z_1, have been assumed as constant.

While this is approximately the case in the ordinary induction motor, it is not the case with the repulsion motor which works over a wide range of magnetic flux densities.

With increasing load and thereby increasing current and decreasing speed, magnetic saturation is approached and causes a decrease of the impedances Z, Z_0, Z_1, which has to be taken into consideration in predetermining the characteristic curves of such a motor. Furthermore, the different component magnetic fluxes are affected differently by saturation. The flux M interlinked with the primary coil is approximately constant and therefore affected by saturation only indirectly, while the flux M^1 at right angles to the line of polarization of the secondary coil is approximately proportional to the load, and so reaches saturation at high loads, and the impedances become thereby different in the different directions of the magnetic structure.

The magnetomotive forces in the preceding have been treated as vector quantities, independent of their distribution around the periphery of the armature. This distribution, however, is different with the different magnetomotive forces. The magnetomotive force causing the effective flux M_1 is due to a zone of the primary winding within the angle $\pm w$ from the axis of the secondary coil, hence nearly a concentrated winding, which gives a flat-topped flux distribution, while the flux M_2 in the

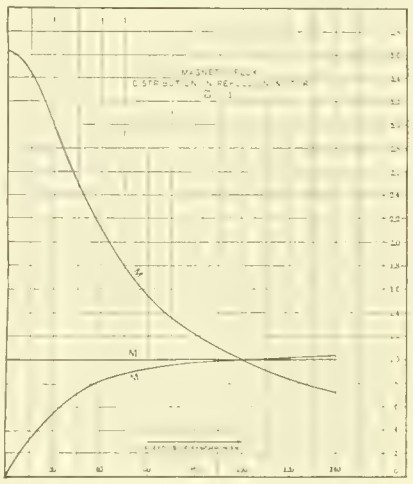


FIG. 7. ALTERNATING-CURRENT RAILWAY MOTORS.—TWO QUADRATURE FIELD COMPONENTS OF REPULSION MOTOR.

direction of the axis of the secondary coil is that of a distributed winding or peaked. For the same magnetomotive force the effective flux M_1 is therefore greater than the effective M_2. Taking this into consideration, gives the motor somewhat better characteristics than calculated above. Due to the different wave shapes of the fluxes M_1 and M_2, they are affected differently by saturation. The flat-topped flux M_1 reaches saturation at a much higher value, but then over the whole range, while the peaked flux M_2 shows the effects of saturation at a lower value, but then gradually, by a rounding off of the peak. In the repulsion motor it is therefore not sufficient merely to consider the resultant magnetomotive forces as vectors, but their distribution in the air gap and the effect of saturation must be taken into consideration in the calculation and design of the motor. An exhaustive investigation hereof has been made by my assistant, Mr. M. Milch, and may be communicated at a later date.

The secondary circuit of the motor has been considered as the seat of two electromotive forces induced respectively by the rotation through flux M_1 and by the alternation of flux M_2. These electromotive forces, however, have no separate existence. At synchronism, for instance, the magnetic field is an approximately uniformly rotating field, and therefore no electromotive force is induced in the armature conductors except that required to overcome the resistance. The secondary frequency varies with the load and thereby the secondary self-inductive reactance which we assumed as constant in the preceding discussion. This is best taken into consideration by a theory developed by my former assistant, Mr. S. Sugiyama of Japan. The primary impressed alternating magnetomotive force of the current I is resolved into two component magnetomotive forces of half intensity, revolving synchronously in opposite directions. If now a = the ratio of speed to synchronism, the two oppositely revolving components of I revolve with regard to the secondary system with the speeds 1 − a and 1 + a, respectively. The same consideration applies to the secondary magnetomotive force I_1, and in the secondary system we then have induction at two frequencies 1 − a and 1 + a, of which the former becomes zero at synchronism. That is, at synchronism the secondary current in the armature conductors is of double frequency, similar as in the ordinary single-phase induction motor. At other speeds it is the superposition of two currents of the frequencies 1 − a and 1 + a, respectively. This theory more closely allies the repulsion motor with the ordinary induction motor. Using the same values of secondary impedance Z_1 for both components obviously leads to identically the same equations as given in the preceding.

The complete investigation of the repulsion motor must also take into consideration the current flowing in the armature coil during the moment where the coil is short-circuited by the brushes passing from commutator segment to segment. The magnetomotive force of this short-circuit current of commutation is at right angles to the axis of secondary polarization of current I_1, hence has the angle of brush-shaft — (90 — w). A corrective term must therefore be applied, taking this phenomenon into consideration, essentially of the character of a repulsion machine with negative or generator brush angle of 90 — w and very high effective secondary resistance. This term is very small or negligible at speeds up to a point somewhat beyond synchronism, but becomes noticeable at speeds considerably above synchronism, due to the decrease of the main current at these speeds. The main effect of this phenomenon is that the power factor of the motor instead of increasing indefinitely with the speed up to 100 per cent. at some very high speed (and then decreasing again slightly, with leading current), reaches a maximum somewhere between 90 and 97 per cent., according to the constants of the motor, and then very slightly decreases with increasing speed, as is shown in the curve of the power factor of a repulsion motor in Fig. 2.

Speed Torque Characteristics of the Single-Phase Repulsion Motor.

BY WALTER I. SLICHTER.

The single-phase commutator motor has attracted considerable attention of late, as there is quite a demand in railway work as well as in numerous other lines for an alternating-current motor that will start under a heavy load with a reasonable consumption of energy. At present it appears that a commutator motor is the only type that will fulfill these conditions.

For some months past the writer of this paper has been in charge of a series of experiments with various types of alternating-current commutator motors. During these experiments much attention was given to the repulsion motor. It is the purpose of this paper to place before the Institute some of

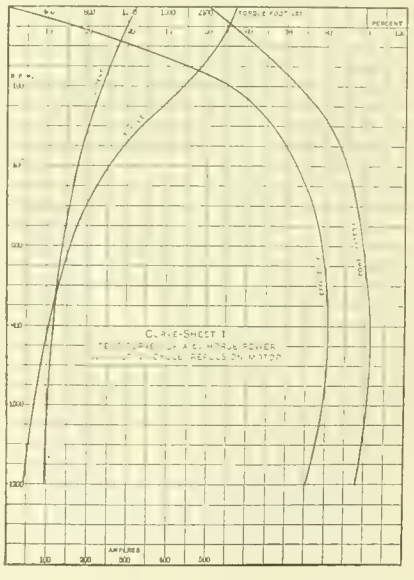


FIG. 8. ALTERNATING-CURRENT RAILWAY MOTORS.—TEST CURVES OF REPULSION MOTOR.

the results obtained, and to point out some of the characteristics of the motor which give future promise of making it a very prominent factor in some lines of electric railroading.

For the benefit of those not already familiar with this type of motor, it may be here stated that it is a single-phase commutating motor, resembling very much a regular direct-current armature in an induction-motor field. The resemblance to the induction motor is carried still further in that there is no electrical connection between the primary and secondary. This makes it possible to wind the primary for a high line voltage, while the voltage of the secondary winding is chosen at such a value as may be commutated satisfactorily, since it is short-circuited on itself through its brushes.

The motor has the same characteristics as the direct-current series motor, namely, maximum torque at starting, increasing torque with increasing current and decreasing speed, and comparatively constant

efficiency, through a wide range of speed. The maximum speed of the motor is limited only by the load and impressed voltage and has no relation to the synchronous speed.

Due to the reactance of the motor circuits, the power factor at starting is low and will be with any alternating-current motor; but in the repulsion motor a low power factor does not mean small torque. On the contrary, the maximum torque occurs simultaneously with the lowest power factor; that is, at starting. The power factor of the repulsion motor rises very rapidly with the speed; it reaches a good value at one-third synchronous speed, and values near to 90 per cent. are obtained over a considerable range of speed. For this reason a large number of poles is not necessary, and frequencies of 25, 40, and even 60 cycles may be employed.

The rotating conductors of the secondary cutting the primary flux, generate a leading electromotive

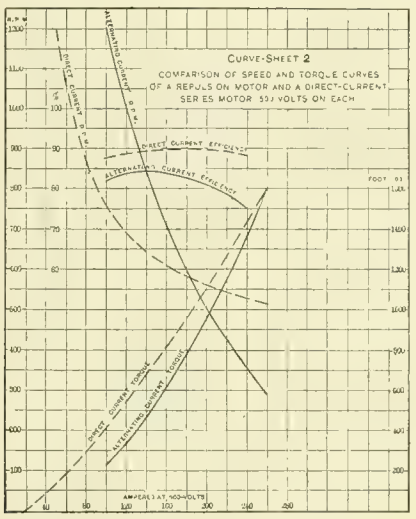


FIG. 9. ALTERNATING-CURRENT RAILWAY MOTORS.—COMPARISON OF SPEED AND TORQUE CURVES.

force, which causes a leading current to flow therein and gives the high power factor of the motor. In the plain repulsion motor, this leading current never reaches a value great enough to compensate entirely for the magnetizing and other wattless currents at available speeds, but the phenomenon is utilized to obtain unity power factor in the compensated type by the addition of a second circuit. The inherently good power factor of the repulsion motor makes it possible to use larger clearance between field and armature than is permitted in induction motors, thus greatly increasing its value in railway work where comparatively large air gaps are necessary.

The curves given are partly from test and partly from calculation of motors having air gaps on a side of one-eighth inch and more. The air gap of corresponding stationary induction motors would be 0.040 inch and more.

The efficiency, while not so good as in a direct-current motor, is yet very good, reaching values of

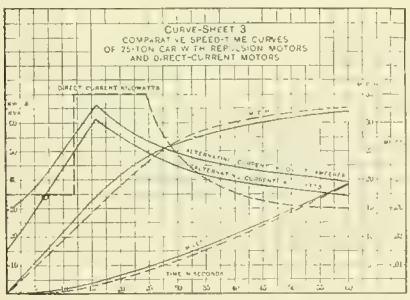


FIG. 10. ALTERNATING-CURRENT RAILWAY MOTORS.—SPEED-TIME CURVES COMPARING REPULSION AND DIRECT-CURRENT MOTORS ON CARS.

from 80 to 85, including gear loss for sizes ranging from 50 to 200 horsepower.

Commutation at normal speeds is inherently good, due to the revolving field. As the speed decreases the current increases rapidly, producing a tendency to spark, but with the reduced voltage of starting the rush of current is limited to values within the range of good commutation, as in the direct-current motor.

At higher speeds, ranging above 1½ times synchronism, the frequency of commutation becomes high and sparking appears.

The motor of Fig. 8 will start with 75 per cent. of full voltage and twice full-load current with no trouble from sparking. As these curves are prepared upon a railway-motor basis, and full-load current will produce a rise of 75° Centigrade after one hour's run, the ability of the repulsion motor successfully to commutate overloads is equal to that of the direct-current series motor; in fact, it is better, due to the short-circuited commutator, which makes flashing-over impossible.

Fig. 8 shows the characteristics of a repulsion motor plotted with revolutions per minute as a base. These curves are taken from tests on a 60-horsepower, 25-cycle, 500-volt motor; they show the rapidly rising efficiency and power factor and the large torque at starting. The starting torque is 2,300 foot-pounds, with an input of 325 amperes, and the normal torque during acceleration, 450 foot-pounds at 750 revolutions and 125 amperes. Thus the starting torque is five times normal and the starting current 2.6 times normal; or the torque per ampere at starting is 1.92 times what it is at normal speed, should occasion demand the full starting capacity of the motor.

This gives an idea of the steep speed characteristics of the motor, which are even better shown in Fig. 9. The full lines refer to a later type of repulsion motor and the broken lines to a standard direct-current series railway motor; these curves are plotted in the usual way, with current as a base. This shows that the torque increases more rapidly with increasing current in the repulsion motor than in the series; and, conversely, that the speed of the repulsion motor increases more rapidly with decreasing current than in the series motor. Efficiency, including gear loss, is given and is 84.5 per cent. at the maximum for the alternating-current motor. This motor was designed with the steep-speed characteristics for acceleration work, while the motor of Fig. 11 is designed for constant-speed running, and has not such steep curves but better constants at light loads.

The characteristics show the repulsion motor to be admirably adapted for acceleration work, the efficiency of acceleration being higher than in direct-current work, due to the possibility of obtaining fractional electromotive forces with alternating currents without introducing the dead-resistance losses of the direct-current system of control.

This is shown in the curves of Fig. 10, which gives the acceleration curves from a test of a 25-ton car equipped with two 60-horsepower repulsion motors. The full lines indicate the repulsion-motor characteristics and the broken lines those calculated for a

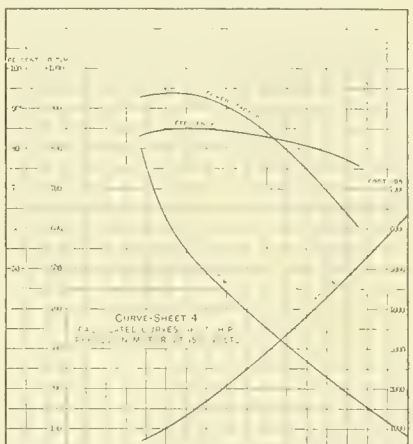


FIG. 11. ALTERNATING-CURRENT RAILWAY MOTORS. CALCULATED CURVES OF 175-HORSEPOWER REPULSION MOTOR.

direct-current equipment. The gearing is chosen for the same free-running speed, 33 miles per hour, the same average acceleration, and the same distance covered in 60 seconds. For the direct-current motor the curves of kilowatt input, miles per hour, and miles traveled, are given as calculated; and for the alternating-current motor the kilovolt-ampere input, kilowatt input, miles per hour, and miles traveled, from test.

The repulsion motor remains on the controller only 16 seconds and the direct-current motor 25 seconds. The maximum power taken by the direct-current motor is 70 kilowatts and by the repulsion motor 61 kilowatts, or 67 kilovolt-amperes. At the end of 25 seconds, the total kilowatt-hour input in the two cases is 0.375 for the direct current and 0.30 for the alternating current. At the end of 60 seconds both cars have covered a distance of 0.039 mile and have reached practically the same speed of 32.5 miles per hour, the kilowatt-hour input being 0.72 for the direct current and 0.685 for the alternating current.

By comparing the areas of the kilowatt curves in the two cases, the gain, or, rather, the saving, by the use of the alternating current is readily seen It is also worthy of note that the volt-ampere input of the alternating-current motor is least at starting; that is, the line current is least. As this is the time at which the power factor is lowest, it is seen that the effect of the low power factor on the regulation of the system is much modified by the small value of the current.

Fig. 11 shows the calculated characteristics of a 175-horsepower railway repulsion motor having an air gap of 0.15 inch and wound for 1,500 volts and 25 cycles. The efficiency, including gear loss, is 85 per cent. at the maximum and the power factor is 93. Such a motor is designed for heavy, slow-speed locomotive work, which is probably one of the most promising fields for the alternating-current motor. It is readily seen how well it is adapted for freight haulage by the fact that the efficiency of 85 per cent. is attained at a speed as low as 500 revolutions, thus permitting a speed of 12 to 15 miles per hour, with a good gear reduction.

Thus the repulsion motor is well adapted for acceleration work, as well as for efficient running at light loads, and having good constants at low speeds, is well adapted for freight haulage at low speeds.

The curves given in this paper all refer to the simple repulsion motor, the theory of which is given in the paper by Mr. C. P. Steinmetz. There are many variations of the repulsion motor, more or less complicated, from which a better power factor and even a better efficiency have been obtained in test. However, a description of these various schemes, with their characteristics, would require sufficient space to warrant a distinct paper, and it is hoped to present such to the Institute at some future date.

Aluminum Welding.

The various methods of soldering aluminum so far tried have proved unsatisfactory on account of the galvanic action which takes place between the aluminum and the solder, the metals which enter into the combination of the solder being electro-negative with relation to the aluminum. Another difficulty is also encountered in completely removing

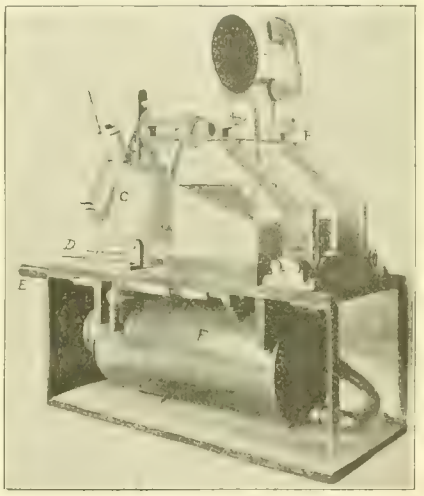


FIG 1. ALUMINUM WELDING MACHINE.

the film of oxide on the surface, which is necessary to the adhesion of the solder.

Welding instead of soldering seems to present the better solution of the problem. The most serious difficulty encountered in welding arises from the fact that at a few degrees under its melting point aluminum passes into a mushy or brittle state, and being a very good conductor of heat, the solder rapidly cools and freezes before flowing sufficiently. The best welding temperature lies just below the point where this pastiness occurs.

Sherard Cowper-Coles, an English experimenter, in a paper recently read before the Faraday Society, describes, among other processes of aluminum welding, one developed by him.

The process uses no flux or solder of any kind and does not necessitate the hammering of the joint while in the semi-fluid state. This method is especially suitable for wire rods or tubes and other drawn or rolled sections, and consists in placing the parts to be welded, after being faced off square, in the machine shown in Fig. 1, fitted with clamping screws, which are capable of moving horizontally on suitable guides. The movement of the clamping screws is controlled by the levers (D). The aluminum to be welded (B) is heated by means of an ordinary benzine lamp (C), and as soon as

FIG 2. WELDED JOINT IN ALUMINUM.

the rods have arrived at the necessary temperature slight pressure is applied to the levers (D), which causes them to unite, and a ring of metal is squeezed out, as shown in Fig. 2. This ring of metal is largely composed of aluminum oxide, and acts as an insulating and supporting collar, the molten metal being retained within this collar. The weld is then instantaneously quenched by turning a handle attached to the screen (A), which allows water, under pressure, to be projected on to the joint from the reservoir (F). The same handle which turns the water on places a screen (A) in front of the heating flame. The water pressure is maintained by air supplied by the hand pump (E). The rod is then removed from the machine and the collar filed off, when it will be found that the joint is as strong as the rest of the metal.

An oxygen-hydrogen flame or ordinary gas with or without air can be substituted for the benzine lamp. The process is a simple one, and can be worked by an unskilled workman.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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DATES AHEAD.

Independent Telephone Association of Wisconsin (annual convention), Hotel Pfister, Milwaukee, February 10th and 11th.

Ohio Independent Telephone Association (annual meeting), Grand Hotel, Cincinnati, February 17th to 19th.

National Electric Light Association (annual meeting), Boston, May 24th to 26th.

OWNERS and managers of hydro-electric installations will be interested in the recent decision of Judge Artman in the Boone County Circuit Court of Indiana in the case of the Noblesville Hydraulic Company against Evans and Illyes. Here the question involved was one of eminent domain. The plaintiff operates an electrical generating plant driven by waterpower. It contends that since it supplies electricity to the public at large its work is a public utility, and that therefore it has a right to condemn property for its use under the law of eminent domain. The defendants opposed this contention. The court held that the hydraulic company, by acquiring property by such a procedure, would be serving itself and not the public. Further, since the company is not furnishing the electricity under such conditions as binds it to render service to the public as a matter of law, it is not discharging a public duty, but is exercising the powers and functions belonging to a corporation established under an entirely different statute from that which gives the right of acquiring property by eminent domain to a hydraulic company for the erection of dams in rivers in the state of Indiana. To come under the latter statute the power must be used for public service, the judge says. It therefore appears, on the strength of this decision, that a private hydro-electric company selling electricity to private consumers is not such a hydraulic company as is vested with the right of condemning land under the law of eminent domain in the state of Indiana.

ONE of the important problems now in process of solution by the electrical engineering profession is the application of the single-phase alternating-current motor to railway work. It is a problem that has to do with the latest and most interesting advance in electrical engineering as applied to traction, and is being studied not only in the United States, but in Germany, Italy and other countries as well. The American Institute of Electrical Engineers did well, therefore, to devote its New York meeting of last week to the subject. Two papers were read—one by Charles Proteus Steinmetz on "The Alternating-current Railway Motor," dealing with the topic from the mathematical point of view and giving some account of the work of Eickemeyer, and the other by Walter I. Slichter on "Speed-torque Characteristics of the Single-phase Repulsion Motor," written as a more general contribution to the subject. Arnold and Lamme—engineers who have devoted much attention to the subject—were also at the meeting. The former occupied the chair as president of the society, and was thus precluded from taking an active part in the arena of debate. The latter opened the discussion. The two papers are given in full in this issue of the Western Electrician; an abstract of the long discussion will appear next week. As it seems likely that the single-phase motor is to occupy the place in railway work which electrical men have long hoped could be achieved, these papers and the discussion should be studied by all striving to keep abreast of the art. A single-phase motor adapted for commercial railroading would certainly give a great impetus to the electric railway and would have an appreciable effect on the future of the steam locomotive.

ELECTRICAL interests are in some measure concerned in the possibility of war between Japan and Russia, growing out of the situation in Korea and Manchuria. For instance, the last link of the American Pacific cable, connecting Manila, in the Philippines, with the mainland of Asia, remains to be laid. A war in the Far East might further delay the laying of this cable, or, under conceivable circumstances, might accelerate it. Again, the American interests in Korea are largely concerned with electrical enterprises. It is only of late years that railways, telegraphs, telephones and a postal system have been introduced into Korea. A railway from the seaport of Chemulpo to Seoul, the capital, a distance of 26 miles, was built by American contractors, and has reduced the time between the seaport and capital from eight hours to 1¾ hours. The Seoul Electric Company, organized chiefly by Americans and with American capital, has built and operated an electric railway near Seoul, which is much used by the natives. Electric lighting is also supplied. This electrical plant is said to be the largest single electrical plant in Asia, although this statement is rather doubtful. The machinery was imported from the United States, and the consulting engineer, a Japanese, is a graduate of the Massachusetts Institute of Technology. Again, Japan is rather a good customer of the United States in the matter of electrical machinery, taking from us goods of this description valued at $341,743 in 1902 and $332,539 in 1903. War might seriously interfere with this trade, although benefiting some other lines, such as foodstuffs. Altogether, it will be seen that the situation is not without individual interest to many American electrical men.

READERS of the Western Electrician will be greatly interested, we are sure, in the leading article in this issue, which is devoted to the "Power Supply at the St. Louis Exposition." Naturally, electricity is the agent employed to transmit the power used mechanically and for light, and three sources of current are provided—a service plant in Machinery Hall and the Steam, Gas and Fuel Building, an exhibitors' plant similarly located, and a St. Louis central station on the Mississippi River. Altogether, it is expected that some 45,000 horsepower of electrical energy will be available, which is about 50 per cent. larger than the total capacity of the plants installed at the World's Fair in Chicago, which, as we remember, was about 30,000 horsepower. Coal is to be used for fuel, instead of oil as at Chicago, but it is expected that complete combustion will be effected. Of course, a "smoke nuisance" would be decidedly out of place at a great exposition, and the success of the management in this respect will no doubt serve as a valuable object-lesson. The largest unit in the two generating plants in Machinery Hall is of 3,500 kilowatts capacity—over twice the size of the largest generating set at the Chicago World's Fair, but not particularly remarkable in these days of 5,000-kilowatt and larger generators. There are to be some interesting foreign generating sets, although it must be confessed that the showing of over-sea types is not so large or so representative as might be wished. Particularly to be lamented is the non-appearance of the 3,000-horsepower Cockerill gas engine, which would have formed one of the most interesting mechanical features of the exposition. The "juice" will be mainly distributed as 6,600-volt, 25-cycle, three-phase current, and the switchboard should be large, modern and interesting. On the whole, the power plants of the exposition will be sure to attract the careful attention of all visitors interested in applied mechanics.

AMONG the many interesting matters brought to the attention of the present session of Congress, none is more so than those pertaining to the electrical industries in their varied forms. For one thing, a bill has been introduced giving permission for the erection of poles for the stringing of overhead wires in the District of Columbia, in order to facilitate work on the undertaking now under way to eliminate grade railroad crossings in all parts of Washington. It is proposed to continue this work at night, and for that purpose it will be necessary to use electricity for both lighting and power purposes, and for the running of temporary car service. It has been recommended that the privilege be allowed, as it will greatly facilitate the work, and will only be for a temporary use of the poles and wires

Representative Gillett of Massachusetts has introduced a bill for the prevention of the use of interstate telegraph and telephone lines for gambling purposes, either in the form of "bucket shops," pool-selling, lotteries, "book" making, or horse-racing. The bill provides that any person using the lines for any of these purposes shall be guilty of a misdemeanor, punishable by either imprisonment for not more than two years, or a fine of not more than $1,000, or both, and for subsequent offenses of a like nature, by imprisonment only. If common carriers engage in such business, they shall be guilty, and shall be punishable in the same manner. The bill further defines the term "bucket shop."

A bill providing for the granting of a right-of-way for a telegraph and telephone line in Alaska has been introduced by Representative Cushman. Anyone securing such right-of-way will be required to have not less than 200 miles of such right-of-way occupied by constructed lines during the first two years, and failure to meet this requirement will release the land back to the original public lands and reservations from which it has been secured.

Electrical Exports for December and for the Year 1903.

The electrical exports from the United States for the month of December, 1903, amounted to a total value of $852,598, as compared with $760,981 for the corresponding month in 1902. There was also an increase of $139,563 over the figures for November, 1903.

Comparing the figures as classified by the Bureau of Statistics, Department of Commerce and Labor, it will be seen that exports classified as electrical machinery gained $19,390 in December, 1903, as compared with December, 1902, and electrical appliances, including telegraph and telephone instruments, gained $72,227. The figures are as follows: Electrical machinery—December, 1903, $448,921; December, 1902, $429,531. Electrical appliances—December, 1903, $403,677; December, 1902, $331,450.

With the official figures for December now at hand it is possible to give the exact total value of electrical exports from the United States for the calendar year of 1903. In a summary of last year's electrical exports, printed in the New Years number of the Western Electrician, giving the exports by months, the figures for December were necessarily estimated, as official figures were not available at that time. It is now seen that both classes—machinery and appliances—were underestimated. Machinery was estimated at $370,000 and was actually $448,921, and the estimate for appliances was $390,000, while the official figure is $403,677. This adds $92,598 to the partially estimated figure of $9,762,387 and, considering a few slight changes in the months preceding December, places the official total for the year 1903 at $9,856,047. A decrease of $93,660 is thus shown from the figures of 1902. For the year just closed goods classified as electrical appliances show an increase of $691,993 over 1902, but this was not quite enough to make up the falling off of $833,141 in electrical machinery.

Comparative figures for the last two years are as follows:

	1902.	1903.
Electrical machinery	$5,937,643	$5,104,502
Electrical appliances	4,059,552	4,751,545
Total	$9,997,195	$9,856,047

Classified according to destination, the following are the exports of electrical machinery for 1903:

United Kingdom	$1,724,182
British North America	1,380,198
Mexico	548,609
Japan	332,539
European countries not elsewhere specified	284,737
British Australasia	220,276
Brazil	170,153
British Africa	66,203
Germany	64,463
British East Indies	57,426
South American countries not elsewhere specified	51,461
France	49,623
Argentina	30,313
Cuba	28,016
Philippine Islands	25,962
West Indies and Bermuda, not elsewhere specified	17,505
Hongkong	15,408
Central American States and British Honduras	11,385
African countries not elsewhere specified	8,400
Chinese Empire	7,268
Colombia	6,726
Asia and Oceania, not otherwise specified	3,649

Annual Reports of Chicago Elevated Roads.

The annual report of the South Side Elevated Railroad Company, presented at the stockholders' meeting, showed the year 1903 to be the most prosperous in the company's history. The gross income was $1,697,310, an increase of 13.1 per cent. over the previous year. The operating expenses also increased 15.3 per cent. and were equal to 59.2 per cent. of the earnings from passengers. The surplus for the year, after allowing for maintenance, operating expenses, bond interest and dividends, was $242,051. The average daily number of passengers carried during the year was 89,280, being an increase of 13.65 per cent. The old officers were re-elected with the exception of Secretary and Treasurer John H. Glade, who resigned on account of ill health, his place being filled by Horace F. Hardy. In the annual statement President Carter outlined the new service which it is proposed to give and also gave a clear statement of the financial plan of raising between $6,000,000 and $7,000,000 capital through the sale of stock at 93. The proposed new lines include 3.8 miles of single track and 6.8 miles of double track, nearly doubling the system, the work to be completed by March 16, 1907.

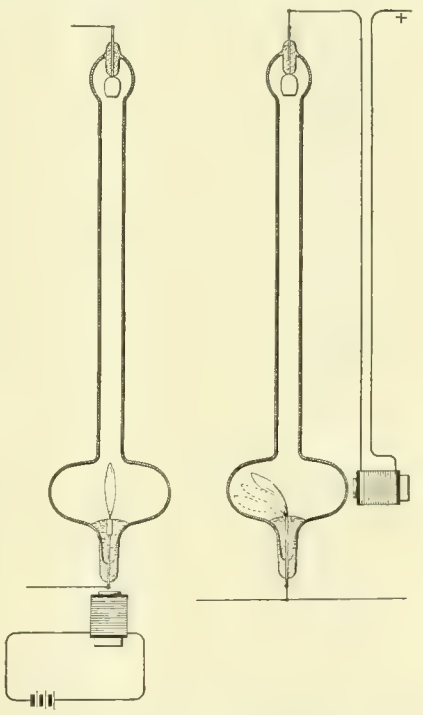
The earnings of the Northwestern Elevated Railroad Company of Chicago for the year ended December 31, 1903, after deducting operating expenses, maintenance, taxes, interest, etc., were $202,534. The gross earnings for the year amounted to $1,542,039, an increase over 1902 of $131,041, or 6.7 per cent. Total operating expenses were 42.59 per cent. of the gross earnings. A daily average of 68,310 passengers was carried in 1903, an increase of 6.76 per cent. over 1902.

The annual meeting of the stockholders of the Lake Street elevated railroad was held in Chicago recently, but no financial statement was presented, owing to the fact that the company is at present adjusting its accounts with the Chicago Union Traction Company. The stockholders will meet again on March 3d. The election of officers resulted as follows: President, Clarence A. Knight; vice-president, Redmond D. Stephens; secretary and treasurer, W. V. Griffin.

Regulator for Vapor Lamps.

The appearance of what has been called the "negative" flame in certain types of gas or vapor electric lamps was referred to by Peter Cooper Hewitt in one of his early patents. At that time reference was made to the fact that under ordinary conditions the negative flame acts as a resistance to the passage of the electric current, particularly when the flame stands in the direct line of the current between the positive and negative electrodes of the lamp. It was also noted that when the negative flame is acted upon by a magnet or solenoid the condition of lowest lamp resistance is attained when the flame lies in the direct path of the current through the lamp. In other words, either a permanent or an electromagnet will so influence the negative flame as to change its character as a resisting medium and cause it actually to lessen the normal lamp resistance. Further, it is to be noted that the tendency of the flame is to project itself or lie along the lines of magnetic force, and in this way the flame is made very steady by the action of a magnet, so that the normal resistance of a lamp in which the negative flame is mechanically controlled can be governed without any essential fluctuation.

Accordingly Mr. Hewitt has undertaken to construct a lamp with as low a normal resistance as possible. Assuming a vertical type of lamp in which the negative electrode is at the bottom of the transparent container, the proper position for the magnet



FIGS. 1 AND 2. REGULATOR FOR VAPOR LAMPS APPLICATION OF MAGNETIC REGULATOR.

or solenoid would be directly below the negative electrode, with the lines of force projecting toward the lamp electrode. This would cause a projection of the flame in an upward direction, thus bringing it into a right line with the current between the electrodes, thereby minimizing the normal lamp resistance. On the other hand, it may sometimes be desired to operate lamps at a resistance higher than the lowest possible resistance, in which case the magnet or solenoid may be located in such relation to the negative electrode as to throw the flame into other than a vertical position, thus predetermining the lamp resistance at a desired value within certain limits.

When a magnetic field is utilized for fixing the position of the negative flame or for deflecting it from the direct line between the electrodes, a permanent magnet may be employed, if desired, or an electromagnet supplied from any suitable source. By using an electromagnet, however, and putting it in series with the lamp and then so placing it with respect to the negative electrode as to deflect the flame away from the direct line it is possible, according to Mr. Hewitt, to secure excellent regulation of the lamp resistance. It should be said that the length of the flame and under certain conditions the amount of the deflection depend upon the strength of the magnet employed. When, for example, a vertical magnet is placed so that its poles are located anywhere below the negative electrode in a vertical lamp, successive increases of magnetic strength will project the flame farther and farther, but in a fixed direction, while if the magnetic pull be located above the surface of the negative electrode successive increases of magnetic strength will project the flame farther and farther away from the vertical, thereby increasing the lamp resistance. By these means variations in the circuit of the electromagnet, if an independent circuit, may be recreated

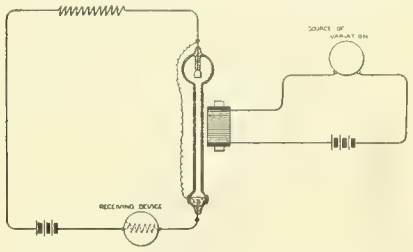


FIG. 3. REGULATOR FOR VAPOR LAMPS CONNECTED FOR SERVICE.

in the circuit of the lamp with varying intensity, depending on the magnetic circuit and on the lamp circuit.

An elevation of a vertical lamp in which the flame is projected vertically upward by an electromagnet underneath the lamp is shown in Fig. 1. Fig. 2 is a diagram illustrating electromagnetic means for automatically regulating the resistance of a lamp by altering the strength of current through the solenoid and thus regulating the strength of the deflecting field.

A feasible application of the lamp might be in reproducing variations of current in a secondary circuit by means of variations in the solenoid circuit. Fig. 3 shows the connections for such a current-varying device. By means of this device it is said to be possible to produce in the secondary or receiving circuit electrical variations of greater magnitude than the original electrical variations of the primary or transmitting circuit. This is due to the fact that a given magnetic variation may cause a wider fluctuation of effective resistance in the gas or vapor than the fluctuations of electrical energy producing the variation of the magnetic field of force. Accordingly by employing one of these lamps the vibrations of the circuit may be magnified not by inductive effects but by varying the ohmic resistance of the circuit in which the apparatus is included.

Odd Fires Due to Heedlessness.

Apparently the general public is not well aware that an incandescent lamp bulb can radiate sufficient heat to cause a fire when placed in the neighborhood of highly inflammable material. Were it otherwise, the quarterly fire report of the Electrical Bureau of the National Board of Fire Underwriters would not list four fires attributed to this cause. In one instance the lamp set fire to celluloid goods in a show window, which does not seem particularly remarkable when it is remembered that celluloid is ignited at 300 degrees F. More strange, however, is the fact that a fire was caused by laying an incandescent lamp on a roll of carpet. In another case a bunch of hay was ignited by the same cause, while in the fourth instance a lamp attached to a flexible cord was shut up in a folding bed during the daytime, and when the current was turned on at night the bed clothing was set on fire.

The Outlook for Copper.

Active buying in Europe and large shipments to that country have given a firmer tone to the copper market. Large contracts have also been closed with wire manufacturers in this country, and the prospects for a good business in 1904 are bright. Although recent sellers have been taking 13 cents a pound, the feeling at present is that the supply at those figures is limited. Manufacturers have been carrying light stocks for some time, and it seems reasonably certain that the market will remain firm after the recent fluctuations, due to the unsettled condition of the money market. In Europe the conditions are quiet, Germany being the heaviest buyer.

Health Commissioner J. H. Simon of St. Louis thinks that a large percentage of the 500 cases of pneumonia in St. Louis are due to poorly heated street cars. He says that "the street cars, as they are now operated, are perfect generators of pneumonia. Expectoration on the street cars is permitted, and thus the disease is allowed to spread."

Central-station Heating.[1]

By W. H. Schott.

Hot-water heating is in operation in a great many cities, some using a single-pipe, closed-circuit system, others a two-pipe, static-head system, and others a two-pipe balanced-column system. The single-pipe system is adaptable only, where there is a limited territory to serve; but where the district to be served is extended over large areas, then a two-pipe system becomes necessary in order to give the system the necessary amount of flexibility required and to furnish a positive circulation. Where the district to be served is compact, with large buildings ranging in height from six to 16 stories, the situation then becomes a steam-heating situation, the steam being supplied at low pressure, being taken either from engines or being furnished direct from boilers.

Where exhaust steam exists, and it is desirable to use it, it can be used more economically in a hot-water system than in a steam system, due to the fact that it may be used at atmospheric pressure and even at a pressure represented by a 20-inch vacuum during the milder periods, the circulation being made positive by using a pump of some pattern as the circulating medium, the power required to operate this circulating medium being governed by the character of pump used and the head which it must work against.

In a well-designed water system there is only required from 10 to 30 pounds pressure to overcome the pressure due to circulation and friction of mains, the power utilized by the circulation being absorbed in the circulating water so that it is not lost.

With a steam system, sufficient pressure must be maintained upon the mains to overcome the friction in the street work and to furnish the necessary circulation to the surface which is to be heated, this pressure ranging from two to 20 pounds, and even higher, but normally at from five to 10 pounds pressure.

In taking up the question of the central-station heating plant, the territory to be heated should be carefully examined by someone familiar with its needs and then a plant designed that will give an economical operation, together with a superior service, to meet the needs as found.

If the territory, after having had the physical examination made, proves that it will be a paying investment providing the plant is properly installed and managed, then the next feature that needs serious consideration is the franchise question. After having secured the proper franchise, then the plant to be installed should be of the best design possible to attain, no matter whether it be a steam or water proposition.

High-grade power-house equipment in any power plant has proved conclusively that it pays only to use the best that can be obtained in the market and should be ample evidence that the same would apply to a heating system.

The street work should be installed in the best possible manner known, great care being taken to see that the mains have ample capacity; the expansion to be taken care of in a proper manner so as not to throw undue strain on any fitting in the system; that the insulation should be of the best so as to reduce the street losses to a minimum; the pipe lines should be properly underdrained so as to eliminate the possibility of waterlogging, and, if a steam system, great care should be taken in the maintaining of grades so that the mains will be properly drained.

In the piping and connecting of buildings to the system great care should be taken in the equipment, as no system will operate economically and satisfactorily unless its pipes are properly proportioned so as to circulate with practically no friction, and its radiation is so proportioned so as to properly heat in the coldest weather, or, namely, 20 degrees below zero in this climate.

All piping in buildings, no matter whether it be a steam or water system, should be properly covered.

The radiating surface set should be of ample surface to heat the space to be heated without calling upon the risers and mains in the building to assist, due to the fact that in the milder periods, when the minimum amount of heat is required, while the circulation to the radiator may be closed off, the heat would still dissipate itself through the mains and risers, if not covered, and whenever the temperature of the space so heated rises above the standard, it then becomes wasted, due to the fact that doors and windows are opened and the same is permitted to pass to the outside atmosphere.

The covering of the pipes and mains and placing of sufficient radiation to maintain the temperatures desired, increases the cost of the installation to the consumer, but as this installation is of a permanent nature, the small percentage of increase due to its requirements is not excessive and should be insisted upon.

More plants throughout the country are not operating satisfactorily to their owners on account of the buildings which they are heating not being properly radiated than from any other cause known.

The radiation required for a building should be based upon the minimum temperature contended with, or 20 degrees below zero. If sufficient radiation is set to maintain standard temperatures at 20 degrees below zero, a company is only called upon to operate 40 per cent. of its maximum of the radiation so set as an average during the entire heating season.

On account of the requirements varying as they do, it becomes (in order to make the system as economical as possible) an absolute necessity to adopt some form of regulation, or otherwise a large amount of heat is wasted.

In a water system it is much easier to regulate the temperatures without using automatic regulation than it is in a steam system, due to the fact that the temperature of the water may be varied to suit the outside conditions, so that in the milder periods the surface cannot throw off as many heat units as otherwise, due to their lower temperatures, but from tests made, a regulated system will save to the central station 40 per cent. of its fuel requirements, and in making this 40 per cent. saving in fuel, it must necessarily mean also that 40 per cent. more business can be carried on a given plant with regulation than it can without. This statement is correct during the average of the season, but due to the fact that the requirements must be based upon 20 degrees below zero, the plant must operate under one of two conditions, namely:

The plant having ample capacity to handle the connected load at 20 degrees below zero, or, it having capacity to handle this load economically during the average of the season and then depending on its overload capacity to take care of it during the coldest periods, which would correspond to the peak in a lighting station during the holiday period.

While the above may be true, it is poor engineering to undertake to carry out a station upon these lines, as the plant should have ample capacity to meet its requirements at 20 below zero, due to the fact that enough can be saved in operation during its extremely cold period to offset any charges chargeable against the property, due to its larger capacity, in addition to insuring to the consumer an absolute service.

In a well-designed water system, during the average temperature of the heating season, six to eight pounds of water per square foot of radiation per hour is ample to furnish all the heat required by the surface so supplied, but when the temperature is 20 degrees below zero, it then requires 12 to 18 pounds of water per square foot per hour, and the plant must have capacity to deliver a sufficient amount of water during these periods to furnish the heat to the surface to heat the space as required.

In tests made recently I find a wider range in a steam plant than in a water plant. Comparing the tests taken in a building where the radiation set was up to the requirements, against a building where the radiation was set on a 52-per cent. basis, I found that a change of 34 per cent. in outside temperature varied the condensation in the building where radiation was properly set 13.72 per cent., while in the building underset, the same change in outside temperature varied the condensation 24.24 per cent.

In comparing the condensation in buildings where the radiation is properly set against the condensation in buildings underset, I find it to be as follows:

First—Building properly set: Wind velocity, 10.3 miles per hour. Average outside temperature, 30 degrees. Average condensation per square foot per hour, 0.158 pound per hour.

Second—Building set 52 per cent.: Wind velocity, 10.3 miles per hour. Average outside temperature, 30 degrees. Average condensation per square foot per hour, 0.365 pound per hour, or, on account of this building being underset, 22 per cent. more condensation took place than would have taken place if the radiation had been set to requirements.

From the above you will readily see that the proper installation of the radiation is a very important factor. In both of the above buildings the steam supply to the buildings was controlled by regulation.

On the question of how to charge for heating a given space, various methods are used, some basing their charges upon a cubical-contents basis, varying the charges on account of the construction of the building. Others charge on a basis of so much per square foot of heating surface. Others charge upon a basis (and this applies to steam only) of the number of pounds of steam condensed.

Certainly the cubical-contents-charge basis is entirely wrong. A building, due to its construction and exposures, may vary from two to eight or 10 changes of air per hour. These changes govern the amount of heat required to heat the space in question. Necessarily, to heat properly, the radiation must be based upon the maximum number of changes of air that will take place per hour, and as the number of square feet or radiation set governs the operating expenses of a central station, it must in that case be the basis of charge, either from a square-foot basis or a meter basis.

The objections usually raised to a meter basis are the same objections that have been raised by consumers of electric-light companies; namely, that when the current which they have used to supply their light and power is furnished through a meter, they are limited in service. In other words, they will take care of their light and power and use it only as their requirements call for it, while if they have a flat rate they pay no attention to the same, thereby very materially increasing the cost of operation to the central station, in addition to requiring a much larger amount of capacity to take care of the connected load than they would otherwise. This applies to the meter basis of measurement.

The consumer will call upon the station for his maximum demand, which is represented by the connected amount of radiation when we have our minimum outside temperatures, but during the milder periods will have a large amount of the radiation cut out of service, first, due to the fact that they do not need it; secondly, due to the fact that they are trying to save in heating bills and are very liable to cut them down to a point where it is below their actual requirements, resulting in a dissatisfied consumer.

With the radiation furnished on a square-foot basis and without regulation, a price that would justify the company in operating the same without any restrictions would seem prohibitive, but the application of regulation to the same acts practically in the same capacity as the meter does to the electric-light plant, in not permitting the building to be overheated, yet furnishing to the consumer the necessary heat to maintain 70 or 72 degrees, the temperature usually agreed upon, and with the consumers securing their heat upon this basis, they are usually much better satisfied than upon a meter basis, and the income to the company per foot per season should average higher than where the same is on a meter basis.

Probably the ideal method of furnishing heat to the consumers from the station standpoint would be to furnish the same through a meter, and at the same time give the consumer automatic regulation. The regulator would prevent the building being overheated, in addition to giving an even temperature line, and at the same time the company would be paid for all heat so supplied.

To anyone considering the installation of a heating plant, all of the features and facts herein referred to should be very carefully considered, as they are extremely important in making the enterprise the success that it should be.

Central electric-lighting stations should find heating plants, when properly installed, valuable additions to their properties. If a lighting and power company is in position to furnish heat in addition to its light and power, it can eliminate a large percentage of the isolated plants with which it has always to contend.

Discussion (in abstract).

H. Almert, Chicago: In a system with a fairly tight boiler and heating plant, heating, say, 200 or 210 days a year, and using coal 11,500 to 12,000 B. T. U., costing, say, $2.25 a ton, what would be the cost for coal per year?

Mr. Schott: Taking the coal cost on the water proposition, in a test made recently by Purdue University, Professor Goss there reports that he finds the cost was 50 per cent. higher than it should be, due to the condition of the plant; that the cost was 3.8 cents a square foot a season, based upon each $1 of cost for fuel. In that particular case the coal tested 10,500 B. T. U.; that would put it on a $2 price for coal. Assume that same value of coal, it would cost a fraction under eight cents a square foot a season. That is for water. Now, the actual test was 77 pounds of coal a square foot of radiation a season. Our figures were about 70 pounds of coal.

With a steam proposition which runs 130 pounds a square foot, an estimate can easily be arrived at to determine the cost, with regulation; without regulation, it will run as high as 180 pounds a square foot.

R. N. Kimball, Kenosha, Wis.: In Kenosha we have great difficulty in differentiating between what is properly chargeable to the electric-lighting plant and what is properly chargeable to the heating plant, where we are running a combined plant, and we are inclined to separate them as much as we can, and not give the electric plant credit due to the heating plant.

Mr. Schott: On the Purdue test everything was charged against the heating plant except the efficiency of the engines and pumps. The engines in that case absorbed seven per cent. of the heat transmitted to them, and the pump absorbed four per cent. When it came to the condensation, the engines tested at 28.5 pounds and the pumps ran 95.5 pounds per indicated horsepower per hour, and everything was charged against the heating plant except the actual heat units absorbed by the engines and pumps.

J. H. Harding, Laporte, Ind.: I would like to ask what difference there would be between furnishing heat on that basis with a regulator running direct from your plant, and without a regulator, and the cost of furnishing it with regulators, speaking of a hot-water plant?

Mr. Schott: The test has proved that the difference in operation is just about 40 per cent. If it is going to cost you 40 per cent. more to operate, you ought to get 40 per cent. more income. It won't affect the labor end of it so much as the actual fuel burning; but on account of acquiring a larger percentage to take care of an equal amount of space, it will take more plant; so that if you consider as a whole the increase at 40 per cent., you ought to get at least 40 per cent. more for heating without regulation than with it, to be on the same plane.

President F. W. Bowen, Kenosha, Wis.: I would like to ask Mr. Schott one or two questions, because I feel interested in this subject myself. First, whether he has formulated any figures based upon the pounds consumption of coal per annum for each foot of connected radiation?

Mr. Schott: Yes. With a well-designed plant (and I speak of the very latest practice) and where we have a climate which averages 30 degrees, as

[1] Abstract of a paper read before the Northwestern Electrical Association, at Milwaukee, January 20, 1904. Mr. Schott is a well-known Chicago engineer.

through Central Illinois and Indiana, and taking our Illinois coal as a basis (slack), the consumption should not exceed 70 pounds—63 and a faction are the figures, but 70 is ample, allowing for losses. On the Purdue test, where they arrived at a 77-pound basis, and with coal that tested 10,500 B. T. U., we were only getting in the boilers a fraction over 4,000 B. T. U. That was due to the boilers not being properly constructed to get the proper circulation through them in the first place; in the next place, the fire was being controlled by the ash-pit doors, instead of the damper being adjusted, and in the third place, the boilers had not had a cleaner on them for six months, and five feet of the lower tubes were absolutely banked in with soot and ashes, so we could not get the efficiency. That trouble was discovered after we got through testing.

President Bowen: I ask this question simply for a sort of checking purpose. You compute the B. T. U. radiated per hour per foot of radiation to be about 175, I believe; is that correct?

Mr. Schott: That is a question of the temperature of your circulating water. If you carry a temperature of 200 degrees for each foot of radiating surface, you will throw off not less than 246 heat units; and if you get down to 170 degrees, you will throw off 170; at 160 you will throw off 155; 160 is the average temperature you are supposed to carry through your heating season. Providing your radiation is figured on that, there is one point where you can throw the operation of your plant 50 per cent. either way.

President Bowen: That would involve an increase in the amount of radiation connected about 20 per cent. if you were to keep a straight line of 160 degrees as your top figure for the temperature of your water.

Mr. Schott: Yes; it increases a little over 50 per cent. You base your radiation so as to take care of your space at 20 below zero on a 210 basis, and that is one proposition; it takes more radiation with your circulating water at 160 degrees than at 210.

President Bowen: Now, then, if you raise a degree in temperature for every drop of a degree outside, you only get 182 degrees at zero.

Mr. Schott: You would raise from 160 degrees at freezing to 190 degrees at zero, and if you go to 20 below it would put you above steam temperature. The figures for radiation may be stated as follows: At 140 degrees you can throw off 115 heat units; at 150 you can throw off 135 heat units; at 160 degrees you can throw off 155 units; at 130 degrees you can throw off 177 heat units; at 180 degrees you can throw off 199 heat units; at 190 degrees you can throw off 222 heat units; at 200 degrees, 246; at 210 degrees, 270; 220 degrees, 300. The question of drop in the supply is usually figured on this basis—that when the pipe line is handling 60 per cent. of its capacity, you should get a change of water in an hour's time. You might increase that, but when a line is working above 60 per cent. capacity, you ought not to get to exceed two degrees, and it is being done on less than one.

Mr. Harding: In our operations in La Porte (we have one of the oldest heating plants in the country) we have had occasion to do a little remodeling from year to year, and we have found that we get very much better results by adjusting our houses to a drop of 40 degrees than we got when we undertook to run with a drop, say, of 25 to 30 degrees. We find that in varying the working pressure to correspond with the temperature outdoors that we reduced very largely the amount of water that we have to circulate and that we can get very much better results, especially on our outlines, by throwing in more resistance, and with a greater amount of radiation in the single loop or in series, and regulating the whole plant for an average drop of from 30 to 40 degrees we get much better results and use less coal to heat the buildings than we otherwise would.

President Bowen: The next question I would ask Mr. Schott would be the relative amount of horsepower required in such a building as he describes in general terms in his paper for the heating and for the lighting of that building; in other words, how nearly would they balance?

Mr. Schott: That depends entirely upon the character of the building. Assuming a store building where they have the ordinary lighting, there will be a surplus of steam at all times required for lighting over and above what would be required for the heating of it. I have one case in hand now where the building is of sufficient size to require 17,000 feet of radiation to heat it from a steam standpoint. Now, under normal conditions that would mean it would take 170 horsepower to heat it. Their load on the electric end of it runs as high as 350 and averages about 200 horsepower, so that the exhaust steam in that building will more than heat it; and in that particular case they have agreed to take their heat and power from the company with a minimum guaranty that it will not run over $15,000 a year.

The Knoxville Electric Company, which furnishes electric light and power in Knoxville, Iowa, is said to have suffered about $10,000 damage from the recent snow and sleet storms. Telephone service was also completely wrecked, some 15 miles of poles being broken down in Marion County.

Proposed Court of Patent Appeals.

Washington, D. C., January 27.—Senator Platt of Connecticut has presented to the Senate the report of the committee on patent, trade-mark and copyright law of the American Bar Association on the subject of a Court of Patent Appeals, and this report expresses very clearly the needs for such a measure in the light of the experience of those most interested in the matter and in the best position to know what is required. This subject has been receiving the attention of the patent section of the Bar Association for several years, and the bill before Congress is the result of prolonged study and consultation by the members of that section of the association.

It is asserted that the present system is a breach of faith on the part of the government to both patentees and the public. The constitution and the statute recognize a right of property in inventions. They authorize the granting of patents vesting the title to the property. The title rests on the grant. It rests legally only by force of the statute. It is of value only as it is supported by the law and the courts. Without courts sufficient in number, jurisdiction and organization to uphold the patentee's rights wherever they may be invaded, the grant is in effect a fraud on the guaranty. It is a short-lived grant. Relief against those who disregard it must be prompt or it will be inadequate. It is a case in which justice delayed is justice denied.

The people are commanded by the law to respect the rights of patentees. They are charged with knowledge of the law and of the existence and contents of patents. They are bound to know whether a patent is valid or not. An invalid patent is a wrongful grant to an individual of that which justly belongs to the public. The decisions of the courts of last resort show that more than half of all patents granted are invalid. Society is entitled to the benefit of the mere scientific knowledge and mechanical skill of all of its members without the payment of tribute in royalties.

Our judicial system fails to meet these plain requirements of justice. We have, in effect, nine supreme courts for the trial of patent causes. They are not bound to follow one another's decisions in respect to the same patent on the same facts. A patentee having established the validity of his patent in one circuit has no certain assurance that it will be respected in any other. A manufacturer who has defeated a patent in a suit against his customer in one circuit may be compelled to defend another customer in another circuit against suit on the same patent and fight the whole ground over again. A patent upheld by one circuit court of appeals may be nullified by another.

The power of the Supreme Court to hear patent appeals on certiorari affords no substantial relief. A patent is too short-lived to survive the proceedings. The government issues to the inventor a grant which purports to invest in him a legal title to his invention for the whole country. But it fails to provide means by which he can establish that title against trespassers for the whole country. It issues as many illegal patents as legal ones, and yet fails to put it within the power of the people to protect themselves against wrong by the holders of them.

When we consider the part which patent invention has borne in the development and prosperity of our country, the capital and labor invested in that form of property, and the extent to which patented inventions enter into all industries, this omission of the government to provide adequate means for settling controversies about patents is nothing less than a flagrant failure in the discharge of plain duty.

There should be one court of appeals in patent matters, because each patent covers the whole United States, and a suit on it is in reality one between the patentee and all the people in the United States, the issue being the right of the patentee to exclude the public for a time from the use, without his consent, of the thing patented or alleged to be patented. When brought into litigation the patent should be dealt with once for all by an appellate court, whose conclusions would be binding upon the courts and the people of the whole United States. It is only in this way that the patentee and the public generally can become assured of the extent and limitation of their respective rights. Moreover, all patents should be dealt with not only in accordance with the same rules of law, but with the same spirit and from the same point of view, and this is only possible when as to all patent questions there is a single court of last resort. A. F. T.

Electric Road Issues Mileage Books.

The Indiana Union Traction Company has put its revised rates of fare into effect. These rates are as follows: Single-trip fares, on the basis of 1½ cents a mile (minimum cash fare, 10 cents); round-trip fares on the basis of 10 per cent. reduction from single-trip fares; 250-mile mileage books, good on all lines of the company, $3.25; 1,000-mile mileage books, $12.50. Mileage books will be sold only by company cashiers at passenger-waiting rooms. An additional seat fare will be charged on limited trains.

The first train over the Intramural railway at the St. Louis Exposition was operated last week.

OBITUARY.

F. E. Perry.

F. E. Perry, a salesman for the Bullock Electric Manufacturing Company of Cincinnati, and well known to many electrical men, died on Saturday, January 30th, the cause of death being typhoid pneumonia. The remains were taken to South Natick, Mass., for burial, the date of the funeral services in that place being February 3d. Mr. Perry had charge of the city business in Cincinnati for the Bullock company and was well liked. He was an associate member of the American Institute of Electrical Engineers.

William C. Whitney.

William C. Whitney, former secretary of the navy and a leading financial spirit in large street-railway and central-station systems, died at his residence, 871 Fifth Avenue, New York city, on February 2d, while preparations were being made for a second operation for appendicitis. The attack of appendicitis which ended in the death of Mr. Whitney was brought on by over-exertion and exposure during a fire at Aiken, S. C., a week ago when Mr. Whitney in person directed the work of extinguishing the flames in his residence there. He had a number of fine residences throughout the East. Mr. Whitney, with Thomas F. Ryan, were the principals in the building up and developing of the great corporation known as the Metropolitan Street Railway Company of New York. He was also instrumental in organizing the $50,000,000 New York Electric Light, Heat and Power Company, which now controls, under the name of the Consolidated Gas Company, nearly all the electric-light and gas plants as far north as Yonkers. Mr. Whitney was born in Conway, Mass., in July, 1841.

A. G. Bowers.

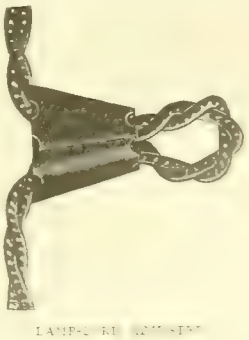
Alfred Graham Bowers, sales representative of the Fort Wayne Electric Works in the state of Iowa, died at Des Moines on January 21st of pneumonia after a few days' illness. The funeral services were held at Port Huron, Mich., on January 23d.

Mr. Bowers was born in Port Huron on March 31, 1870. As a young man he entered the employment of the Michigan Telephone Company at Detroit. Later he removed to Montreal, and while there pursued the study of electricity. Returning to Port Huron he entered the service of D. J. Stevenson, an electrical contractor, where he gained considerable experience in general wiring and construction work. He was subsequently employed by E. C. Lombard, a construction contractor at Jackson, Mich., and afterward was superintendent of the Whitehall (Mich.) electric-light plant. Leaving Whitehall he took up sales work and was successively identified with the Bryan-Marsh Electric Company as its Iowa and Minnesota representative, the Ewing-Merkle Company of St. Louis in the same territory, and the Fort Wayne Electric Works, with which he became connected only a few months ago.

In 1901 Mr. Bowers married Miss Lillian Scoville of Battle Creek, Mich., who survives him. His mother, Mrs. A. Bowers, and several married sisters live at Cass City, Mich. Mr. Bowers was widely known among the central-station men and representatives of other electrical supply houses in his territory, among whom he had many warm friends who will miss his genial and sincere friendship. He was a member of the Knights of Maccabees and the United Commerical Travelers' Association.

Lamp-cord Adjuster.

A clever cord-adjusting device recently placed on the market is the Crown adjuster for lamp cords shown in accompanying illustration. As will be seen, it consists of a hollow tapered shell with notches cut in on either end to engage the loop of the cord passing through. This peculiar construction makes it impossible for the adjuster to fall off or slip on the cord, and the maker asserts that the



LAMP-CORD ADJUSTER.

material used makes it practically indestructible. When needed it can instantly be placed on the cord at any time either before or after the socket and lamp are attached, and the length of the cord is adjusted by merely pulling the loop.

The manufacturer of the article is John H. Seaman, 175 Dearborn Street, Chicago.

The Storage Battery in Small Central Stations.[1]

By J. M. S. Waring.

Owing to the impossibility of drawing any distinct line separating storage-battery practice in small central stations from that in the larger stations, and to the fact that many or most of the economies and advantages effected are common to all direct-current stations, irrespective of their output, I have decided to deal with this subject in the following way:

First, to cite a battery application peculiar to small stations, and then to dwell briefly on the features common to all central stations.

In the first case, the consideration will be that of a lighting station in a small village. In such cases it usually proves unprofitable to furnish continuous service throughout a 24-hour day, as the demand for current during the early morning hours and throughout the greater portion of the day would be so small that the additional shift of men required and the increased fuel consumption on the plant would prohibit the commerical success of the venture.

It is, however, true that the manager of a central station operating only a night schedule is greatly handicapped. In order to secure any great amount of residential-lighting business continuous service must be supplied, as the owner of a residence would naturally demand light during all hours of the night, and would further probably desire fan service throughout the day during the summer months. If these facilities cannot be offered to the public the amount of business of the small central station is necessarily limited.

As an illustration of what has been accomplished along this line I might cite a case in actual practice where the conditions were as follows: The plant I have in mind consisted of one 60 and one 120-horsepower non-condensing engine, which in addition to driving certain machinery, operated two 125-volt generators, one having a capacity of 20 and the other of 25 kilowatts, the two being operated in combination on a three-wire Edison system, with 220 volts across the outside mains. This plant had been operating and supplying a load concentrated within a very small radius. By referring to the accompanying sketch you will notice the nature of the load at this time, the dotted line (curve 1) being the load curve. The maximum peak load, of 150 amperes, was on the station for about an hour and a half in the evening—that is, from 6:30 until 8; it then gradually decreased to about 10 amperes at 11 o'clock at night, and at 12 the plant was shut down.

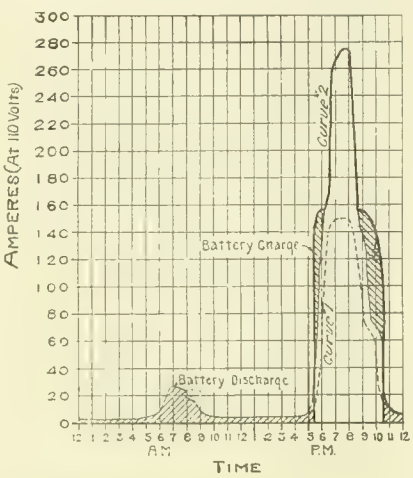
An opportunity arose for this plant to obtain the contract for city lighting, but the cost of the necessary transmission line, including poles, copper, etc., amounted to so much that the returns from the city lighting alone would not warrant the investment; however, it was obvious upon investigation that if a sufficient amount of residential lighting could be assured the investment would become a decidedly paying one, and with this in view a storage battery was installed. This installation made, the station continued to operate for the same number of hours daily. On account of the new business the load was increased to an amount illustrated by curve 2 of the sketch. The shaded portion on each side of this peak shows where the battery was being charged while the station was in operation, and from 12 o'clock (midnight) until dusk in the afternoon the entire load was taken care of by the battery.

While this was a three-wire system, with 220 volts across the outside mains, only a 110-volt battery was installed, for, during the hours that the battery was operating the load was so light that by connecting the two outside mains together at the station the system could be operated by a two-wire 110-volt system, and even under these conditions, owing to the light load, the drop was considerably less than when operated as a three-wire system with the maximum load. In this case there was an increase in load after the installation of the battery of about 66⅔ per cent. and an increase in fuel consumption of only about 25 per cent., showing that the cost of fuel per kilowatt-hour was decreased about 37½ per cent., this decreased fuel consumption being due to the fact that the generator set, while operating with the battery, was run at a considerably higher percentage of full load than was the case before, the efficiency being correspondingly increased.

Another instance which occurs to me is similar to the above, with the exception that the plant supplied the adjacent district from a three-wire direct-current system, while in the outlying districts the load was on an alternating system. While this alternating load was extremely heavy during the peak it was very light during the day, consisting only of a small amount of fan service in the summer months. A battery was installed in this plant which furnished current directly to the direct-circuit mains and at the same time operated a direct-current motor running a small alternator so that the fans on the alternating-current system could be operated. These and cases of a similar nature are, of course, confined to very small plants. Another application of the storage battery, which is irrespective of the size of the plant, is that of a battery operating in conjunction with a waterpower plant. A number of cases have come before the attention of the writer where there was sufficient waterpower to supply considerably more than the load existing during the greater portion of the 24-hour day, the peak load during the evening hours, however, being in excess of the capacity of the turbines. In this case the value of the battery is apparent, as the generators while carrying the day load are charging the battery at the same time, the battery assisting to the extent of its capacity during the peak, thus giving an increased station capacity, which would otherwise be only obtainable by the addition of an auxiliary steam plant, with a correspondingly increased cost of operation, which would probably make the investment prohibitive.

There are a number of features which may now be briefly mentioned as being of interest to the central-station manager regardless of the size of the plant he is operating.

To the central-station manager a minimum cost of production and transmission, allied with reliability of service, are essential. The consumer, however, demands that the latter item be not sacrificed in the pursuit of economy. Intermittent service results in a loss of business to the central station, and, while it may be difficult to compute the expense to which a lighting station is subjected by a 10 or 15-minute interruption, the official who receives the complaints of his customers fully realizes that a loss of revenue does result from frequent recurrences of this complaint. The storage battery insures increased economies of production and transmission, at the same time almost entirely preventing interruptions to service. A battery at the source of the direct-current transmission—that is to say, in either a direct-current power house or a rotary sub-station—will offset, in the first place, the installation of a corresponding capacity of boilers, engines and generators. In the second case—that of a rotary sub-station—in addition to this apparatus it will also offset a certain proportion of the static transformers and rotary equipment, with the cost of which apparatus that of the battery will compare favorably. It is of the greatest value as a reserve in either case, tiding over shutdowns occasioned by trouble on any of the apparatus just mentioned, or in the high-tension line in the latter case. The battery, being ever present on the system, is readily available as a reserve. It further obviates the necessity of carrying boilers under steam in anticipation of a peak load, thus insuring a decreased fuel consumption.



LOAD CURVES OF SMALL CENTRAL STATION

Another familiar application of the storage battery is that of placing it at the center of a load on a direct-current system of distribution. When the volume of business in a congested locality covered by a low-tension system of transmission reaches a certain amount (and the more remote this locality from the central station the sooner this point is reached), the amount of copper required to care for the power from the central station necessitates an outlay tending to render this system of transmission prohibitive. By the installation of a battery of a capacity sufficient to care for a certain portion of the peak the amount of copper between the central station and the center of load is decreased to such an extent that the battery investment is decidedly the preferable one from a commercial standpoint.

One of the more recent adaptations of the storage battery, and one whose importance will readily be recognized by central-station managers is its use in connection with the direct-current exciters in alternating-current power and lighting plants. With an installation of storage batteries floating at all times on the exciter bus, interruptions of current in the exciter circuit are practically obviated. Reduced fluctuations of the exciter voltage are assured, together with corresponding reductions in the alternating-current voltage fluctuations. Where alternating-current motors are used to drive the exciters the battery also serves to supply field current when starting up the plant after a shutdown. An attractive feature in any battery installation is its adaptability to changes of conditions over a very wide range. Its capacity or voltage may be increased or decreased by varying the number of plates per cell or the number of cells in series without affecting in any way the original installation, thus obviating the necessity of anticipating any future increase in business.

It may be said in general that there are few direct-current systems on which the service may not be improved, the liabilities of interruption decreased and the operating expenses minimized by the use of a storage battery auxiliary.

Discussion (in abstract).

George H. Lukes, Evanston, Ill.: There is one point I do not think Mr. Waring touched on in his paper. The great proportion of small stations, I think, are alternating, and very often they are given the opportunity to sell current to either interurban or small electric railroads. A man comes along and gets a franchise and puts in a road which is operated with one, two or three cars, and they almost always go to the electric-light company and endeavor to buy power. Now, if most of these companies are still operating line shafts—and the general practice is to make the railroad buy the equipment—if these railway generators are belted to the same line shafts, it almost always affects the regulation very seriously. In fact, considering the price at which they demand the current, it is a very serious question whether it pays to sell current under those circumstances. I do not know of any cases where batteries have been installed on the railway circuits in order to prevent the abrupt fluctuations, but it seems to me there is a possible use. These fluctuations are very severe, the load changing from almost zero to perhaps 50 or even as high as 150 kilowatts. I would like to ask Mr. Waring if he knows of any instance of that kind?

Mr. Waring: The use of a storage battery in conjunction with a street-railway plant is very common, and is perhaps the most common application of storage-battery work in large stations. The application that you speak of principally, as I imagine, is that of a battery to take off the fluctuations of the railway load so that all your machines may be belted to one shaft; then you will have no trouble with your regulation on your lighting circuit. We have installed batteries for that purpose, too, and have got very good regulation. There is a case that came to my notice the day before I came here. A firm of consulting engineers in Chicago has just made a test on an interurban system where there were three sub-stations with a storage battery in each. They made one test there of the sub-station, running with the rotaries alone, the batteries being out of service. The next test was made with the battery running without a booster, the battery merely floating. The third test was made with the battery operating with booster in conjunction with rotaries. In the last case the fluctuations either side of the average voltage were three per cent., that is, on a 600-volt system, when the battery was operating with booster; when the battery and booster were off the voltage fluctuation was 16 per cent. under just about the same load variations. In that case we were not aiming at voltage regulation, because it made no difference whether the rotaries did vary somewhat, but that may serve as an illustration of what it will do.

F. W. Bowen, Kenosha, Wis.: My own observation is that a three-car railroad system, such as is spoken of, requires at its peak about 200 amperes, that is, unless it is in a locality where there are heavy grades, in which case the requirement of such a load would probably be in the neighborhood of 300 amperes in the peak. Now, the average load is somewhere about 25 or possibly 30 amperes, so that the storage-battery capacity, in my opinion, would have to be sufficient pretty nearly to take up the difference between its average and its peak.

Mr. Waring: It is customary in railroad work of that character to install a battery of such a capacity that it would be just sufficient to take care of the momentary fluctuations, and by momentary fluctuations I mean the difference between the average load and the maximum load. Now, in most interurban practice that I have come in contact with we figure on certainly not over 100 watt-hours a ton-mile for cars, and the starting point will vary from two to three times the average current, so you can get from that an idea of the extent of the fluctuation. That does not mean necessarily such a large-sized battery as you might think, because the battery only has to take care of the fluctuation momentarily and not for any length of time.

O. M. Rau, Milwaukee: We have a 1,500-kilowatt storage battery running on our railway system, and it is so arranged that one-half of it can be used on lighting and the other half on railway service. It floats that way continually, that is to say, our ordinary use of it is to have one-half of it floating on the lighting system and the other half on the railroad system. In an emergency or breakdown the entire battery is thrown on the system that is affected. Our battery was installed to relieve our boilers. The boiler capacity in the plant was rather small, and to overload our apparatus at the peak we did not have sufficient steam, so the battery was brought into play to help us out in that way.

Mr. Waring: If I may be allowed to go into detail a little on the battery system used by Mr. Rau [that of the Milwaukee Electric Railway and Light Company], I would say that it is a 550-volt battery. All the cells are connected in series across the railway bus for railway work. There are taps brought out from each fourth of the battery, the battery being divided into four banks, so that it will

1. Paper read before the Northwestern Electrical Association, at Milwaukee, on January 21, 1904.

give approximately 250 volts for half the battery. There are two banks in parallel on each side of the system. The battery can be thrown instantly on the railroad or lighting work to help out in an emergency.

Union Outlet Switch-box.

The "Union" outlet switch-box, manufactured by the Chicago Fuse Wire and Manufacturing Company of Buffalo, is designed to fulfill the latest requirements of the Underwriters' National Electrical Association, the body of the box being of 14-gauge cold-rolled steel with dovetailed joints. The knock-out plugs are of the same thickness as the walls and are placed in both the bottom and ends. The box, being smooth in finish and rectangular in form, will fit recesses so as to leave the work perfect in

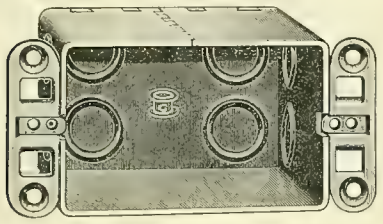


Fig. 1.

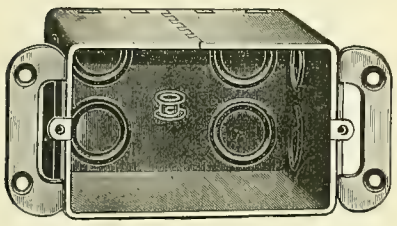


Fig. 2.
UNION OUTLET BOXES.

appearance when the switch is in place. The boxes are made in three styles and sizes and will take all well-known push-button switches.

Style A, shown in Fig. 1, is made with adjustable lugs which insure connection with any switch. The dimensions under the switch-plate are 4½ by two inches, the outside dimensions at the bottom being 3 1-16 by two inches, while the depth is 2⅞ inches. Another type, known as style "B," is illustrated in Fig. 2, and is fitted for rectangular push-button switches especially. These boxes are 4⅛ by two inches under the switch-plate, the other dimensions being the same as in the previous case. The third type is not shown, but is similar to type "B," with the exception that the lugs to hold the switch are turned inward instead of outward, making it adaptable to Perkins and Hart & Hegeman switches.

Chicago Street-railway Situation.

The city of Chicago has filed in the United States Circuit Court its answer to the bill of the receivers of the Chicago Union Traction Company in the 99-year controversy. The feature of the answer is the argument of Attorney David T. Watson of Pittsburg, who was brought into the case as counsel for the city. In it the Union Traction receivership is assailed, the jurisdiction of Judge Grosscup to hear the suit in question is denied, and every contention made by the receivers in support of the company's rights in the streets is attacked. Several maps accompany the answer and show the routes of North Chicago City Railway Company, which company, the answer declares, with all the rights under its charter, has been out of existence since 1884, owing to a blunder on the part of traction men when they sought long-term franchises in Chicago.

The City Council at its last meeting passed an ordinance establishing a permanent Bureau of Local Transportation. The ordinance provides that at the head of this department shall be a local transportation expert, holding office two years, on appointment of the mayor and confirmation by the council. Clerical assistance is required, subject to civil service. An office is to be maintained at the City Hall to receive complaints on traction service or failure of companies to comply with the terms of their grants. These complaints must be investigated by the expert. A law assistant is to be appointed and an annual report to the council is required. The ordinance was brought up by Alderman Bennett, chairman of the local transportation committee, and was met with some objection, but was finally passed by a vote of 47 to 14.

Chicago Institute Meeting Postponed.

The telephone meeting of the Chicago branch of the American Institute of Electrical Engineers will be held February 16th instead of February 2d, as announced. The papers to be read and discussed at that time will be: "The Economics of the Automatic Telephone Exchange," by F. J. Dommerque; "Two Methods of Giving Toll Service with Automatic Exchanges," by Charles S. Winston.

Electrical Appliances in the Navy.

Some interesting facts are contained in the report of Lieutenant Harry George, U. S. N., inspector of electrical appliances. Among other things it is shown that the sum of $376,964 was expended during the last fiscal year upon the installation and repair of electrical appliances on shipboard, and $212,836 on the manufacture and repair of electrical apparatus and appliances in navy yard shops. Alterations, additions and repairs to the electrical appliances of 119 naval vessels were made during the last year.

A portable searchlight has been designed for use in connection with coast-defense districts and the occupation of advanced naval bases. In general, the apparatus consists of two units, each mounted on broad traction wheels suitable for operation in a rough country, and so constructed that it can be readily assembled or disassembled for transportation in ships' boats. This apparatus is now at the New York navy yard undergoing additional tests before issue to the service.

During the last year the Bureau of Equipment of the Navy Department has acquired two sets of the Ducretet loud-speaking telephone, marine type, extensively used in the French navy. This apparatus, together with a set of the Graham instruments, English navy type, will be tested in competition with the Bell and other instruments of American manufacture and installed on board ship for further observation.

A new system of battery-fire control has been designed during the year to meet the requirements of the Bureau of Ordnance. In this system the guns are divided into groups instead of by divisions, as heretofore, each group including all guns of practically the same nature and having the same arc of fire. The system possesses great flexibility and enables separate and distinct orders to be transmitted simultaneously to the various groups of guns.

The school at the New York navy yard for the instruction of enlisted men for the rate of electrician with a view of detail on shipboard as dynamo tenders and for the care of electrical appliances has been successfully conducted during the last year. It will soon be moved into more suitable quarters with additional appliances, where it can be still more efficient.

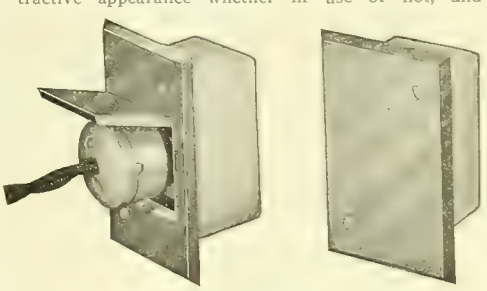
Lieutenant George renews the recommendation that a corps of warrant electricians be established.

New England Street Railway Club.

The New England Street Railway Club held its annual banquet and meeting at the Hotel Brunswick in Boston on January 28th. About 400 members and guests attended, and there were notable addresses by Henry M. Whitney, former president of the West End Street Railway Company, who was the pioneer promoter of electric railways in Massachusetts; General William A. Bancroft, president of the Boston Elevated Street Railway Company; George W. Bishop, of the Massachusetts Railroad Commission; Fuller C. Smith, of the Vermont Railroad Commission; George G. Crocker, of the Boston Rapid Transit Commission; Henry M. Putney, New Hampshire Railroad Commissioner; Hon. Russell A. Sears, of the legal department of the Boston Elevated Street Railway Company, and Representative Guy A. Ham, member of the state Legislature. The retiring president, Master Mechanic H. E. Farrington, of the Boston and Northern Street Railway Company, presided at the business meeting. John H. Neal, chief of department of accounts, Boston Elevated Railway Company, was elected president.

Flush Wall Receptacle.

A flush pocket wall receptacle manufactured by the General Electric Company of Schenectady, N. Y., and one having several advantages, is shown in the accompanying illustration. It presents an attractive appearance whether in use or not, and



FLUSH WALL RECEPTACLE.

does not require a special attaching plug, which could not be used in other sockets or receptacles in the same installation. It is a handy device in connection with fan motors, desk lights, etc. The face plate is of heavy brass, having a polished-nickel finish, other finishes being furnished when called for.

It is said that work on the proposed line of the Fountain-Warren Traction Company to connect Lafayette and Danville, Ill., will begin shortly, and that the contract, which has been signed, provides for the completion of the line by October 1, 1904. The proposed line will run south from Lafayette on the east side of the Wabash River.

Electric Railway Plans in Utah.

The absorption of the Ogden (Utah) street-railway system, it is reported, is designed by the Consolidated Light and Railway Company of Salt Lake City. This would give the new consolidation control of every line of electric railway in the state. The only circumstance which appears to stand in the way of the early consummation of the deal is the plan of the directors of the Ogden system to extend their road into Ogden Canyon, where a summer school is to be established. If the system is retained by the present management, the motor lines running to the Hot Springs in the suburbs of the city will be converted into an electric road. Other extensive improvements are under contemplation, if the prospective sale to the Consolidated is not consummated at an early date.

By the terms of a contract between Simon Bamberger, general manager of the Salt Lake and Ogden Railway Company, and J. J. Burns, an electric railway which will connect Salt Lake and Ogden will shortly be constructed, the work to begin within the next 30 days. The capital stock of the Salt Lake and Ogden road, now operated by steam, will be increased to $1,000,000, and bonds of a similar amount will be issued and sold. Eighteen miles of road, to Farmington, will be converted into an electric system. Power will be supplied from a main power house and two sub-stations. The generating station will be built at Farmington and will cost about $100,000. The locations of the sub-stations have not yet been decided upon. The cars will be of the most improved pattern and will be equipped with motors of a capacity of 56 horsepower. Each of the cars will be equipped with a telephone, which will be operated by means of a switchboard established on poles at intervals along the line.

The construction of an electric system between the two leading cities of the state has been contemplated for a number of years, but it has remained for Mr. Bamberger, one of the most experienced railroad men of Salt Lake, to place the plan in some tangible shape. The matter has progressed so far that it is confidently stated that the new road will be in operation within 18 months from the time the preliminary work begins.

Canadian Electrothermic Steel Commission.

The Canadian government commission, recently established to report on all existing processes of manufacturing iron and steel by electrothermic methods, sailed from New York for Europe (Queenstown) on January 23d, on the Lucania of the Cunard Line. The party consisted of Dr. Eugene Haanel, superintendent of mines for the Canadian government; C. E. Brown, electrical engineer; Mr. Nystrom, draftsman, and Thomas Cota, secretary. A steel expert and a photographer will be added in England. The commission will probably go first to Sweden, then to France, and later to Italy. It will probably be in the field three or four months, or more. The purpose of the work is to encourage the industry in Canada, where there are many undeveloped iron mines and much available waterpower. The minister of the interior in Canada believes it will be a great thing for the Dominion.

Eugene Haanel, Ph. D., has been superintendent of mines in Canada for three years. He was professor in several colleges and universities in the United States previous to going to Canada. C. E. Brown, electrical engineer of the commission, is a graduate of Ames College, Iowa. He took up special work in electrical engineering at Cornell University. Then he went with the General Electric Company at Schenectady. For the last five years he has been electrical engineer for the Canadian General Electric Company at Peterborough, Ont., where the work he has been doing has been of a high order. He has recently resigned his position with the Canadian General Electric Company to assume the duties of the commission.

Chicago Lighting Statistics.

For the nine months ended with September, 1903, the city of Chicago operated a total monthly average of 36,397 lights. Of this number a monthly average of 24,835 were gas lights and 6,132 were gasoline lights. The city operated a monthly average of 4,787 electric lights and an average of 626 a month were rented electric lights. In the last two items the increase over the corresponding period in 1902 is 304 in the former instance and 14 in the latter. The average daily candlepower used for lighting the streets of the city for the nine months ended with September, 1903, was 12,183,265, while for the whole of 1902 the daily average was 11,601,277. During the nine months aforesaid the city issued 7,393 permits for installations of electric-light wires and apparatus, while during a similar period in 1902 the number was 6,580.

The City Council of San Jose, Cal., will receive bids until February 15th for a 50-year franchise to construct and operate an electric street railway in that city.

Indiana Telephone Items.

The Cynthiana Telephone Company has filed articles of incorporation. The capital stock is $3,000. The company proposes to build and maintain a telephone line from the switchboard of the Fortville Telephone Company to Olio, in Hamilton County, and other branch lines. John T. Arnett, U. C. Canada and Floyd Whitesel are the incorporators. The principal office will be in Cynthiana.

The Velpen Home Telephone Company has been incorporated with a capital stock of $5,000. The company will build and operate telephone lines and exchanges in Pike and Dubois Counties. The principal office and exchange will be in Velpen. L. R. Bradwell and W. S. Risby head the incorporators.

At the annual meeting of the Sweetzer Telephone Company of Sweetzer the board of directors elected L. M. Hoggatt president, A. Bechtel secretary and J. B. Reed treasurer. The report for the year was quite satisfactory for a rural plant.

The Central Union Telephone Company, which has been operating in Wabash without a franchise for the last five months, has made formal application again for a franchise. The council directed the city clerk to notify the company that unless the officers sign and accept the franchise offered to the company some time ago, without change, the city marshal would begin the removal of all poles and wires in the streets and alleys. It was stated that the company would quit the field, but it is generally believed that it will accept the ordinance and remain in the city.

The Central Union Telephone Company has perfected plans for the rebuilding of all its outside construction and placing a new switchboard at Shelbyville. Manager Morris states that already several thousand dollars have been allowed on estimates for rebuilding the lines in the city and county. Work on the farmers' lines will be begun as soon as good weather will allow. These lines will be put in good condition and the wires for several new circuits will be strung. The new switchboard equipment will be central-energy and of the best type of the Western Electric Company, thoroughly up-to-date in every respect. It is the purpose of the management to extend the use of the telephone to every town, no matter how small, throughout entire Shelby County, and at all places to put telephones in at the most reasonable rates consistent with good service.

The Mutual Telephone Company of Shelbyville is preparing to add four more rural-exchange lines to the company's list. In addition, the company will build a line west on the Marietta pike, connecting a number of farm residences. The company's new switchboard is being put in place now.

The Bell Telephone Company is preparing to establish an exchange in Portland, Jay County, within a few days.

The Home Telephone Company of Elkhart now has four lines to Goshen, the latest addition being what is technically known as a "phantom circuit." It is formed by using one wire of each of two metallic circuits already in operation, with the assistance of coils at each terminal.

Telephone companies operating in Indiana are discontinuing the practice of making a "morning test." Numerous patrons object to the unnecessary annoyance. There is apparently no difference in the service when the morning tests are omitted.

Arthur Berger, a recent graduate of the Indianapolis Manual Training High School, has constructed apparatus and devices for sending wireless messages. Mr. Berger gave a demonstration of his apparatus before the Indianapolis Technical Society on January 30th and showed such familiarity with the matter and demonstrated so successfully that he is attracting much attention by the local scientific men. F.

Telephone News from the Northwest.

The Zenith City Telephone Company of Duluth appeals to the voters to indorse the amended franchise to that company allowing an adjustment and increase of charges.

The Twin City Telephone Company of Minneapolis and St. Paul has filed a report with the state auditor that its gross earnings for 1903 were $309,496.64, on which the state will receive a gross-earnings' tax amounting to $9,284.90. The earnings for 1902 were $185,111.66, on which the tax was $5,553.35.

The Farmers' and Citizens' Mutual Telephone Company of Springfield, Minn., has been organized with $25,000 capital stock. A local system and rural lines are to be constructed.

The Interurban Telephone Company of Holmes City, Minn., has reorganized and transferred its headquarters to Alexandria, Minn. The directorate has been reduced from 23 to seven.

The fight to retain the service of the Twin City Telephone Company, in connection with the St. Paul postoffice, has been taken up at Washington. Postmaster A. R. McGill of St. Paul has presented the case to the postmaster-general.

An ordinance is before the council of Sparta, Wis., requiring all telephone wires in the fire limits to be placed underground. The Bell interests propose a contest in case it passes, as the city does not require electric-light wires placed underground.

The Tri-State Telephone and Telegraph Company was stopped in the construction of a pay station in Northfield, Minn. The company was given permission to build through the city, but no provision was made for a pay station.

The Harrison Telephone Company, a large Independent company of Deadwood, S. D., has been reorganized and will expend considerable money in extensions and improvements.

The city officials of St. Paul are considering if the telephone and street-railway companies cannot be reached under the gross-earnings'-tax provision of the city charter. It is said that the companies are all liable, and efforts will be made to reach them.

Six rural telephone associations will establish a central office at Frost, Minn.

The Farmers' Mutual Telephone Company of Lucas County, Iowa, has been incorporated with a capital of $10,000. C. E. Conner is president and C. C. Burr, secretary.

A telephone franchise was voted at Cedar Falls, Iowa, for a mutual company being formed by R. A. Davison of Waterloo.

The new Independent telephone company has let the contract for the building of a toll line from Sioux City, Iowa, to Odebolt, a distance of 60 miles, and another to LeMars, a distance of 25 miles.

The Southwestern Telephone Company was formed south of Bloomfield, Iowa. F. Bullock is president and A. Morgan, secretary.

The Grafton (Wis.) Telephone Company has been incorporated. The capital stock is $4,000. John G. Buch heads the list of stockholders.

The Leeds Farmers' Telephone Company of Poynette, Wis., increased its capital stock to $10,000. J. E. Larson is president.

The Dunn County Telephone Company of Ridgeland, Wis., has been incorporated with a capital of $10,000 by M. L. Randall. R.

Southeastern Telephone Developments.

The directors of the Augusta County Telephone Association met at Staunton, Va., recently, to take action against the pending "Duke bill," requiring all telephone lines in the state to connect with each other and have a fixed rate of charges. Sixty companies were represented at the meeting.

The Randleman (N. C.) Telephone Company has been chartered by T. E. Marshall and others of Randleman with $3,000 paid-in capital stock and $5,000 authorized.

The Memphis (Tenn.) Long-distance Telephone Company has executed a deed of mortgage for $1,000,000 with the Tennessee Trust Company as trustee, bonds to this amount to be floated to meet expenses, complete the plant and acquire other properties. The mortgage is signed by B. O. Henning, president, and Belle Boyd, secretary.

The Home Telephone Company of Louisville, Ky., has paid a tax of $178, this being the amount to fill the conditions of the law requiring a tax on each telephone above 6,000.

It is announced that the lines of the Long-distance Southern Bell company will be extended from Wilmington, N. C., to Florence, S. C., 110 miles. The Bell company is busy taking down the wires of the recently absorbed Interstate company at Wilmington, N. C. L.

Michigan Telephone Matters.

The home office of the Union Telephone Company at Alma has been notified that at a meeting of the grocers and butchers of Clare it was decided to discontinue the use of Bell telephones and use the Union or Independent telephone exclusively. This is a result of the fight between the Independent and Bell companies which has been going on in Clare for some time.

Delray was practically cut off from telephonic communication with Detroit during the severe ice storm last week, 600 to 700 telephones being out of commission on account of the breaking of the poles on one of the trunk lines.

The construction gang of the Michigan Telephone Company is expected to commence work on a telephone exchange at Hopkins Station in a few days. This will be the largest Bell exchange between Grand Rapids and Kalamazoo, taking in a large portion of Hopkins and Monterey Townships, with the north half of Watson Township. Alvah M. Weaver, formerly of the Citizens' line, will act as local manager. W.

Market and Weather Reports by Telephone.

The Northern Indiana and Southern Michigan Telephone Company, operating in LaGrange, Ind., with exchanges in Ashley, Lima and other towns, has adopted the plan of giving subscribers daily market and weather reports. A universal call is rung over the line, and all subscribers may listen if they choose. The Lima office has been made an all-night exchange, with a woman operator in charge. The all-night service and weather and market reports are doing much toward increasing the number of subscribers.

The Vermilion County Telephone Company of Danville, Ill., has increased its capital stock from $150,000 to $400,000. It is asserted that the company has made arrangements to take over the Central Union local exchange in Danville and that it will consolidate the two exchanges. An underground system has just been finished at a cost of $65,000.

Independent Companies Refused Franchises in Cincinnati.

The applications of four Independent telephone companies—the Fitzsimmons, the Queen City, the Interstate, and the Cincinnati—for telephone franchises in the city of Cincinnati, Ohio, have been refused by the City Council. The committee on telephones, telegraphs and conduits, in a long report, gave its reasons for the conclusion arrived at. Among other things, it stated that the Fitzsimmons Telephone Company already had a Probate Court franchise and had erected some 60 miles of wire and connected up various hotels, railway stations and public and private places, but that up to the present time it had not shown the city anything better than the service rendered by the Bell company. By reason of its contracts with outside Independent companies and its initial construction already up within the city limits, the Fitzsimmons Company is said to hold the strongest position of any of the Independents. All it needs is a permit for underground conduit, preferring this to overhead construction. With the refusal of the council to grant any franchises the various companies will again resort to the Probate Court.

The Fitzsimmons Company, which obtained a franchise through the Probate Court, is of the opinion that the council cannot oust it from the city, as it is now doing business there. David J. Hauss and Mr. Fitzsimmons say that if the Probate Court grants its petition it will immediately make connections with Independent telephone companies through Kentucky and Tennessee, and thus open the Independent telephone field of the South to Cincinnati.

GENERAL TELEPHONE NEWS.

The Monclova Telephone Company of Monclova, Mexico, will extend its system and make other important improvements.

The Southern States Telephone Company of Norfolk, Va., has awarded a contract to R. M. Price for remodeling its quarters on Roanoke Avenue.

The Southwestern Telegraph and Telephone Company has purchased a site at El Paso, Texas, for its proposed telephone-exchange building, and the contract will soon be let for its construction.

The telephone line which runs from Beeville, Texas, to Oakville, and to a number of ranches, has been sold to I. N. Powell. Mr. Powell will make important improvements and extensions of the line.

The Rochester (N. Y.) Telephone Company will issue $3,000,000 of five per cent. 30-year bonds, $150,000 of which will take the place of 1,500 shares of preferred stock, which is to be retired, and $100,000 will be offered for public subscription.

The Independent Home Telephone Company now has on hand about all the materials required for its line between Salt Lake City and Ogden, Utah. The buildings in the two cities are also practically completed and the manager states that the lines will be in operation by the first of June.

The preliminary steps in the reorganization of the Michigan Telephone Company have been effected through the incorporation of the Michigan State Telephone Company at Lansing, Mich., with a capitalization of $25,000 and the right to increase this amount. Temporary directors have been elected, consisting of the incorporators. The full reorganization plan is expected the first week in February.

Frank J. Leonard, general manager of the Canadian Telephone and Telegraph Company, has informed the city clerk of Toronto, Ont., that his company is ready to do business with the city on the following basis: "Business telephones at a yearly rental of $36, residences at $24. We will pay to the city for competitive franchise the same fee that the Bell Telephone Company has been paying for exclusive privileges. We will build a conduit system through the principal streets of Toronto, as may be required by city ordinance, or, in case the city would build its own conduit system, we agree to lease ducts in said system, sufficient for our business at such rental as may hereafter be decided upon."

MANUFACTURERS AND DEALERS.

The Automatic Electric Company of Chicago has recently sold complete equipment for 1,000 stations to the Auburn Telephone Company, Auburn, N. Y. It has also received an order for 800 stations from the Ideal Construction Company, Hopkinsville, Ky. These figures are for present installation, and the ultimate capacity for each exchange will be 10,000 stations. About seven years ago the Auburn company installed an Automatic board with an ultimate capacity of 400 stations. This was soon filled, and in order to increase the list of its subscribers, it purchased two manual boards of two operators' positions each, and connected them with the Automatic switchboard by means of trunk lines. The new equipment replaces the old automatic board and the two manual boards which were later installed to give service in conjunction with it.

CORRESPONDENCE.

Great Britain.

London, January 20.—A peculiar state of affairs has arisen at Poplar (London). Here the Borough Council has an electrical plant which was so overloaded that further applications for a supply of electrical energy had to be refused. At the same time the Borough Council, for some reason, declined to expend further capital in extending the existing plant. Of course, under its statutory obligations the Borough Council is bound to supply all who apply for current, and in refusing the new consumers was acting illegally. Consequently it was no surprise when a large iron and steel company, after having applied for and been refused a supply, threatened legal proceedings to enforce its claim. The Borough Council has had to accede, and presumably will have to overload its plant still further until some new machinery can be installed. Naturally one new consumer having been successful in this manner, all the other rejected ones may be expected to act in a similar manner, so that it would appear that the Borough Council will have to adopt a new attitude and extend its undertaking. It may be mentioned that this is the first case that a public-supply authority has refused in this manner.

The Goodwin Sands lightships are to be put into communication with the shore by means of space telegraphy. The Admiralty already has a space-telegraph station near Dover, off the Goodwins, and four lightships will be put into communication with this. This is the first part of a programme which the government put in hand early in the year for communication between all lightships and the shore, an agreement having been entered into with the Marconi Wireless Telegraph Company with this object. The Goodwin Sands installation is expected to be in operation within one month.

Mr. Herbert Spencer, the great philosopher who has just died, states in his will that his pamphlet against the introduction of the metric system is to be reprinted, with some alterations, and distributed among the members of the House of Lords and House of Commons in the event of a bill being introduced into Parliament proposing the adoption of this system of weights and measures.

Municipal telephony has been particularly quiet of late with regard to new schemes, but the Bournemouth corporation contemplates an effort in this direction. The corporation has decided to call in an expert and to discuss, among other things, rates to suit local circumstances, etc. The National Telephone Company, which has been forced to reduce its subscription rates in every town in which a municipal exchange has been erected, offers to grant the same rates to Bournemouth as exist in Portsmouth (where there is a municipal service and consequently lower rates). Nothing definite has been arrived at yet.

The "G. B." surface-contact system of electric tramways [see Western Electrician of last week], which has recently been "boomed," so to speak, is in contemplation for both Folkestone, on the South coast, and Musselburgh, in Scotland. In the latter case Professor A. B. W. Kennedy, who, after a visit to the United States, recommended the conduit system to the London County Council, has been appointed to inspect the system and the neighborhood and to report. In the case of Folkestone its originally parliamentary powers bound the corporation to adopt any system but the overhead. An attempt has been made to apply for new powers enabling the use of the trolley system, but the latest development is that an expert is to be called in to advise upon the surface-contact system.

The discussion upon Dr. Hibbert's paper upon the Edison accumulator, which was read before the Institution of Electrical Engineers just before Christmas, is fixed for next week.

Dr. Walmesley, principal of the Northampton Institute (a London technical college), visited the United States some time back and made a report upon the methods of technical education adopted there. This was summarized in these notes at the time. Dr. Walmesley is now going into the matter more in detail in a paper, which will be read before the Institution of Electrical Engineers early in February. G.

New York.

New York, January 30.—The New York Central Railroad Company is said to have purchased the Belmont property, which lies just west of the Mott Haven station and extends to the Harlem River. It is rumored that this property will be the site for the proposed large power plant for the operation of the Central's trains by electricity. The land runs parallel with the company's tracks and has two blocks of water front.

The Overland and Marine Telegraph Company of this city was incorporated at Albany yesterday with a capital of $100,000 to carry on the business of space telegraphy and to manufacture telegraphic instruments. The directors are John W. Chapman, W. R. Sainsbury, H. R. Dennis, J. Norris Miller, Jesse W. Toby, and Harry J. Peel of New York city.

The annual meeting of the stockholders of the Brooklyn Rapid Transit Company was held yesterday at the offices of the company in Montague Street, Brooklyn. Four directors whose terms expired—Horace C. Du Val, R. Somers Hayes, John G. Jenkins, and David H. Valentine—were re-elected. This was regarded as indicating that there would be no change in the administration and that Edwin W. Winter would continue at the head of the company for another year at least.

The electrical department of the New York Board of Underwriters reports that there were only 25 fires in this city during last year which were directly attributed to electricity. The loss caused by these is estimated at $10,250. The causes of these fires are classified as follows: Nine due direct to short-circuit, nine due to grounding conductors on metal pipes, six due to overheating connections, one due to stock-ticker wires underneath the floor.

A railway company known as the Eastern Traction Company of Waterbury, Conn., has had representatives in Williamsburg for several weeks getting consents of property owners for a proposed electric road from the new Williamsburg Bridge plaza through Greenpoint and Long Island City, connecting Astoria with the new Blackwell's Island Bridge. The promoters of the movement, in addition to obtaining consents, are giving an opportunity to property holders of becoming stockholders in the railroad company. It was said yesterday that many consents had already been obtained and that the company is capitalized at $5,000,000.

The proposed pipe galleries for the Borough of Manhattan have received a setback from Supreme Court Justice Fitzgerald, who has issued an injunction upon application of J. Rhinelander Dillon restraining the president of the Borough of Manhattan from opening bids, or taking any steps toward making a contract for the construction of pipe galleries to carry gas and water pipes and telegraph, telephone and electric wires in the rapid transit subway in Broadway, between Fulton and Morris Streets. Justice Fitzgerald holds that the commissioner of water supply, gas and electricity has control of these matters.

At a meeting of the East Side Rapid Transit Association, recently formed for the purpose of advocating an East Side tunnel route, Joseph B. Bloomingdale, president of the association, read his report as chairman of the executive committee, in which he said: "We are glad to report that the board is in favor of constructing an East Side tunnel, and it seems to us that the day is not far distant when our hopes in this direction will be realized." The funds now available in the hands of the board for tunnel construction do not exceed $5,000,000, and legislation at Albany will be required to enable the board to undertake the work. O.

New England.

Boston, January 30.—Legislative matters relative to electrical companies have come to the front in the new year somewhat prominently. One of the Worcester representatives has introduced an extremely radical bill, which has been designated the limited-franchise measure. It not only provides that, when franchises are granted by local authorities for street-railway companies to operate in a given city or town, there shall be a preliminary or an annual payment for the franchise, but further provision is made that the ratification of such locations must be determined by a referendum vote of the citizens, and that no franchise shall extend more than 20 years, while all existing franchises shall terminate in 1924. There is little chance of the passage of any such bill through the Legislature, as at present constituted, but it has challenged attention.

Another bill that comes close to the interests of the electrical companies is an excise bill, so-called, which aims to impose upon every public-service corporation having locations granted in the thoroughfares of a municipality, an excise tax amounting to one per cent. of the concern's gross receipts on business done within the state, if the dividends paid aggregate six per cent., with an additional one-half of one per cent. upon gross receipts to every one per cent. of additional dividend paid. Of the tax thus collected, 25 per cent. is to go to the state and 75 per cent. to the cities and towns wherein the taxed business is carried on.

A bill to remedy delays in the delivery of telegrams provides that hereafter any telegraph message sent within the state of Massachusetts shall bear the name of the originating place, the month, day of the month, hour and minute, morning or afternoon being designated. Similar recording of the time of its receipt at destination shall also be observed. Penalty for violation is fixed at $100. This bill may get on the statute books.

The Norfolk Western street railway has gone into receivers' hands, Judge Colt of the United States Circuit Court having appointed George H. Poor and Albert F. Hayden as the receivers, by agreement of the creditors and parties in interest. The floating indebtedness of the company is said to be about $60,000.

The Pittsfield Street Railway Company has petitioned the town of Lanesboro for an extension of its line to that town, with a view to connecting with the Hoosac Valley company's system at the new Ashford-Williamstown line.

Taunton's miniature war with the Massachusetts Telephone and Telegraph Company has resulted in the capitulation of the company in regard to most of the points at issue. The city government is in receipt of a petition and order wherein the differences that have arisen are deplored, and the company agrees to furnish 25 free telephones for the use of the city, at the same time acceding to most of the other stipulations which were made a basis for the grant of further privileges in Taunton to the corporation.

As a sequence to the recent equipment of one of the Boston and Albany railroad's branch lines in Newton with electricity, the statement is published that plans are under consideration for the application of the same methods to the operation of several other branches, the success of this experiment having been immediate and unquestionably a benefit for the road and its patrons.

An important franchise was granted recently by the town of Millbury, near Worcester, to the Worcester and Providence Street Railway Company, which will help to overcome objections which have been encountered along the proposed route from the "heart of the commonwealth" to the capital of Rhode Island. B.

Dominion of Canada.

Ottawa, Ont., January 30.—The Dominion government has purchased 10 submarine bells at a cost of about $2,000 each. It will require $500 annually to keep each of these bells in order. They will be located on the Atlantic sea coast and in the Gulf of St. Lawrence and will be placed in position early in the coming season.

The shareholders of the Sherbrooke Electric Company of Sherbrooke, Que., have decided to accept the offer of the city to purchase the company's electric-light plant and property for the sum of $200,000, provided the city will also take over the gas property of the company.

At a recent meeting of the council of the town of Port Arthur, Ont., the question of further developing the power on Current River received favorable consideration. It is the intention of the council to produce from 8,000 to 10,000 horsepower and to offer the surplus power at a low rate for manufacturers. Port Arthur, having the Current River power nearly in the center of the town, is able to utilize it at a minimum cost for generating power for electrical energy. It is said that taking the cost of the power development on a five per cent. interest basis the interest on borrowed cash for this purpose, which the town now pays, brings the cost down to about $4 per horsepower a year. The cost of maintenance is comparatively trifling.

At the annual meeting of the shareholders of the Shawinigan Water and Power Company the treasurer reported that the company was now selling in Montreal 6,000 horsepower and at Shawinigan Falls 20,000; that there was still a large surplus of power in the development at the falls, the total being estimated at 100,000 horsepower. The operation of the power plant at Shawinigan Falls had proved satisfactory, and the successful transmission of power to Montreal had demonstrated the commercial feasibility of transmission to any point within a radius of 100 miles of the falls.

The Montreal Light, Heat and Power Company now includes the Montreal Gas Company, the Royal Electric Company, the Montreal and St. Lawrence Light and Power Company, the Imperial Electric Light Company, the Lachine Rapids Hydraulic and Land Company, the Standard Light and Power Company, the Citizens' Light and Power Company, and the Temple Electric Company. Further combinations are looked for, notably that of the Montreal Street Railway Company with which the combine is already closely allied. The combine now controls all the lighting and supply of power of Montreal, St. Henri, Ste. Cunegonde, St. Louis, Westmount, Maisonneuve and Cote St. Paul, with a population of 322,327. It also controls the public lighting of the city of Montreal under a contract running until January, 1909.

At the annual meeting of the Toronto Street Railway Company the reports showed that the gross earnings of the company for the year were $2,172,089, an increase of $337,179 over the gross earnings of last year. The company's net earnings were $971,264, an increase of 18.5 per cent.

The annual report of the Ottawa Electric Railway Company shows gross receipts for the last year of $348,888, giving a net profit of 94,541, or nearly 11 per cent. on the average capital stock. The number of passengers carried during the year was 7,911,718, or an increase of nearly 1,000,000 over the previous year. At the meeting of the directors Mr. T. Ahearn was elected president; P. Whelen, vice-president, and James D. Fraser, secretary-treasurer. W.

Southeastern States.

Charlotte, N. C., January 30.—At the annual meeting of the Georgia Railway and Electric Company of Atlanta all of the old officers were re-elected, P. S. Arkwright being the president.

J. D. Hopkins of St. Louis has decided to put in electric door openers in the proposed new theater in Louisville, Ky., by which every exit in the building may be opened by merely pressing a button.

Shields & Sons & Co. of Providence, R. I., have secured an option on a valuable waterpower on the Catawba River, near Newton, N. C., and, it is said, will begin a big electric development to supply power to neighboring cotton mills.

The Bay Shore Terminal Company of Norfolk, Va., will issue $150,000 receiver's certificates in accordance with a recently granted petition, and an extension to the road may be built.

The Rapid Transit Company of Chattanooga,

Tenn., has filed a bill to enjoin the Alabama Great Southern Railway from abrogating a contract to allow the Rapid Transit Company the use of extensive rights on the Belt Railway. Should the contract be abrogated the trust company would be badly crippled.

The engine at the power house of the Birmingham (Ala.) Railway, Light and Power Company was damaged by fire recently to the extent of $1,500, and the service was slightly hampered for several days.

The location of the route for the electric lines of the Shelby Traction Company of Memphis, Tenn., has been completed and estimates are now being made for the construction of the 20-mile line.

An electric-lighting plant to cost $3,000 may be put in at the City Hall of Richmond, Va., by the city.

The city of Winston, N. C., has contracted with the Fries Power and Manufacturing Company for 70 arc lights at $60 per light a year. The contract covers three years, beginning March 31, 1904.

L.

Texas and Mexico.

Austin, Texas, January 28.—It is announced that interests closely identified with the Union Traction Company of Indiana will build an electric interurban railway from El Paso, Texas, to Las Cruces, New Mexico.

Grading is in progress on the interurban electric railway that is to be constructed between Batson, Texas, and Houston.

The Legislature of the state of Michoacan has granted a concession to John W. DeKay of the United States Packing Company to build and operate an electric railway from Uruapam, Mexico, to Los Reyes, where connection is to be made with the Mexican Central railroad. Under the terms of the concession, steam may also be used for motive power. The distance is 80 miles, and the route of the proposed road is through a populous and rich section of country. There is an abundance of waterpower within convenient distance and the road can be operated with electricity at a minimum cost.

An electric-light and power plant will be installed at Coatzacoalcos, Mexico, for service at the piers and in the harbor-improvement work. Sir Weetman Pearson & Son, contractors, Coatzacoalcos, can give information.

The Mexican government has granted a concession to F. Brennan for the purpose of establishing hydraulic works on the Rio Grande de Santiago at Hostotipaquillo, Mexico. Under the terms of the concession authority is given to utilize the water of the river for motive power. An electric power plant will be established.

The Amparo Mining Company will install an electric-light and power plant at its mine situated near Etzatlan, Mexico.

Edward T. LeClair will commence the construction of an electric power plant on El Fuerte River in Mexico, as soon as his application for a concession from the federal government is granted. L. Arturo Paz of the City of Mexico can give information in regard to the project.

A new electric street-railway line is being built from the depot of the Mexican Central railroad at Aguas Calientes, Mexico, to Plaza Principal. The line is owned by J. Douglas, a wealthy Englishman of Aguas Calientes. He contemplates extending the line to other parts of the city.

The Dwight Furness Company of the City of Mexico is about to take over the municipal electric-light plant in Guanajuato, Mexico. It will be improved if the deal is consummated.

A street railway is to be built from Saltillo, Mexico, to the town of Artega. Walter Willett of Saltillo is interested.

D. R. Williams and associates, who own an extensive tract of timberland in Mexico, have taken the preliminary steps looking to the construction of an electric railway from Guanajuato, Mexico, to their property, a distance of 20 miles.

A street-railway line is being built on Independencia Avenue, in Oaxaca, Mexico.

H.

Michigan.

Detroit, January 30.—Bay City's municipal commercial electric-light committee has adopted a new scale of electric-light charges, bringing the price from two to three cents a kilowatt below that of the private electric-lighting concern. The former scale, formulated by the city superintendent, was higher than the private company's, where large amounts were used, and only slightly lower for small amounts.

The village of Ecorse is at a loss to decide which plan of lighting to install. Sentiment is about equally divided between gas and electric lamps for lighting the streets. The matter will be discussed at the next meeting of the council.

Prominent citizens of Wayland are considering a plan of lighting the streets, business places and residences by electricity, the power to be obtained from the surplus energy at the mills.

After much discussion the council of Lansing has voted to submit to the electors, on February 1st, the question of granting a franchise for the operation of a heating and electrical power plant to John H. Chase and William L. Haag. Municipal ownership of such a plant is suggested.

The details of the new belt-line scheme for the city of Detroit have reached definite shape, so far as it has been possible for the city officers to go. It is proposed to have two north and south lines built, one on the east side and one on the west side of the town, these to connect with all of the roads running out of the city and with the crosstown line of the Detroit United Railway now in operation, thus forming a belt line taking in the manufacturing districts of the east, north and west sides, and connecting with the river at both ends. The manufacturing interests are anxious to have such a line built. It is somewhat difficult for those in the outlying districts to get down to the Detroit and Cleveland and other lines of boats. If such a belt line were in operation, with liberal franchises as to the handling of freight, enabling the cars to run oftener, a great deal of new freight business would be created. The matter is now in the hands of the traffic committee of the Board of Commerce and the street-railway officials. Statistics will be gathered by the Detroit United and the cost of the system ascertained. Manufacturers and property holders on both the east and the west sides have offered to donate a good deal of the necessary right-of-way through their property, in order that they can secure the benefit of this frequent and rapid electric-freight service.

C. G. W.

Indiana.

Indianapolis, February 1.—The last two weeks tested severely the ability of electric railways to combat the forces of flood and snow in Indiana. The flood put a few lines operating in the Wabash valley out of business, and the heavy snowfall retarded all the lines somewhat, but all are operating regularly again. Traffic has not been interfered with on the electric lines to any greater extent than upon the steam lines.

A new traction company to be known as the Indianapolis, Rushville and Cincinnati Traction Company is being organized in this city with a capital stock of $2,500,000. The promoters are the same men who are backing the Columbus, Greensburg and Richmond Traction Company, but the company will be a distinct organization which proposes to build a line from Greenfield through Carthage, Rushville, New Salem, Andersonville, Laurel and Brookville to Harrison, Ohio, and thence to Cincinnati. C. N. Wilson, chief of the promoters, says the line will be the shortest between Indianapolis and Cincinnati and that the carrying of freight will be made an important feature. The work of getting the right-of-way is progressing, and the promoters say that work will begin in early summer.

A mortgage for $500,000 covering the property of the Indiana Northern Railway Company between Marion and Wabash in favor of the Trenton (N. J.) Trust Company has been filed in Wabash County. The mortgage is to secure $500,000 bonds, to run 30 years with five per cent. interest. The proceeds will be used in completing and equipping the road.

The first order for the equipment of the Wabash-Rochester electric line was placed last week. The order is for two electric cars to be used in construction work and later in hauling freight; also for six passenger cars, 10 box cars, six trailers and one snowplow. All of these are to be delivered early next summer.

The Chicago, Cincinnati and Louisville Railway Company is experimenting through Indiana with a new system to prevent collisions, and there is much evidence of efficiency. The plan is the invention of R. D. Peters of Knox, Ind. Tests will be made at a number of points along the line. At the interlocking towers by use of this system the dispatcher is able to follow the trains under his care every foot of the way for five miles on each side of his tower. Electric wires connected at points along the line with the rails run into the towers. By means of these wires the movements of the trains are shown upon a chart. Even the movements of a light handcar are shown in this manner.

A car-barn fire destroyed 28 cars belonging to the Indianapolis Terminal and Traction Company on January 26th. The loss is placed at $100,000, fully covered by insurance. The Holland palace sleeping car constructed for service between Indianapolis and Dayton, Ohio, was badly burned in the Greenfield barn, January 25th. The car was to have made its initial trip the next day.

The interurban companies entering Indianapolis paid into the city treasury $2,332.91 franchise tax at the rate of five cents for each round trip during 1903, as against $1,056.95 the preceding year.

The City Council of Fort Wayne has granted the Fort Wayne Electric Light and Power Company a 31-year franchise at $70 a year for street lights and 10 cents a kilowatt for private current. There has been a six-month fight over this franchise, owing to a sentiment favoring municipal ownership of the lighting business.

The citizens of Zionsville are promoting an electric-light plant. Subscribers are being sought and a company will be organized if sufficiently encouraged.

The Harper Electrical Company of Fort Wayne has incorporated with a view to manufacturing supplies. Raymond and Joseph Harper and others are the incorporators.

H. B. Marsh, of Sanborn, Marsh & Co., of Indianapolis, discussed the Cooper Hewitt mercury lamp before the Indianapolis Technical Club Saturday night. Mr. Marsh explained the methods used, illustrating his lecture with the lamp.

The draft of the new electric-lighting specifications for a 10-year contract to light the city of Indianapolis will be ready for bidders on February 2d.

F.

Northwestern States.

Minneapolis, Minn., January 30.—Mayor J. C. Sullivan of Creston, Iowa, is forming a local company which will ask for an electric-lighting franchise.

Bonds have been voted at Walnut, Iowa, for electric lights.

The DeWitt Electric Light and Power Company of DeWitt, Iowa, will spend several thousand dollars in improvements on its plant this spring.

The electric-light plant of the city of McGregor, Iowa, was destroyed by fire, with a loss of $11,000.

William J. Bell of Baraboo, Wis., is promoting an electric railway from Portage to Grand Rapids, Wis., via Columbia, Adams, Wood and perhaps Marquette Counties. It is backed by Chicago capital.

The officers of the La Crosse and Black River Falls (Wis.) Electric Railway Company have deferred their plans for construction for another year.

A council committee of Webster, S. D., is considering needed additions to the equipment of the power plant of the city lighting system.

The city of Dike, Iowa, has voted a franchise for the proposed interurban line to be built by the Marshalltown Electric Street and Interurban Railway Company.

J. B. Mickelsell and Fred Fairchild have bought the electric-light plant at Mitchell, S. D., and will add new machinery thereto.

J. E. Peterson of Barrett, Minn., has made a proposition to install an electric-light plant and furnish light for the village at $1,400 a year.

The Outagamie Traction Company has been incorporated to build an electric interurban line from Appleton, Wis., to Hortonville and other cities.

The Eastern Wisconsin Electric Railway and Light Company has filed an acceptance of the new franchise which provides that it must build its own line into Oshkosh, Wis., before 1905.

The franchise committee of the Minneapolis council is investigating the possibility of increasing the lighting of the streets by electricity.

The third annual convention of the Minnesota Electrical Contractors' Association was held this week in Minneapolis. About 30 members were in attendance.

The machinery of the new power plant of the Twin City Rapid Transit Company is being tested and will be ready for operation in about a week.

The Chippewa Valley Electric Company has paid the $8,000 taxes which were in dispute at Chippewa Falls, Wis. This, it is thought, will end the long controversy.

The Iowa City (Iowa), Kalona and Washington Railway Company has elected G. C. Rodman president and W. Welch secretary.

R.

Rocky Mountain States.

Salt Lake City, Utah, January 28.—The Utah Light and Railway Company as the first step in the inauguration of radical changes and improvements has authorized the issue of $10,000,000 in first mortgage five per cent. 30-year bonds. The board of directors has also given authorization for the expenditure of $150,000 for the payment of the outstanding claims of the two companies absorbed in the recent consolidation. It was also decided at a recent meeting of the board to install a 1,000-horsepower generator plant as an adjunct to the street-car system.

The contract for the extension of the Salt Lake and Ogden Railroad lines from Farmington to Ogden and the conversion of the system between Salt Lake and Ogden into an electric line has been let to the La Porte (Ind.) Construction Company. The contract involves an expenditure of about $500,000, and the construction company has agreed to have the system ready for operation within 10 months from the time the work begins, which will be some time in March.

Surveys are being made for an electric line between Ogden and Huntsville, in Ogden Canyon. The northern terminus of the line will reach a large number of summer resorts. Davis Eccles, a capitalist of Ogden, is at the head of the enterprise.

C.

Pacific Slope.

San Francisco, January 28.—S. W. Roberts, who has been with the Charles F. Sloane Company for some time, in the incandescent-lamp department, has left for the East, being called there by the Bryan-Marsh Company.

The Department of Electricity has had its attention called to the unsafe wiring that exists in this city's hotels, theaters, dance halls, etc., and action will probably be brought to have many places rewired and brought up to standard.

The Drendell Switchboard Company is installing a switchboard for the Majestic Theater in the William Ede Building. The board is of marble and will cost $3,850 when completed.

The California Electrical Works has received the contract for furnishing a number of small slow-speed Western Electric motors for use in the culinary department of the Army Hospital at the Presidio.

S. E. Ericson of Seattle, a dealer in electrical machinery and supplies, was in this city last week.

Morehouse & Merrill, a firm of electrical engi-

neers and contractors, who have been located in Central America, have removed to San Francisco and have offices in the Crossley Building.

Manager Ben Maddox of the Mt. Whitney Power Company states that by the first of next July his company will have installed the new machinery in its second power house on the Keweah River. The foundation for the building has been constructed and the dam across the Middle Fork has been built. The water will be taken from a stream independent of the one supplying the old power house. The new machinery, all of the Westinghouse manufacture, for power house No. 2, has been ordered and will arrive in a few days. The work of putting it in place will then commence. A ditch of four miles will be built along the side of the hill from the dam to the new power house. All of this will be cement-lined, with the exception of 3,500 feet, which will be of the very best flume. The new plant will be capable of generating 2,000 horsepower.

It is reported that the Petaluma and Santa Rosa Electric Company is figuring on an extension of its plans in the way of a branch through Occidental and Camp Meeker, to the Ocean Beach, at a point a little to the north of Bodega Bay.

A syndicate of eastern capitalists is backing the proposition to construct and operate an electric-railway line to American Lake from Tacoma, Wash. E. J. Felt of Tacoma, who is interested in the enterprise, states that surveys for the proposed line will be commenced at once.

A. J. Smith, S. J. Crutcher and A. H. Gustin of Pine City, Wash., are interested in a project for the construction of an electric railway, to run from Spokane to Colfax, via Rosalia. The initial length of the line is 65 miles.

Robert G. Paddock, who represents an electric power company in which it is supposed the Southern Pacific company is deeply interested, has been in Stockton, Cal., recently, investigating a site for the construction of a power plant. This gives color to the rumor that the Huntington and Harriman interests are planning some extensive electric-railway improvements in the vicinity of Stockton.

Surveys have commenced on the proposed electric line to run from Suisun to Vacaville, Cal., the franchise for which was granted some time ago. The franchise calls for a line to run from Suisun to the Yolo County line, going by the way of Vacaville and Dixon. A.

Seattle, Wash., January 28.—The Gray's Harbor Electric Company of Hoquiam, Wash., is placing two 150-kilowatt alternating-current generators for street-railway and power uses; also a 200-kilowatt alternating-current generator for incandescent lighting. Thirty-two arc lamps have been shipped from the factory, and the town will have a lighting system equal to any on the coast.

Calvin Lunceford, president of the Adams County Electric Transit Company, is the authority for the statement that construction will commence at once at the Spokane end of the proposed line and be rushed to completion. A branch line is planned to run from Davenport to the Columbia River, where the company has located a water right, and is contemplating the development of from 20,000 to 30,000 horsepower. The southern terminus of the road will be Monumental Rapids. This company has franchises to almost all of the towns in and about Adams County.

The Olympia Light and Power Company of Olympia, Wash., has executed a mortgage for $100,000 in favor of the American Loan and Trust Company of Boston. The amount will be secured by 100 first-mortgage bonds of $1,000 by the light and power company. The bonds will run for 25 years and bear interest at the rate of five per cent.

Mayor Fletcher of North Yakima, Wash., has suggested that the City Council annul the franchise of the Yakima Light and Power Company, as its rates are considered exorbitant. The life of the franchise is 25 years.

W. H. Snyder and J. W. Hall have secured a franchise for the construction of a trolley line from Snohomish to Monroe, Wash. The franchise is for 50 years.

The Wenatchee Electric Company of Wenatchee, Wash., will improve its plant at a cost of $20,000. The plant will be enlarged and new machinery added.

S. A. Buckman has started construction on the electric-light plant at Monroe, Wash. Poles are up, wires are being strung and electric lights will soon be in evidence. The franchise was granted last summer. P.

PERSONAL.

M. Thompson has been appointed manager at Eau Claire, Wis., for the Western Union Telegraph Company, to succeed William McMoran.

Richard T. Laffin is on his way to the Philippine Islands in the interest of the American street-railway system to be constructed in Manila and suburbs.

The death of Sir Frederick Bramwell created a vacancy upon the British Engineering Standards Committee, where he represented the Institution of Civil Engineers. Sir W. H. White has been appointed in his stead.

Dallas Leonard of Clarksburg, W. Va., has resigned as local manager of the Fairmont and Clarksburg Electric Railroad Company, to accept an important position with one of the traction companies of Wheeling. Ernest Hutton of Fairmont, W. Va., will probably succeed Mr. Leonard.

Luke Robinson, superintendent of the Montreal Street Railway Company, Montreal, Can., has resigned his position and will devote some attention to his health, which for some time has not been of the best. Mr. Robinson was appointed assistant superintendent in February, 1903, and in March of the same year was appointed to the senior office.

R. C. Quin of London, England, was drowned at Tamney, Ireland, while in that country on an inspection trip. He was swept into the sea by a tidal wave while standing upon a pier, and though nearly saved by a friend, who plunged in to his rescue, was carried back when almost in the reach of those on the shore. Mr. Quin was a well-known English electrical engineer. He was quite prominent in electric-railway work and had established a consulting practice in London. Numerous papers were read by him before the leading electrical associations, and he was also a contributor to current engineering literature.

Professor B. V. Swenson, of the College of Engineering, University of Wisconsin, who was among those injured in the Iroquois Theater fire, is in a serious condition. He was badly burned, and it is feared that he may lose his eyesight. He was removed from the scene of the disaster in an unconscious condition and did not regain consciousness until the following morning. Pneumonia was also threatened, owing to his being left for dead for a number of hours, drenched with water. He is now slowly recovering at the home of his sister in Chicago, not having been removed to Madison as was at first reported.

Northwestern cedarmen, as well as others interested in the cedar-pole industry, will regret to learn of the sudden death of George R. Arnold, vice-president of the C. H. Worcester Company of Chicago. Mr. Arnold's death occurred January 27th, in L'Anse, Mich., and was caused by a stroke of apoplexy. Mr. Arnold was in the best of health an hour before his death. He was buried in Marinette, Wis., where he resided. Mr. Arnold was in charge of the Worcester company's northern operations and had been with the company since its organization. He was one of the most respected men in the cedar business, and his untimely death will be keenly felt.

ELECTRIC LIGHTING.

The Monclova Electric Light and Power Company will install an electric-light plant at Monclova, Mexico.

The city of Hannibal, Mo., has voted to issue $100,000 of bonds for the installation of a new electric-light plant.

The stockholders of the Kewanee (Ill.) Light and Power Company have authorized an expenditure of $50,000 for improvements to the plant.

The Richwood Light, Heat and Power Company of Richwood, Ohio, has been incorporated with a capital of $20,000. Among the incorporators are O. P. Lenox, L. G. Peet and B. Cahill.

The Citizens' Gas and Electric Company of Lorain, Ohio, will erect a new plant, plans for which are now being prepared. At the present time the company uses the plant of the Loram street railway for its electricity.

An ordinance extending the franchise of the City Electric Light Company of Vincennes, Ind., was rejected by the Vincennes City Council at a recent meeting. The ordinance carried with it free electric lighting at the City Hall.

The towns of Castle Dale and Orangeville, Utah, are considering the proposition of establishing a lighting plant, and have appointed a committee to perfect arrangements for the work. The committee includes A. G. Van Buren and J. B. Crawford of Orangeville, and W. J. Seeley and L. Christensen of Castle Dale.

Henry Oellien of Maplewood, Mo., has filed a petition asking the County Court for permission to lay pipes over and along the highways of St. Louis County for the purpose of furnishing the residents with heat, fuel, light and electrical power. He states that the pipes would be connected with a plant to be erected at Maplewood.

The Commonwealth Electric Company of Chicago has acquired by purchase two additional tracts of land adjacent to its present large Fisk Street holdings. The property, which aggregates 195,000 square feet, will not be developed immediately, but will be utilized as conditions demand. Another tract along the river has been leased and will be used for coal docks.

The Oregon Boom and Timber Company has acquired, by purchase, the water and electric-light plants of the Roseburg Water and Light Company of Winchester, Ore., and the Douglas Electric and Water Company at Roseburg, for considerations, respectively, of $125,000 and $50,000. The Oregon Boom and Timber Company has extensive timber holdings in that vicinity and contemplates the erection of two sawmills at an estimated cost of $200,000. The chief object of the company in making the purchases is said to be to secure control of a dam across the North Umpgua River and the splendid water frontage adjoining.

The Cincinnati Gas and Electric Company has been given the right by the City Council to charge 11 cents a kilowatt-hour for electricity for the next 10 years, which is one cent a kilowatt-hour more than is now charged. No special maximum rate was mentioned for electricity used for power, but the company is given the right to make a charge of $1 a month to customers using less than 10 kilowatts.

Among the recent Illinois incorporations was that of the Aurora, Elgin and Chicago Light, Heat and Power Company, with principal offices in Aurora, Ill. The company proposes to furnish electric light, heat and power to towns and cities along the route of the third-rail electric road connecting the cities named in the titles. The capital is $5,000 and the incorporators are Edwin F. Faber, J. T. Huntington and W. F. Harvey.

The plant and system of the Monterey Electric Light and Power Company of Monterey, Mexico, will be enlarged and the old 133-cycle 1,100-volt generators will be replaced by 2,200-volt and 60-cycle apparatus. The city arc lighting will also be changed from the open-arc to the series-enclosed, alternating type. J. G. White & Co. of New York city, who are the engineers for the extension, have purchased from the General Electric Company a 500-kilowatt turbine set, two 240-kilowatt revolving-field alternators, two 7½ and 25-kilowatt exciter generators and a complete switchboard to be installed. An additional boiler has been purchased from the Babcock & Wilcox Company. Four condensing pumps and other material, which will include meters, transformers, fans and arc lamps, will be purchased.

An installation of Cooper Hewitt mercury-vapor lamps may now be seen in Chicago in the windows of a shoe store on the corner of Dearborn and Washington streets. The lamps are of the tilting type, the tubes being about three feet long and normally hanging at an angle of 30 degrees with the horizontal. There are six in all, each requiring three amperes at a pressure of 70 volts. The lamps are connected across the 120-volt mains of the three-wire lighting system, a permanent and variable resistance being connected in series with the lights. The candlepower of each light is 750. To light the lamps, after the pressure is applied the lamp is tilted by means of a cord so that the mercury runs from one end of the tube to the other and back, which vaporizes a portion of it, enabling the resistance of the vacuum to be the more easily broken down.

ELECTRIC RAILWAYS.

Charles H. Stanley of Laurel Fork, Va., is interested in an electric-railway company which will develop waterpower and build an electric plant for the transmission of power near Floyd C. H., Va.

A franchise has been granted the Southern Illinois Electric Railway Company to enter the city of Belleville, Ill., where the line which extends from Mascoutah, Ill., will connect with the East St. Louis and Suburban interurban road.

The rails are laid to Freeport on the Rockford and Freeport (Ill.) electric railway. Regular trips are being made from Rockford west to Pecatonica every two hours during the day. The road will be pushed to completion as soon as the weather will permit.

The electric-light company which operates the plant at Paris, Idaho, has decided to build an electric railway from Montpelier to Fish Haven, Idaho, passing through Paris, Bloomington and St. Charles en route. President Slusser of the electric company will superintend the work.

O'Brien Brothers of Anniston, Ala., have begun grading for an extension of the Anniston Electric and Gas Company's electric car line to a park near Hobson City, where a company of prominent negroes of Anniston are developing a large summer garden, and will later lay out a town.

It is announced that the Douglas Street Railway Company will soon commence the construction of about two more miles of track at Douglas, Ariz. The extensions will run to the Calumet smelter and to the offices of the Copper Queen Reduction Works. New equipment will also be purchased.

Announcement is made of the incorporation of the Ohio Union Traction Company of Columbus, which has for its purpose, it is said, the uniting of existing traction lines to form continuous routes from Cincinnati to Cleveland and Cincinnati to Toledo. The incorporators are Richard Emery, W. A. Morgan, Otto F. Ehring, George E. Thomas and Henry L. Dowd. The capital stock is $10,000.

George D. Boulton has offered, through the daily press, a suggestion for relieving the congestion in the Loop district of Chicago. He suggests that all street-car tracks in this downtown district be removed, the North and West Side street-car lines to have their terminals at the river and the South Side cars to stop at Harrison or Congress Streets. This would work no great hardship to street-car patrons, as the terminals he suggests are no further

from the business district than the depots of the various steam roads, where hundreds of thousands of suburbanites are discharged daily. A good service of electric carriages to carry passengers at probably one cent a ride, might be established in the district thus freed from street-car tracks.

At the annual meeting of the Richmond Passenger and Power Association of Richmond, Va., the following-named directors were elected: F. Sitterding, J. D. Patton, M. M. Martin and William Northrop of Richmond, Va.; Aug. Wright and Carter R. Bishop of Petersburg, Va., and Guy Phillips of New York city. At a subsequent meeting of the directors F. Sitterding was elected president, M. M. Martin, vice-president, and William Northrop secretary and treasurer.

The Pennsylvania Railroad Company is to make a locomotive-testing plant the central feature of its exhibit at St. Louis, and is to conduct tests upon locomotives throughout the period of the exposition. That the work may serve as large a purpose as possible, the company has invited the American Society of Mechanical Engineers and the American Railway Master Mechanics' Association to have a part in giving direction to its work. Each of these organizations, in accepting the invitation, has appointed a committee of three to represent it.

A new franchise has been granted the St. Joseph, Parkville and Kansas City electric railway, which company proposes to build an electric road from Kansas City to St. Joseph, Mo. The route as proposed now is what is known as the all-river route, following closely along the river from Kansas City to St. Joseph. It enables the company to reach the Bean Lake and Sugar Lake territory, a country that can be greatly developed, and which can be made to yield a great deal of business to such a line of transportation.

A farmer writing to the Springfield (Ill.) Rural Life says: "We would rather give a hundred feet along one side of our farm to an electric road than to give the same to a wagon road. The wagon road would not be worked and would be impassable a large portion of the time, would grow up to weeds and become unsightly, but the right-of-way of a trolley line would be kept in the best of order and would advance the price of land from $10 to $20 an acre. We believe the interurban lines are the salvation of the country. They unite city and country in such a way as to get the greatest amount of good from both conditions."

Experiments have recently been conducted on the one-meter-gauge line connecting St. Georges de Commiers and La Mure, in the department of Isère, France, with a 500-horsepower electric locomotive, using a continuous current at 2,400 volts. This locomotive weighs 50 tons, is 12½ meters long, and admits a speed of 22½ kilometers an hour, with a load of 110 tons, over the stretch of line rising on an average 0.0275 meter per meter, and with curves of 100 meters in radius. The electric power required is supplied by the hydro-electric plant operated by the Drac torrent. The line is worked on the overhead system.

United States Consul J. B. Milner, at Calais, France, writes as follows concerning electric railways in that city: "Calais still has horse tramways, operated by an English company, that has a franchise to run for 17 years. The municipality recently projected an electric-tramway system and was granted the concession by the French government. The contemplated system is estimated to cost $600,000, in which three lines were comprised, having a length of 16 miles—eight miles within the corporate limits of the city—the contemplated system of traction being the Dickinson trolley. It was intended to commence the construction next spring and have the same in operation within one year. These plans have been upset by the death of the contractor, whose heirs are now trying to sell his rights. This leaves an opening for some company to become his successor by arranging with his heirs. An opportunity may exist here for some enterprising American company."

MISCELLANEOUS.

Chicago Typographical Union No. 16 has appropriated $1,000 to a fund to be used to assist in agitation for municipal ownership. The treasurer was directed to ask similar action from other unions. The proposed franchise for the Chicago City railway is especially objected to in resolutions.

A German press dispatch states that a patent has been taken out in Berlin for a combination meter, calculating machine and automatic press which, it is predicted, will render disputes between the consumers of gas, water and electricity and the companies or municipalities supplying them unnecessary and perhaps impossible. By the use of this machine a consumer can ascertain the amount of his bill at any time, for, by simply turning his lever, he receives a card upon which is printed the amount he owes.

The last member of the great Ferris Wheel has been taken down and Chicago will lose a well-known landmark. The wheel will soon be transported to St. Louis, where it will run at the exposition. Two of the "Burlington" railroad company's largest flatcars will be used to transport the great axle, which is over 40 feet long and almost three feet in diameter and weighs 76 tons. The axle was moved on rollers to the railroad tracks. For the transportation of the entire construction 120 cars will be required. Two months ago the wheel was actually sold for junk, but negotiations were entered into with the exposition officials, and a concession was obtained for its erection on the fair grounds.

SOCIETIES AND SCHOOLS.

A Boston newspaper has revived the story that Harvard University is about to absorb the Massachusetts Institute of Technology. But there appears to be no substantial basis for the report—at least at present.

The annual dinner of the American Institute of Electrical Engineers will be held on the evening of February 11th in the ballroom of the Waldorf-Astoria, New York city. Thomas A. Edison will be the guest of honor. T. C. Martin will act as toastmaster, and the list of speakers includes B. J. Arnold and Samuel Insull of Chicago, Charles L. Edgar and Dr. A. E. Kennelly of Boston, Professor C. F. Brackett of Princeton, and J. B. McCall of Philadelphia.

AUTOMOBILES.

It is expected that there will be at least 600 automobiles entered at the opening of the fourth annual exhibition to be given under the auspices of the National Association of Automobile Manufacturers and the Chicago Automobile Club at Chicago. The big show will be held in the Coliseum, beginning February 6th and lasting one week. Many noted automobiles will be in the exhibit, including the 90-horsepower car of W. K. Vanderbilt and Barney Oldfield's "Bullet." The available space in the Coliseum has all been assigned and some applicants have been turned away.

TELEGRAPH.

F. H. Lamb, superintendent of the Pacific division of the Western Union Telegraph Company, states that the company is planning to improve its present wire service in Southern Arizona. The line extending along the Southern Pacific railroad will be rebuilt entirely.

A young couple at Fort Apache, Ariz., were married recently by a ceremony performed by telegraph. There being no justice of the peace at Fort Apache, a justice at Holbrook, 90 miles distant, was called to the telegraph instrument at Holbrook, while the bride and groom took their places at the other end. Then the questions incident to the wedding ceremony were clicked over the wire and the couple pronounced man and wife.

The New York Pilgrim Society and a similar society in London gave their annual dinner simultaneously a few nights ago. During an hour of the evening the guests of the two clubs were in telegraphic communication with each other. A transatlantic cable had been leased for the occasion and during the hour the guests exchanged messages of good will. Many prominent men were present at the dinner. Henry Mortimer Durand, British ambassador, was the guest of honor at New York, while Earl Roberts enjoyed the honor at the London end.

PUBLICATIONS.

A new periodical published in Zurich, Switzerland, is the Schweizerische Elektrotechnische Zeitschrift. It is the first Swiss publication to be devoted wholly to electrical subjects and is issued bi-weekly.

Two bulletins from the Croftan Storage Battery Company of Toronto, Canada, describe that company's stationary batteries and electric automobile batteries. The latter are supplied with removable connections. The other bulletin takes up type "S" storage cells, which range in capacity from 26 to 234 ampere-hours, and are put up in either glass or rubber jars.

The second of a series of booklets issued by Sibley College, Cornell University, at Ithaca, N. Y., describes a compound-engine test made upon a Buffalo Forge engine. The purpose of the test and description of apparatus is given first, followed by the data and results obtained. All the facts concerning the test are systematically recorded and the data carefully tabulated.

The first number of the European edition of the Street Railway Review (Chicago) was issued on January 15th. C. B. Fairchild, Jr., is the editor of the new venture, which is published in London. Among the articles in the first number is one by James R. Chapman of London, formerly of Chicago. The initial issue is a creditable one, handsomely illustrated, and especially prepared for the needs of English readers.

The new price book just issued by the Wesco Supply Company of St. Louis, covering its No. 50 Catalogue, has been sent out to all of the trade who have a catalogue, and anyone who has not received this catalogue can secure one on application. In addition to the latest market prices on all articles shown in the catalogue, the price book contains several lines of new goods, and a copy of the latest rules of the National Board of Underwriters. These rules will be found useful for ready reference.

The Department of Commerce and Labor, through its Bureau of Statistics, of which O. P. Austin is chief, has published a document entitled "Diplomatic and Consular Service of the United States," which presents a full list of the consular representatives of the United States in all parts of the world, and maps showing the location of each embassy, legation, consulate, consular agency, etc., in all parts of the world. This list of names, and especially the maps, will prove valuable for permanent reference.

Motors for special applications manufactured by the Holtzer-Cabot Electric Company of Boston, Mass., are set forth in a neat brochure which, with very clear and large-sized cuts, shows up these machines to advantage. Among the special designs are dustproof motors for woodworking rooms, multicycle ringing sets with busy-back for telephone purposes, enclosed motors, with idler pulley attached to drive printing presses, direct-connected elevator motors, etc. Small machines for very light work, such as grinding-machine tools, are also mentioned.

TRADE NEWS.

The Illinois Electric Specialty Company of Chicago has increased its capital stock from $7,000 to $25,000.

The South Park commissioners of Chicago (E. G. Shumway, secretary) will receive proposals until February 17th for 3,000 feet of electric-light cable.

Electric-light plants at Pecatonica and Pittsfield, Ill., and Blairstown, Iowa, have been sold recently through the J. S. Maurer & Co. agency. This agency seems to have a number of people who are anxious to invest in the electrical business. It is located in Chicago.

The McGarvey Electric Company of Youngstown, Ohio, $10,000 capital stock, has been incorporated to deal in electrical appliances. J. M. Reed, Edward McGarvey, Benjamin Emerson, F. W. Robinson, A. M. Anderson and V. J. Lamb are the incorporators.

The credit men of the electrical supply houses of the territory bounded by Pittsburg, Chicago, St. Louis, Kansas City, Louisville and Cincinnati held their annual convention at the Grand Hotel, Cincinnati, on January 28th and 29th, with about 40 members in attendance.

A drafting-room apprenticeship course has been established by the General Electric Company, to which young men who are able to pass a satisfactory examination in arithmetic are eligible. The course is intended to fit applicants for drafting-room positions. Further information can be obtained by application to J. W. Upp, engineer-in-charge of the drafting room, General Electric Company, Schenectady, N. Y.

The report of the Crocker-Wheeler Company of Ampere, N. J., for the year ended December 31, 1903, shows satisfactory improvement over the preceding year. The year's operations resulted in a gross business of more than $2,000,000. The gross profit was $519,781. After paying fixed charges, dividends and reserves a balance was carried to surplus of $167,994, making the total surplus to date $408,868. At the time of the report orders amounting to more than a half million dollars were passing through the works.

John A. Walker, vice-president of the Joseph Dixon Crucible Company, writes: "The wealth of the country is more equally distributed between the people and more equally distributed as to territory than ever before. There are plenty of places west of the Mississippi full of money that would not know what Wall Street was unless some one told them. Down with the pessimist! Down with the coward! Down with the discontented, the lazy, the shiftless, the thriftless! Wave this flag for the brave, the worker, the industrious, the saving man, the thrifty woman. 'Pitch in, work hard, and destiny will be on your side.'"

W. W. Smythe, Jr., formerly a member of the staff of the Western Electrician and later with the American Stone Conduit Company of Chicago, has been appointed western manager for the Fiber Conduit Company of Orangeburg, N. Y. Mr. Smythe is well acquainted among electrical people, and his experience and address should fit him admirably for his new position. The Fibre Conduit Company asserts that its product contains many desirable features not found in other conduits, and this, together with Mr. Smythe's ability as a worker, should result in a satisfactory business from the territory in his care. Mr. Smythe's headquarters will be at 1760 Monadnock Building, Chicago.

The annual meeting of the stockholders of the Standard Underground Cable Company was held at the general offices of the company in the Westinghouse Building, Pittsburg, on January 26, 1904. The statement of the company's operations for the year was presented, showing that the company did a gross business of nearly $9,000,000 during the year 1903, and that dividends were paid on its capital stock aggregating 12 per cent., and that the company's assets aggregate the sum of $3,604,457, with only $375,344 of liabilities apart from capital stock. The company

has no outstanding notes, mortgages, bonds, or preferred stock. The following-named gentlemen were elected as the directors for the ensuing year: Mark W. Watson, John B. Jackson, James H. Willock, Robert Pitcairn, J. N. Davidson, John Moorhead, B. F. Jones, Jr., Joseph W. Marsh and W. A. Conner. The only change in the board is represented by the election of W. A. Conner, who has been at the head of the manufacturing department of the company since 1884. The meeting of the board of directors for the purpose of organization was held on the 29th instant, and the former officers were re-elected as follows: President, Mark W. Watson; vice-president and general manager, Joseph W. Marsh; treasurer, Frank A. Rinehart; auditor, C. M. Hagen. This company was the pioneer in the manufacture of underground cables for all classes of electric service, having been formally organized in January of the year 1882, although much experimental work has been done by Richard S. Waring, the founder of the company, prior to its organization. Its reputation for high-class manufacture in each of its departments, comprising bars, copper wire, weatherproof wires and cables, rubber-insulated wires and cables, and both paper and rubber-insulated lead-covered cables for telephone, telegraph, electric-light and power service, together with the favorable location of its factories, Perth Amboy, N. J., Philadelphia, Pa., and Oakland, Cal., and its strong financial condition, place it in a favorable position to command a large business.

BUSINESS.

At the annual meeting of the British Westinghouse Electric and Manufacturing Company, to be held in London this month, a resolution will be submitted, asking that the capital of the company be increased to £3,250,000.

The Kester Electric Manufacturing Company, 254 South Jefferson Street, Chicago, says that there is an unusual demand for the Kester self-fluxing solder, which has for a long time been extensively used by electrical workers. The Kester company asserts that its solder requires no acid and saves time, labor and money.

The Elmore-Fowler-Jacobs Company, Chicago, producer of cedar poles and ties, says that the little booklet entitled "The Testimony of a Telephone Pole," written by Floretta G. Elmore, daughter of the president of the company, which was distributed at the recent Interstate Independent telephone convention, has met with a flattering reception. The company will be pleased to mail copies as long as the supply lasts.

The L. B. Allen Company, 1334 Columbia Avenue, Chicago, maker of the well-known Allen products, used extensively by electrical construction men and others, announces that orders and inquiries for its specialties are unusually brisk at this time. The Allen soldering stick, as well as its other specialties, are recommended by some of the largest users. The Allen company has recently issued a new booklet called "Soldering Sense," which it will mail on request.

The Lewis Lumber and Manufacturing Company, Hattiesburg, Miss., manufacturer of long-leaf yellow-pine cross-arms, says that it makes a specialty of all-heart and special cross-arms. The company also asserts that it manufactures more cross-arms than all other factories combined, and can furnish 100 or 100,000 arms promptly.

The Chicago Fuse Wire and Manufacturing Company, the well-known manufacturer of fuse wire, fuse links and various forms of fuses, and other specialties, says that its product is meeting with a constantly increasing demand. The company has recently issued a neat catalogue which illustrates its full line of specialties, including enclosed fuses to fit all kinds of fixtures. W. R. Goodman, the secretary of this company, who is located at the main office in Buffalo, N. Y., is well known to the trade, and the success of the company is due in a large measure to his efforts.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) January 26, 1904.

750,250. Electric Battery. Winfield S. Bryan, Cincinnati, Ohio. Application filed September 28, 1903.

Resting on the bottom of the battery cell is an inverted cup, provided with openings at its lower edge. A tube extending in the neighborhood of the top of a containing element is connected with a source of fluid pressure, the tube opening into and being secured to the inverted cup, and the positive and negative elements of the battery resting on the top of the inverted cup.

750,261. Brake for Vehicles. William H. Cooley, Brockport, N. Y. Application filed December 9, 1902.

The brake is applied through the agency of a solenoid plunger, which co-operates with a hand brake applied by a lever. The movement of the handle serves to apply the electric brake and also to help in the braking effect for small pressures. As the handle is moved further, however, the electric brake accomplishes the whole, the lever merely taking up the slack in the connecting members.

750,268. Electric Signaling Apparatus. William E. Decrow, Boston, Mass., assignor to the Gamewell Fire Alarm Telegraph Company, New York, N. Y. Application filed April 29, 1901.

Several box number circuit-opening devices are connected by wires run from the main circuit. A switch is supplied for each set and an answer-back bell, operated by the signal-receiving apparatus, is also included in the circuit.

750,269. Electric Signaling Apparatus. William E. Decrow, Boston, Mass., assignor to the Gamewell Fire Alarm Telegraph Company, New York, N. Y. Application filed June 17, 1901.

Telephonic instruments and a condenser connected with the circuit at the signal-transmitting stations and also at the signal-receiving station, an electromagnetically operated buzzer at the signal-receiving station, and means for connecting it in circuit with one of the coils of the induction coil of the telephone equipment are the main ideas. A switch operated by the signaling train at each signal-transmitting station includes the telephone receiver in circuit.

750,270. Electric Signaling Apparatus. William E. Decrow, Boston, Mass., assignor to the Gamewell Fire Alarm Telegraph Company, New York, N. Y. Application filed September 27, 1901.

Two answer-back signal-transmitting devices of different kinds are connected with the circuit at the signal-receiving station and also two at each transmitting station, independently responsive to the answer-back transmitting devices. Means operated by the signal-receiving apparatus operate both answer-back signal-transmitting devices.

750,283. Brake for Hoisting Machines. Frank K. Hoover and Arthur J. Mason, Chicago, Ill. Application filed May 1, 1903.

The electric motor which does the hoisting applies the brakes, an automatic apparatus throwing the device in circuit only during descent of the car or hoist.

750,288. Ringer. Anton M. Knudsen, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed June 6, 1902.

Magnet coils for the bell carried upon the inner side of a plate mounted over an aperture in the casing project through the aperture into the box. Gongs for the bell are fixed upon the outer side of the plate, so that the self-contained bell may be mounted upon the box with its magnets within and its gongs outside without disassembling the apparatus.

750,289. Telegraph-instrument Stand. James W. Leech, Staunton, Va. Application filed January 6, 1903.

The stand comprises a base, a standard arranged upon the base, a relay-board, and a resonator box above the board and the side pieces connecting the relay board and resonator box.

750,296. Electric-railway Signal. William V. Moak, Albany, N. Y. Application filed December 8, 1902.

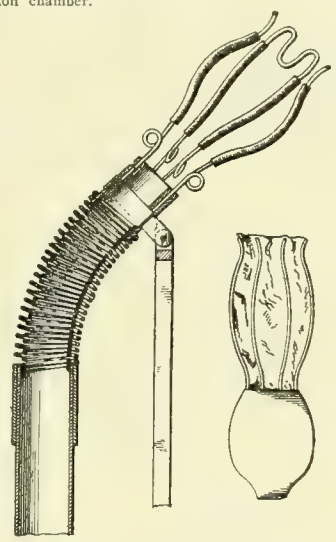
A compound lever is mounted fixedly on the semaphore shaft, the lever being composed of two parts pivoted together at their adjacent ends, each part turning on its separate stationary pivot. A driving wheel loosely mounted on the semaphore shaft engages the lever. An electromagnet also fixedly mounted upon the semaphore shaft controls the lever. An electric motor operates the driving wheel and electrical circuits control the motor and the magnet by means of track relays.

750,309. Annunciator. Lambert Schmidt, Weehawken, N. J. Application filed August 28, 1901.

A magnet core having a relatively flat pole piece disposed in the plane of one end and having its other end extended co-operates with an armature mounted upon the extended end of the core and having its free end overlying the pole piece. A spring co-operates with the armature, and a shutter is normally held in a vertical position and in operative relation with the armature.

750,349. Combined Gas Controller and Igniter for Explosive Engines. Stewart Cunningham, Turtlecreek, Pa. Application filed May 20, 1903.

A pair of sparking electrodes are arranged in the combustion chamber.



NO. 750,408. INCANDESCENT LAMP REPLACER.

750,361. Electrometallurgy of Iron or Steel. Henri Harmet, St. Etienne, France. Application filed September 30, 1901.

The improved means for the conversion of iron ore into iron or steel by electrometallurgy consist in first charging the ore and an excess of reducing materials into an electric blast furnace. Second, heating the base of the charge by electric heat conveyed through electrodes to fuse the charge. Third, collecting from above the charge, the gas arising through the charge from the point of fusion. Fourth, forcing the gas under pressure into and through the fusion zone and charge successively to diffuse and extend the area of the electric heat and create in the charge a reducing zone above the fusing zone of the furnace.

750,368. Trolley for Electric-railway Cars. Charles J. Johnson, St. Louis, Mo., assignor of one-half to Charles W. Benedict, St. Louis, Mo. Application filed May 14, 1903.

A dog engaging a side bolt holds the pole in normal position to the pole base. Upon tripping this dog the trolley falls from the wire.

750,370. Electric Gear for Cranes. Otto Kammerer, Charlottenburg, Germany. Application filed May 11, 1900.

In an electric gear for cranes are combined a motor, rotatable in both directions, magnetic clutches consisting of two members, one of which members is geared to the motor, while the other is rigidly connected to a crane gear, electric coils provided in connection with one member of each clutch, switches for interrupting and closing the current and means arranged in the magnetic clutches and adapted to keep both members apart.

750,408. Tool for Removing or Replacing Incandescent Electric-light Bulbs. Allen T. Speelman, Crestline, Ohio. Application filed July 1, 1903.

The device which grips the lamp is supplied with yielding fingers covered with cloth. The gripping device is mounted on a flexible spring neck, which, by means of a supplemental lever, can be turned in any direction to reach inaccessible lamps. (See cut.)

750,414. Device for Producing Electric Light. Hermann Viertel, Charlottenburg, Germany, assignor to Gebrüder Siemens & Co., Charlottenburg, near Berlin, Germany. Application filed June 1, 1903.

In a device for producing light by means of conducting light-emitting vapors kept incandescent by the passage of an electric current through them, are combined a closed tubular horizontal hollow body or chamber of refractory material having an opening at its bottom, and electrodes projecting into the chamber, the latter having a greater length than diameter.

750,421. Electric Brake. George C. Anthon, Medford, Mass., assignor to the Algonquin Electric Brake Corporation, Boston, Mass. Application filed November 30, 1901.

An electric motor is mounted upon the axle, a winding drum for the brake is also mounted on the axle between the motor and wheel. On the drum is a friction clutch engaging the external periphery of a disk to connect the drum and axle so that the former may be operated by the latter. An energizing coil for the clutch has its axis radial to the axle.

750,422. Electric Brake. George C. Anthon, Medford, Mass., assignor to the Algonquin Electric Brake Corporation, Boston, Mass. Application filed April 11, 1902.

In an electrically propelled vehicle supplied with current from a line wire, are combined an electromagnetic brake operated by a storage battery in shunt to the motor. A regulating controller between the battery and the brakes and means for charging the battery from the line wire are the features.

750,429. Wireless Electric Transmission of Signals Over Surfaces. Ferdinand Braun, Strassburg, Germany. Application filed February 6, 1899.

Currents for transmissions through the ether are generated by means of an oscillation circuit containing a condenser and a spark gap to earth plates connected to opposite poles of the transmitting apparatus. For collecting the impulses earth plates at the receiving station are connected to opposite poles of the collecting apparatus.

750,434. Electric Brake. Perley P. Crafts, Boston, Mass., assignor to the Algonquin Electric Brake Corporation, Boston, Mass. Application filed November 29, 1899.

Combined with a spindle of an electric-brake controller is a removable collar, a handle pivoted to the collar, a locking device between the collar and the spindle controlled by the handle, a mechanical lock for the brake, a magnet controlling the lock, and a switch in the circuit of magnet operated by the movement of the handle on its pivot.

750,454. System of Electrical Distribution. Josef H. Hallberg, New York, N. Y. Application filed October 16, 1903.

Main conductors leading from the generator are balanced by an equalizing conductor. Two motors have their armatures connected across the distribution circuit and centrally to an equalizing conductor. Each motor has its field magnets across the armature of the opposite motor and must be driven at uniform speed.

750,458. Overhead-trolley Attachment. Charles Holyland, Sr., Pittsburg, Pa. Application filed June 6, 1903.

Oppositely disposed spring-actuated rods on the trolley harp carry guiding fingers attached to the inner ends, the fingers extending in different directions.

750,471. System of Electrical Generation, Distribution and Control. Lamar Lyndon, New York, N. Y., and Elmer A. Sperry, Cleveland, Ohio, assignors to the National Battery Company, Jersey City, N. J. Application filed January 17, 1903.

An electric generator, a variable-friction power transmission between the power source and the generator, fluid-pressure-operated devices for varying the friction, a two-way valve for controling the devices, and electrical devices in the circuit to actuate the valve are the principal devices embodied.

750,492. Electric Clock. Fred Schmidt, Oak Station, Pa., assignor of one-half to Henry Bauer, Lock No. 3, Allegheny County, Pa. Application filed May 9, 1903.

An insulated impulse wheel is adapted to engage with

pulse thereto, another device bearing against the wheel for opening and closing the circuit when the wheel is operated.

750,497. System of Electrical Generation, Distribution and Control. Elmer A. Sperry, Cleveland, Ohio, assignor to the National Battery Company, Jersey City, N. J., and Buffalo, N. Y. Application filed December 5, 1902.

Current-controlling devices are operated by fluid pressure. A motor operates the pump and is in circuit with the generator. Between the motor and the generator is a switch with a non-centralizing device acting upon it to throw it quickly past its center of movement.

750,500. System of Electrical Generation, Distribution and Control. Elmer A. Sperry, Cleveland, Ohio, assignor to the National Battery Company, Jersey City, N. J., and Buffalo, N. Y. Application filed July 1, 1903.

Translating devices in circuit with the generator, a storage battery in parallel circuit with the generator and an electromagnetic device to control the regulating devices are the features of the invention. The electromagnetic device has one winding in a shunt from the battery, a second winding in series with the generator and the translating devices, and a third winding in series with the generator and the battery.

750,509. Electrical Conductor. William H. Wherry, Cleveland, Ohio. Application filed November 3, 1902. Renewed October 1, 1903.

An electrical conductor is made up of two conductors, a length of wire to serve as an electrical connector between the two conductors, and cast-metal terminals interposed between the wire and the conductors, the terminals inclosing the ends of the wire, each terminal being cast integral with the wire and a conductor.

750,510. Process of Forming Electrical Rail Bonds Directly in Place on the Rails. William H. Wherry, Cleveland, Ohio. Application filed January 22, 1903. Renewed October 1, 1903.

A process of forming electrical rail bonds directly in place on the rail consists in locating the wire in position and casting a terminal on the wire and rail and continuing to pour molten metal upon them until they are sufficiently heated and softened to allow of the intimate and permanent union of the metal and rail. The heat of the fluid metal which forms the terminal is used to heat and soften the rail, making the terminal and rail integral with each other.

750,525. Transformer. Augustine R. Everest, Lynn, Mass., assignor to the General Electric Company. Application filed August 11, 1902.

Two bowed members hinged together at one end and provided with engaging extensions at the other end form the core of the transformer. The engaging extensions have engaging surfaces greater than the cross-sectional area of the main portion of the core. (See cut.)

750,543. Heat Alarm. Howard F. Jones, Wilson, N. C. Application filed April 13, 1903.

A contact arm on the front end of a rod mounted to [illegible] on the inner end of the tube. A thermostatic coil has one end connected to the rod and its other end connected to the cap. Index pointers connected with contact screw points on the arm indicate their set positions.

750,549. System of Electrical Generation, Distribution and Control. Lamar Lyndon, New York, N. Y., assignor to the National Battery Company, Jersey City, N. J., and Buffalo, N. Y. Application filed January 22, 1903. Renewed December 8, 1903.

An accumulator in parallel circuit with the generator and an electromagnetic device to actuate the controlling devices are the main features. The electromagnet device has a fine-wire winding connected with the terminals of the accumulator and a coarse-wire winding in series with the generator.

750,550. System of Electrical Generation, Distribution and Control. Lamar Lyndon, New York, N. Y., assignor to the National Battery Company, Jersey City, N. J., and Buffalo, N. Y. Application filed July 18, 1903.

Combined with a generator are means to regulate the electromotive force of the generator. Translating devices are in circuit with the generator. A storage battery in parallel circuit with the generator, an electromagnetic device in circuit with the generator to control the regulating means, and means normally inoperative and controlled by the voltage of the battery and generator circuit to vary the magnetization of the electromagnetic device are essential parts. (See cut.)

750,554. Ballast Device for Vapor Lamps. Henry N. Potter, New Rochelle, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed October 19, 1901.

A [illegible] a gas or vapor path within the same, [illegible] a container and a similar gas or vapor path in series with [illegible] self-regulation serve as a ballasting device for the lamp.

750,560. Electric Time Alarm. Theophilous L. Bear, Camden, N. J. Application filed September 27, 1901. Renewed August 8, 1903.

A [illegible] driven by the clock makes one revolution in 24 hours. This pinion carries a stud which throws a switch [illegible] pointer on the dial of the clock.

750,584. Process of Administering Electrical Vibrations. Fred H. Brown, Los Angeles, Cal. Application filed August 25, 1902.

A process of subjecting an animal organism to electrical action consists in passing a continuous electrical current through the organism and rhythmically varying the strength of the current without affecting its continuity.

750,594. Magnet. Henry F. Campbell, Boston, Mass., assignor to the National Magnetic Mineral Separating Company. Application filed May 16, 1901.

Parallel horseshoe-shaped bars have a portion of their contacting faces cut away to form an air space, the upper ends of the bars being serrated. A pole piece adjustably mounted upon the lower ends of the bars is also serrated adjacent to the upper ends of the bars.

750,617. Air Door. John T. Deviese, Crownhill, W. Va. Application filed July 30, 1903.

An electromagnet co-operates with a mine door. Intermediate actuating mechanism is placed between the electromagnet and the door. A tappet bar extends under the door longitudinally of the track. Spring-pressed bars normally press the tappet-bar laterally in one direction, while contact pieces and plates are arranged in pairs and placed in contact when the bars are retracted.

750,646. Combined Electrical-battery Receptacle and Bell Support. William A. Harvey, Scranton, Pa., assignor of two-thirds to Charles Schlager and Walter L. Schlager, Scranton, Pa. Application filed September 9, 1903.

A case for battery cells is described having openings in the proper positions for the connecting wires.

750,689. Plug for Telephone Switchboards. Frank D. Pearne, Chicago, Ill., assignor to Pearne, Krum & Co., Chicago, Ill. Application filed April 20, 1903.

Supplemental circuit wires lead to the plug. Means automatically control the passage of current through the terminals of the supplemental-circuit wires and comprise a movable body carried by the plug and shiftable by gravity to make and break connection through the terminals as the plug is shifted to and from its normal position and into and out of the switchboard jacks.

750,704. Telephone Switching and Signaling Apparatus. Malcolm C. Rorty, Dedham, Mass., assignor to the American Telephone and Telegraph Company, New York, N. Y. Application filed January 3, 1902.

Two conductors electrically unite corresponding contacts of the terminal plugs. A source of current in a bridge between the conductors, and two signal devices associated with the plugs respectively are operated by a relay in the bridge controlling the current supplied to the signal devices. Two relays are in circuit with the cord conductors, one on each side of the bridge, the relays controlling shunts of the signals respectively, determining the display or withdrawal of the signals.

750,716. Electric Fan. Adolph T. Smith, New York, N. Y., assignor of one-half to Myron B. Matthews, Passaic, N. J. Application filed August 10, 1903.

A motor, the shaft of which is vertically arranged, rotates a fan in a horizontal plane, a casing surrounds the fan and is formed of a cylindrical lower part having openings in its bottom. The top part is conical and an annular opening is placed between the lower part and top part. (See cut.)

750,722. Insulator. Louis Steinberger, New York, N. Y. Application filed May 25, 1903.

An outer casing is provided with a constricted portion and a body of insulating material, disposed within the casing and provided with a portion mating the constricted portion of the casing. The body of insulating material has an indentation mating similar ones in the casing, but smaller, for the purpose of supporting the cable out of contact with the casing.

750,723. Binding Post. Louis Steinberger, New York, N. Y. Application filed June 22, 1903.

The binding post comprises a member with a stem having several portions immovable relatively to each other and of different diameters, and separate fastening mechanisms engaging the portions of different diameters for the purpose of separately securing wires to the members.

750,733. Trolley Pole. John J. Tartt, Los Angeles, Cal. Application filed March 30, 1903.

Vertical movement of the trolley pole is secured by an adjustable arm. A second arm pivoted to the first arm on the upper side carries a trolley harp attached, a spring being placed between the arms adapted to cause their free ends to separate.

750,753. Electric Furnace. Rámon C. Contardo, Sèvres, France. Application filed August 24, 1900.

Surfaces of the hearth are upwardly inclined at each side of the center with electrodes above. An arch arranged above the hearth and electrodes and formed by two surfaces sloping downwardly from the center and forming the bottoms of feed flues, the feed flues communicating with the outer ends of the hearth, and a charging shaft constitute the essential parts.

750,765. Electric Motor. Thaddeus W. Heermans, Chicago, Ill. Original application filed December 4, 1899. Divided and this application filed January 22, 1900.

Combined with a rotative armature and rotative field magnet are two wheels or pulleys through the medium of which power is transmitted from the motor to the apparatus to be driven, one of the wheels or pulleys being driven by the field magnet and the other by the armature. A change-speed mechanism between the rotative armature and field magnet is connected with the rotative parts in such a manner that when the speed of one of the parts is retarded the speed of the other is correspondingly increased, and vice versa, and the available power of the motor remains constant. (See cut.)

750,769. Telephone-service Apparatus. Uriah S. Jackson, Ossipee, N. H., assignor to the Superior Automatic Telephone Company, Boston, Mass. Application filed May 31, 1902.

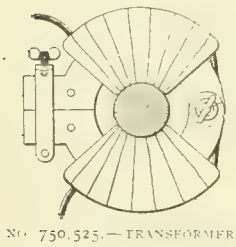
The apparatus is operated by clockwork. Upon pressing a lever the circuit is closed and the recording apparatus set in motion at the same time.

750,770. Telephone-service Apparatus. Uriah S. Jackson, Boston, Mass., assignor to the Superior Automatic Telephone Company, Boston, Mass. Application filed April 22, 1903.

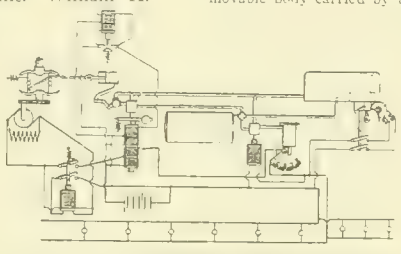
A circuit make-and-break mechanism operates the device by means of a pawl and ratchet attachment driven by clockwork.

750,777. Apparatus for Selective Signaling. Kenneth Moodie and John S. Small, Chicago, Ill., assignors of one-fourth to Richard H. Pierce and Samuel G. Neiler, Chicago, Ill. Application filed September 13, 1902.

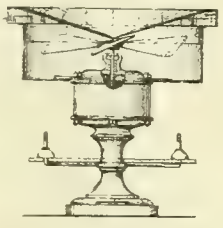
Combined with a main circuit and an operating circuit are a number of electromagnets, each wound with a helix interposed in the main circuit and a complementary helix interposed in the operating circuit. The helices of each pair are so arranged that, when both circuits are closed, either helix may be used to neutralize the electromagnetic effect of the other upon the magnet. Connected with the operating circuit are means for modifying the operating circuit current, whereby any of the operating circuit helices may, at will, be given from the operating circuit a current which shall operatively neutralize the effect of the main-circuit current on the magnet about which the helix is wound.



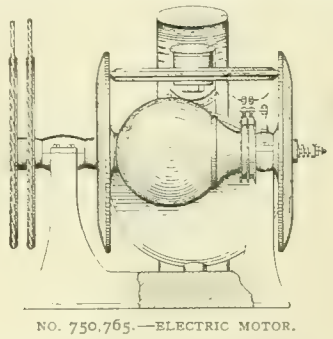
NO. 750,525.—TRANSFORMER.



NO. 750,550.—ELECTRICAL GENERATION AND DISTRIBUTION SYSTEM.



NO. 750,716.—ELECTRIC FAN.



NO. 750,765.—ELECTRIC MOTOR.

REISSUE.

12,195. Electrical Accumulator. Chaimsonovitz P. Elieson and Vladimir de Bobinsky, Paris, France. Application filed October 26, 1903. Original application filed February 4, 1902.

In an electric accumulator plate is a central conductor and two series of strips of thin metal electrically connected thereto and disposed on opposite sides. The strips are constructed and supported so that the movement of their outer extremities due to contraction and expansion may be [illegible] the plane of the plate.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on February 1, 1904:

[illegible] Electric Arc Lamp. Howard L. Pyle, Akron, Ohio.
350,795. Terminal for Incandescent Lamps. Marmaduke M. M. Slattery, New York, N. Y., assignor to the Sun Electric and Illuminating Company, Manchester, N. H.
356,796. Contact Piece for Electrical Apparatus. Marmaduke M. M. Slattery, Woburn, Mass., assignor to the Sun Electric Light Company, Woburn, Mass.
356,834. Electric Motor. William W. Griscom, Haverford [illegible].
356,850. Electrical Call System. John D. Peachey, Denver, [illegible].
356,859. Multiple Switchboard System of Telephone Exchanges. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.
356,878. Electric Motor. Edwin J. Houston, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut.
356,902. Armature for Dynamo Electric Machines. Elihu Thomson, New Britain, Conn., assignor to the Thomson-Houston Electric Company, Boston, Mass.
356,903. Electric Arc Lamp. Elihu Thomson, Lynn, Mass.
356,940. Electrical Weighing Scale. Willis M. Hunt, Glen Gardiner, N. Y.
356,963. Circuit-Closing Apparatus for Electric Brakes and Other Devices. Elias E. Ries, Baltimore, Md., assignor to Edward O. Punchard, Boston, Mass.
356,964. Method of Operating Electric Brakes. Elias E. Ries, Baltimore, Md., assignor to Edward O. Punchard, Boston, Mass.
356,981. Insulating Underground Electric Conductors. David Brooks, Philadelphia, Pa.
357,038. Autographic Telegraph. James H. Robertson, Rutherford, N. J.
357,039. Autographic Telegraph. James H. Robertson, Rutherford, N. J.
357,050. Lightning Protector for Electrical Conductors. Jonathan H. Vail, New York, N. Y.
357,051. Automatic Telephone Switch. Frank C. Watkins, Philadelphia, Pa., assignor to the United States Krotophone Company, New York, N. Y.
357,052. Telephone Signal. Frank C. Watkins, Philadelphia, Pa., assignor to the United States Krotophone Company, New York, N. Y.
357,053. Telephone Hook. Frank C. Watkins, Philadelphia, Pa., assignor to the United States Krotophone Company, New York, N. Y.
357,054. Telephone Receiver. Frank C. Watkins, Philadelphia, Pa., assignor to the United States Krotophone Company, New York, N. Y.
357,055. Automatic Electric Cut-Off for Water Pipes. Leopold Weil, New York, N. Y.
357,056. Electric Method of Detecting Water Overflows. Leopold Weil, New York, N. Y.
357,109. Electric Interlocking Mechanism for Switches and Signals. George Westinghouse, Jr., Pittsburg, Pa.
357,115. Commutator Adjuster for Dynamo Electric Machines. Charles L. Buckingham, New York, N. Y.
357,165. Automatic Electrical Signal Coupler. John S. [illegible], New Orleans, La.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, FEBRUARY 13, 1904 No. 7

Electric Transportation of Freight in Chicago Tunnels.

Quite a twentieth-century project is that of the Illinois Tunnel Company, which purposes to use the tunnels of the Illinois Telephone and Telegraph Company, to which it has succeeded, for the carriage of merchandise by a narrow-gauge electric-railway system under the streets of the city of Chicago. These tunnels were built by the telephone company under an ordinance passed by the City Council on February 20, 1899, by which a franchise for the use of the streets for an opposition telephone company was granted. Under the terms of this franchise a network of large, substantially constructed tunnels was built (is building still, in fact) under the streets of the downtown business district. These tunnels have walls of concrete and are of horseshoe shape. They are of two sizes—trunk conduits 11 feet 2½ inches wide and 12 feet six inches high, inside measurement, and lateral conduits six feet wide and seven feet six inches high, inside measurement. The smaller tunnels are constructed with 13-inch bottoms and 10-inch walls. The trunk tunnels have 21-inch bottoms and 18-inch walls. The roofs of the tunnels are not allowed to come closer than 24 feet six inches from the surface of the street. These tunnels contain the cables for an automatic telephone system now in operation and already serving between 4,000 and 5,000 stations. The cables are strung along the walls of the tunnels on each side and room is left on the floor for a track or tracks of a railway system. Appreciating this fact, the Illinois Telephone and Telegraph Company secured from the City Council last July an ordinance—carefully safeguarded in the city's interest—by which it was given permission to construct and operate in the tunnels and conduits already constructed and in those to be constructed under the franchise, not only telephone appliances, but also apparatus for the transmission of freight, such as newspapers, mail matter, packages, parcels, merchandise and coal. Under this amended franchise the Illinois Tunnel Company, a new corporation, succeeded, so recently as last month, to the property, rights and privileges of the Illinois Telephone and Telegraph Company, both as to telephone service and railway operation. A map of the central or "Loop" district of Chicago showing the tunnels now built and the location of the postoffice and freight depots is given as Fig. 2 on the next page.

Naturally electric power will be used for the operation of the tunnel-railway system. The plans are still in a tentative state, but enough has been determined upon to form the basis of an article of interest to the readers of the Western Electrician.

Two miles of experimental railway has been built already in parts of the tunnel system in the vicinity of the automatic telephone exchange building in Fifth Avenue. The gauge of the track is 24 inches, and 56-pound rails are used, mounted on ties set on cast-iron chairs embedded in the concrete floor of the tunnel.

Much consideration has been given to the style of car and electric locomotive to be used for the work, and since this matter has not yet been decided fully it will be impossible to give complete details of this part of the installation at present. However, the general dimensions are decided upon, together with the most important features, and out of a number of cars and locomotives submitted for trial it has been possible to determine fairly well about what type will be used.

The cars will be of steel and iron construction throughout and will be 12 feet in length over all. They will be of the double-truck eight-wheel type. The design calls for a combination car which can be used either as a gondola or a flat car, and which shall be so constructed that coal may be dumped without removing either sides or ends.

As a box car one of these vehicles will be 48 inches in width and will stand 63 inches above the rails, while the length of the box will be 10 feet six inches. These dimensions give ample room for piling on considerable loads. Fig. 1 shows a train of loaded cars, which, though not of the (as yet) adopted type, have the general dimensions and appearance of those which will ultimately be used.

When it is desired the end and side pieces may be removed and a flat car is the result, sockets being supplied for stakes when necessary. Merchandise of all kinds and coal can be handled, and, the smaller portions of the tunnel network being seven feet six inches high by six feet wide, enough room is left at the sides and above the cars to allow of considerable piling up of the packages. The weight capacity of the car is 30,000 pounds.

FIG. 1. ELECTRIC TRANSPORTATION OF FREIGHT IN CHICAGO TUNNELS.—EXPERIMENTAL TRAIN AT TUNNEL INTERSECTION

As the tunnels now pass under all of the downtown streets, turnouts will be unnecessary, and most of the traffic will in all probability be on the loop system. The cars are so constructed that they are enabled to turn upon a curve of a 15-foot radius. Each of the cars will be provided with the latest automatic M. C. B. coupler.

For motive power the electric locomotive has been decided upon and train operation will therefore be necessary. The locomotive will be operated by a single motor, and the whole is of low and compact construction. Figs. 3 and 4 show respectively a side and front view of one of the types of locomotive being experimented with by the company. As in the case of the cars, though not the officially accepted type, this locomotive represents what seems now to be the most practicable construction, and the one finally accepted will not be far from the general style and size of the one shown in the two pictures.

Third-rail operation has thus far been used in the trials, the rail consisting of a steel strip about half an inch in thickness by four inches wide,

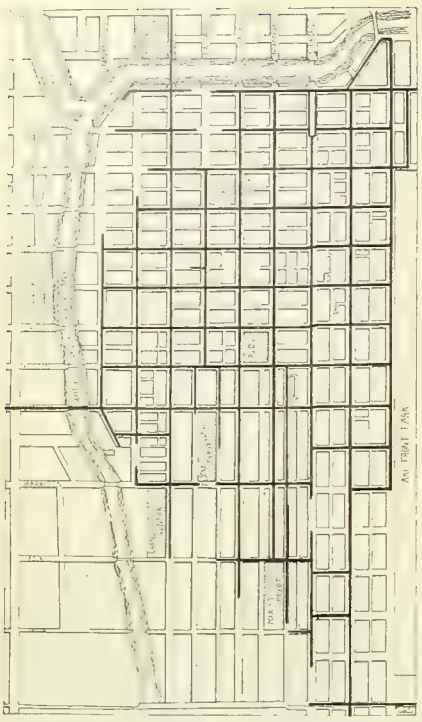


FIG. 2. MAP OF CENTRAL BUSINESS DISTRICT OF CHICAGO SHOWING (IN HEAVY LINES) NETWORK OF TUNNELS.

clamped between insulating wood stringers laid lengthwise in the center of the track, as shown in Fig. 3. This rail furnishes not only the current for the locomotive but the means of moving the locomotive also, for it is provided with openings for cog wheels, which are mounted on the under side of the locomotive. This much has been decided for a certainty—a rack-and-pinion system will be used, the wheels only carrying the weight. A speed of between 15 and 20 miles an hour is attained. In all probability the combined rack and third rail will be mounted between the track rails, as shown, but there is a possibility that it may be found advisable to mount it on the side walls.

Power for the trains will be furnished by a 5,000-horsepower generating plant, for which the company is now about to let the contract. Direct current at 250 volts will be used to operate the locomotives, the rails acting as a return. At present power for experimental purposes is supplied by the Chicago Edison Company.

Many of the large downtown concerns have already asked for connections with the tunnel system, though none has been put in as yet. The connecting shafts when built will lead from the tunnel floor directly up to the level of the building to be connected, and a plunger type of elevator will be installed capable of lifting the entire car and its load, rendering the labor of handling goods a minimum.

The company expects to place orders for 150 locomotives and 3,000 cars as soon as the tunnels are supplied with tracks and ready for train operation.

It is expected that the tunnel railways will go far to relieve the congestion of the downtown business streets. As is well known, of course, Chicago is one of the great railroad centers of the world, 25 trunk lines radiating from it. Six freight depots receive the goods traffic of these railroads, and they are all within a territory 1½ miles square. The city freight traffic is enormous and has much to do with the crowded condition of the streets. Then, again, it is estimated that 4,000,000 tons of coal is burned annually in the Loop district, and this is largely delivered by teams. The tunnel company will endeavor to divert much of this traffic to its railways, not only to its own benefit but to that of the city as well, by relieving the congestion.

An officer of the Illinois Tunnel Company said: "Unless these railroad terminals and freight yards are to be driven out or bridged in some way there are but two directions for the business center to extend—skyward and earthward. The tall buildings indicate that the pressure has exerted itself in one direction, and the underground-transportation project, together with the decision of some architects to design buildings with a sub-basement on a level with the tunnels 40 feet below the surface, to be used as freight yards for the buildings, marks a start in the downward direction."

The Illinois Tunnel Company expects to have its plant in shape to deliver not less than 50,000 tons of freight a day by the beginning of next year. Already contracts are being drawn to go into effect on July 1st for the delivery of coal and removal of ashes from some of the large office buildings. It is said that the cars and tunnels will carry anything that will pass through the door of any freight car in use. It is the intention of the company to extend the tunnels to the outlying districts of the city, with an ultimate system of perhaps 90 miles, nearly 20 miles being now built. President Wheeler states, however, that until the transfer business is placed on a paying basis in the present downtown system no extensions will be made except as necessary to connect basements of buildings and freight yards.

Considerable attention has been paid to the possible carriage of mail matter in the tunnels between the postoffice and railroad stations. Nothing definite, however, has been done in this direction.

The Illinois Tunnel Company has authorized capital stock of $30,000,000 and a bond issue of like amount. Of the $30,000,000 in bonds provided only $15,000,000 has been issued, the remainder being held in reserve for future extensions of the tunnels and transportation and telephone plants.

The officers of the company are: President, Albert G. Wheeler, Chicago; vice-president, C. D. Simpson, Scranton, Pa.; general manager, George W. Jackson, Chicago; secretary, Edward W. Gearhart, Scranton, Pa.; treasurer, John C. Law, Pittston, Pa. President Wheeler is the moving spirit in the enterprise, and to his enterprise and sagacity, ably supplemented by the work of General Manager Jackson, the scope and development of this great undertaking are largely due.

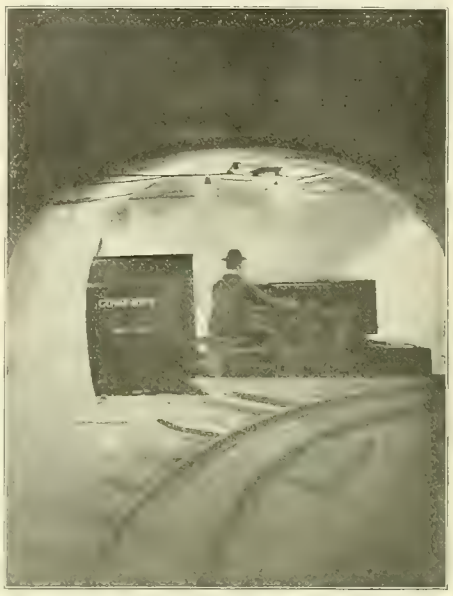


FIG. 3. ELECTRIC TRANSPORTATION OF FREIGHT IN CHICAGO TUNNELS.—SIDE VIEW OF EXPERIMENTAL LOCOMOTIVE.

FIG. 4. ELECTRIC TRANSPORTATION OF FREIGHT IN CHICAGO TUNNELS.—EXPERIMENTAL TRAIN (END VIEW).

Zinc Reduction in Wisconsin.

Zinc has been mined to a limited extent in Southwestern Wisconsin for many years, but recent discoveries have added interest to the locality. At present the chief mines of the section are located at Mineral Point. There are three processes used at the Mineral Point Works, which is a large reduction plant. One process makes use of sulphuric acid, and this is one of the few plants in the country where what is known as the "contact process" of manufacturing sulphuric acid is employed. This process, which is of German invention, minimizes the cost of the acid and allows the use of mixed ore. The fumes were formerly confined in lead-lined rooms, about 20 cubic feet of space being required per pound of sulphur burned per hour. By the new process these chambers are discarded and other improvements—trade secrets, however—have lately been made. The result is that the Mineral Point Works are now able to use a grade of ore that they formerly refused to buy.

The roasting process, which is the second means of separation in use, is one that has lately been widely applied in Colorado. It consists of roasting the ore until the iron becomes magnetic and then picking it out with magnets.

The third process, which was likewise developed in Colorado, though invented in Kansas, is an application of the principles of static electricity to the concentration of ores. The direct effect is the opposite of that produced by the magnets in the roasting process, for the electricity repels the zinc instead of magnetizing the iron, but the process results, in both cases, in the separation of the minerals in the ore. The electrical method is simpler and cheaper. The expense of roasting the ore, which amounts to about one dollar a ton, is saved. In addition to the zinc blende, an iron sulphide is also obtained, which is sold to the manufacturers of sulphuric acid, so that the process thus affords a valuable by-product.

The new fields discovered extend down into Illinois, and it is expected an industry of considerable magnitude will be developed.

Opening of the Intramural Railway at St. Louis.

As very briefly announced in the Western Electrician of last week, the Intramural railway at the St. Louis Exposition was recently opened. The opening took place during the convention of the American Association of General Passenger and Ticket Agents, when the first car was sent over the entire line, carrying the director of works, the engineers of the exposition and members of the visiting association as guests. The cars, one of which is shown in the accompanying illustration, were furnished by the St. Louis Car Company and were delivered to the exposition on the morning of the test. The power was furnished from the feeders of the St. Louis Transit Company, as the Intramural plant to be located in Machinery Hall has not yet been installed. The greater portion of the track has been in place for some months, and has been used in handling building materials and exhibits, the gauge, four feet 8½ inches, permitting the transfer of standard freight cars over the entire line. As the greater portion of the track is not elevated, current is taken from a trolley wire instead of a third rail.

The trip of seven miles was made without accident, and the grades were encountered without difficulty. Arriving at the Inside Inn, the immense hotel located in the southeast corner of the grounds, the party was entertained at dinner by F. M. Statler, manager of this enterprise. Among those present were F. I. Whitney, general passenger agent of the Great Northern and president of the American Association of General Passenger and Ticket Agents; George H. Daniels, general passenger agent of the New York Central; A. J. Smith, general passenger agent of the Lake Shore, and D. B. Martin, general traffic manager of the Baltimore and Ohio. The exposition was represented by Secretary Stevens, Director of Works Taylor and Traffic Manager C. L. Hillery.

World's Fair Notes.

Cale Gough, formerly with the Union Traction Company of Indiana, is now connected with the Department of Electricity of the St. Louis Exposition.

The automobiles operating in the exposition grounds are doing a thriving business, especially on Sundays, when over 1,500 visitors are carried. From 15,000 to 20,000 paid admissions are not uncommon on Sundays, and, as the automobile trip offers an excellent opportunity to obtain a good idea of the extent and principal features of the exposition, the vehicles, which seat 12, are nearly always filled.

The Exposition Transportation Company of Winona, Minn., is making elaborate plans to serve the Upper Mississippi River region, and for that purpose is organizing a fleet of steamers and barges, which will be fitted up in the most modern and approved manner, serving as hotels during the stay in St. Lous. It is planned to spend a week coming down the river, the boats then being moored to private piers during the week that will be spent at the exposition.

The largest organ ever built has just been tested by the maker, the Murray M. Harris Organ Company of Los Angeles, Cal., which reports that it is perfect in every respect, and that the tone is all that could be desired. This mammoth instrument will be installed in Festival Hall, where a series of recitals will be given during the exposition by the greatest organists of this country and Europe. Fifteen large furniture cars will be required for the shipment, although the case will be made in St. Louis. The organ will contain 10,500 pipes and 140 speaking stops.

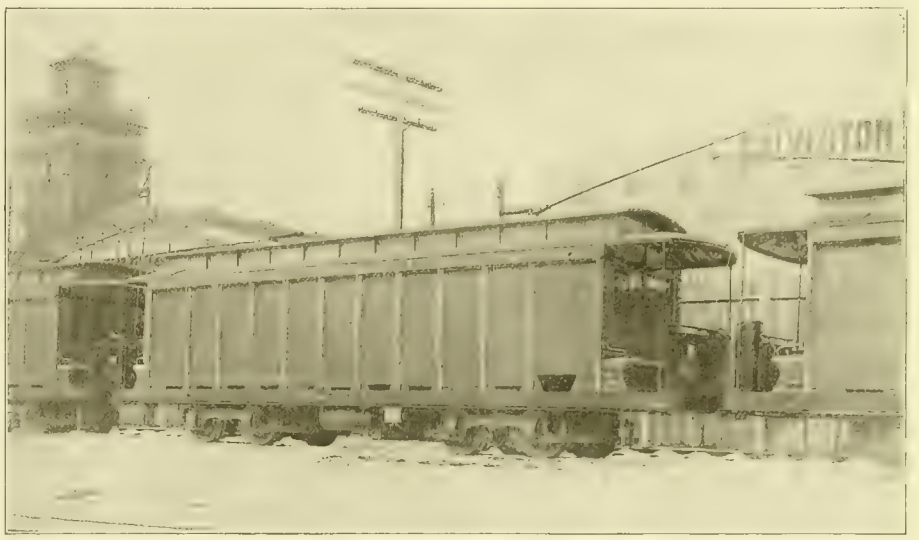
Paul F. Williams, who for the last six years has been connected with the Chicago Edison and Commonwealth Electric Companies, has accepted a position on the staff of the Department of Electricity and will act as superintendent of the Palace of Electricity. Mr. Williams will have direct charge of all exhibit installations, and is well qualified, by reason of his duties in Chicago, to deal with the very complex problem presented, as during the next three months several hundred carloads of exhibits will be received, and executive ability of a high order will be required to bring the installations to a successful conclusion.

The Pennsylvania Railroad Company has begun the erection of the locomotive-testing plant that is to be the main feature of the exhibits in the Transportation Building. The installation will be modeled after that forming a portion of the equipment of the School of Locomotive Engineering of Purdue University, and which has been for the last 12 years the principal locomotive-testing laboratory in the United States. Professor Goss, dean of the Schools of Engineering of Purdue University, is prominently identified with the Pennsylvania testing plant, where it is planned to run comparative tests on a score of representative locomotives from the world's best builders during the exposition period.

The first exhibitor to begin work in the Palace of Electricity is the Kellogg Switchboard and Supply Company of Chicago, which will install a working exchange in its space in the southwest section of the building. Previous to the erection of the big exhibit switchboard, a smaller temporary one will be used; this is now being set up, and will be ready for service by the middle of the month. The instruments of the various departments, concessions, fire-engine houses, etc., will be connected to this exchange, from which trunk service will be extended to the Kinloch exchanges in St. Louis. Long-distance connection will also be made with the Independent toll lines.

The Missouri Building, the largest of the state buildings, is now practically complete, even to the mural decorations. One of the features of equipment is the refrigerating plant, installed by H. H. Humphery, a well-known consulting engineer of St. Louis. This plant, constructed by the United Iron Works of Springfield, Mo., is located in the basement and is designed to reduce the temperature of the entire building to 70 degrees in the hottest weather. Two motors are required for the operation, one of 20 horsepower driving the fan which blows the air over the frosted coils into the rooms above, the other, of 30 horsepower, being connected to a compressor, used in liquefying the ammonia with which the cooling is effected. The test showed the installation to be entirely satisfactory.

The first exhibit to be installed in the Mines and Metallurgy Building has arrived, and will soon be in place. It is a 90,000-pound safe, made by the Manganese Steel Safe Company of New York city, and, because of its great weight, was shipped from New York in a special car, such as is used in the transportation of United States ordnance. This car, owned by the Pennsylvania Railroad, came over that railroad from the factory in Plainfield, N. J., in charge of William Lindgren, a special engineer, who will superintend the erection. The safe is 10 feet four inches long, nine feet wide and nine feet high, and weighs, complete, with doors, safe-deposit boxes, interior fittings and floor, 150,000 pounds. This is one of the heaviest safes built, and will occupy a position immediately in front of the main entrance of the building. Special foundations have been provided, and the entire installation will cost $55,000. Boxes will be provided in this safe for the safekeeping of gems, ingots, bars and bricks of precious metals, and other valuable exhibits, and these will be allotted to exhibitors by the Department of Mines and Metallurgy. The door of the safe weighs 10½ tons and swings on a crane hinge, with roller and ball bearings, and is so delicately adjusted that it can be swung by a child. Twenty radial bolts shot by a screw device and controlled by a Yale & Towne time lock, will form the main protective element. The same company will supply the safe to Collector J. W. Dunn, who will receive the revenues of the exposition.



CARS ON INTRAMURAL RAILWAY AT ST. LOUIS EXPOSITION.

Injunction on Tesla Patents Denied.

Judge Seaman of Milwaukee has decided the motion for injunction made under Tesla patents Nos. 381,968, 381,969, 382,280 and 382,281, which are the Tesla polyphase patents. The suit was brought against the National Electric Company of Milwaukee, and the device involved was that company's polyphase-synchronous motor. Judge Seaman found that the complainant has not made out such a case of infringement as is required in a matter of this kind. The case was argued on January 6th and 7th by Thomas B. Kerr and Parker W. Page for the Westinghouse Electric and Manufacturing Company, complainant, and E. H. Bottum and Charles A. Brown for the defendant. This is the first adverse decision that has been rendered upon the broad Tesla patents involved in this suit.

Track Rails and Track Construction.

The familiar but important question of the weight and characteristics of rails for street-railway tracks in city streets came up as a recent feature of the long discussion of the Chicago traction muddle. It will be remembered that in his report on the Chicago transportation problem, presented to the Chicago City Council, a little over a year ago, Mr. B. J. Arnold, as consulting engineer, recommended for asphalt, brick or granite-paved streets a nine-inch grooved girder rail weighing about 135 pounds to the yard. Discussing the same subject a few days ago Mr. Arnold said:

"Wear upon any track is caused almost entirely by the pressure of the wheels upon the rails. It can, therefore, be understood that heavy cars will produce greater wear upon a track than light cars, and this wear always develops first at the joints where the rails are fastened together. The nearer the joints can be made to approach the stiffness of the rail the nearer perfect the track and the less the wear due to the weight of the cars will be. The construction of a durable track to carry the heavy rolling stock of modern electric railways involves the use of rails of sufficient depth and section to resist bending under the loads put upon them. The depth of the rail in first-class construction is also regulated in some degree by the character of the pavement and its foundation. The rail which seems to be the most suitable to meet all requirements has a depth of nine inches. The yokes used in the construction of nearly all of the cable tracks in Chicago were designed for shallower rails. The track rails supported by these yokes range from seven inches to four in depth."

Richard McCulloch, assistant general manager of the Chicago City Railway Company added this: "The ordinary weight of girder rails will run as follows in height and weight: 4½-inch rail weighs 55 pounds per yard; six-inch rail, 75 to 80 pounds per yard; seven-inch rail, 85 to 95 pounds per yard; nine-inch rail, 95 to 120 pounds per yard. The differences in weight for the same height arise from differences in the width of the base, the thickness of the web, the strength of the head and the kind of head used. Experience has demonstrated that with a modern 20 or 25-ton car it is necessary to have at least a 100-pound rail if good service is to be given. If a rail lighter than this is used, with frequent service of heavy cars, it has not sufficient stiffness, and this lack of stiffness soon results in loss of alignment in the track, wearing out of the head of the rail, loosening of the paving beside the rail, low joints, broken rails and a shaking up of the rolling stock as it runs over the track."

Marconi Plans Overland Test.

It is said to be Mr. Marconi's intention to make a test of his space-telegraph system at long distances overland. For this purpose the inventor is erecting a station at Fraserburgh, in Scotland, with a view to establishing communication with his Cornwall station at Poldhu. The Scotch station, however, will also be used for communication with ships, and it is ultimately intended to establish communication between the North of Scotland and Iceland. Mr. Marconi was in Fraserburgh last month, but will shortly cross the Atlantic on a visit to his space-telegraph installations on the St. Lawrence River.

"Wrinkles" for Central-station Managers.

In central station practice obstacles come up not infrequently which may possibly be overcome by the exercise of a little ingenuity on the part of the operating engineer with the use of home-made appartus constructed at slight expense. Obviously examples of ready resource of this sort are of general practical value, and Mr. Charles H. Williams, general superintendent of the Madison Gas and Electric Company of Madison, Wis., is doing a service to the whole fraternity in collecting and editing such "wrinkles" for a report which is to be a feature of the convention of the National Electric Light Association to be held in Boston next May.

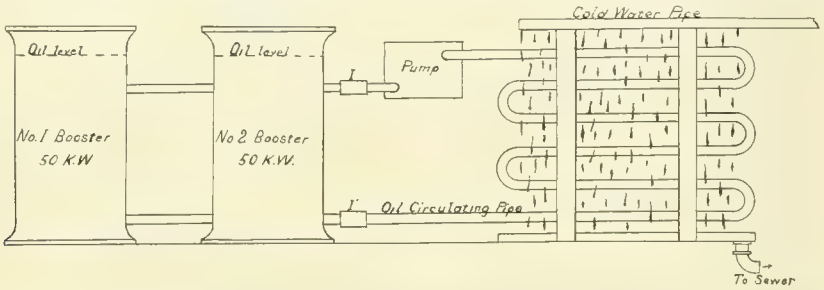


FIG. 1. "WRINKLES." COOLING APPARATUS FOR OIL TRANSFORMERS.

Following are three sample "wrinkles" which will be of interest to the readers of the Western Electrician, who are, in their turn, urged to contribute to Mr. Williams' collection.

Home-made Oil-cooled Transformers.

For maintaining a low temperature in the oil of two heavily overloaded booster transformers the device shown in Fig. 1 may be used to advantage. These boosters are connected to 1,000-volt bus bars and are designed to transmit 50 kilowatts at 2,000 volts. A rapid increase in business on the circuits fed by the boosters made it necessary for them to handle a load 2½ times their normal capacity, and in so doing caused them to run dangerously hot. New apparatus was ordered, but the usual delay incident to ordering special apparatus from the large electric manufacturing companies caused some alarm lest the boosters burn out before the new apparatus arrived, so this scheme was resorted to. It consists essentially of a small circulating pump which draws the cooling oil from the boosters near the top of the oil level and forces it through the system of piping shown in the diagram. Water dripping from a pipe above the radiator keeps the pipes cool by running down on the outside, being caught at the bottom in a pan which drains to the sewer. By adjusting the speed of the pump the oil can be maintained at any desired temperature above that of the cooling water. At the points (I) (I') insulating joints, consisting of short pieces of rubber hose are placed in the circulating system.

Previous to this arrangement the temperature of the oil was in one instance 180° F., whereas afterward it was maintained below 75° F.

A Trouble Transformer.

It frequently happens that it is necessary to install a transformer at some point on the distributing

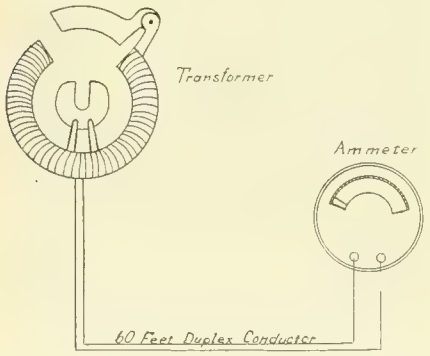


FIG. 2. "WRINKLES."—PORTABLE AMMETER.

system where the delay due to the labor of getting a transformer out of the storehouse and hanging it is a very serious matter.

This may occur at the time of the burning out of one of the regular line transformers, or an exceptionally heavy demand may be brought upon some particular district, say for a day or two, which will require a considerable increase in transformer capacity over that which is normally demanded. Considerable expense and labor as well as delay can be prevented by having a transformer of large capacity mounted upon a light wagon and housed in, so that it is impossible for people walking along the street to touch the transformer or lead wires.

At the station where this scheme is put into service a 60-kilowatt transformer is connected up with leads thoroughly insulated, which are taken out of the top of the housing covering the transformer; a locked cabinet contains the switch and fuses for both primary and secondary sides, and the transformer leads are fitted with clamp connectors of large bearing surface. In case of a transformer burnout, but a few minutes are required to back the wagons up to the pole, clamp on the connections and close the switches, the regular trouble men doing the work without the assistance of the line gang.

The housing is wired on the outside, and red lamps placed in the sockets guard against the wagon being run into by passing vehicles at night should it be necessary to let it stand in the street over night.

Line Ammeter.

Fig. 2 represents a "line ammeter," which is a convenient instrument for the use of central-station operators.

The instrument is used to measure the current flowing in a conductor, although it is unnecessary to open the circuit to measure it. The great value of this instrument lies in its ability to determine instantaneous demands on transformers and to determine as to whether the loads are properly balanced on the two sides of three-wire secondary network.

The apparatus consists of a series transformer wound on a two-piece iron ring, so arranged that a small segment of the ring on which there is no winding acts as a hinge to be opened and closed over the conductor carrying the current. Connected to the transformer coil is a 60-foot length of duplex flexible cable ending in terminals, which fit in the binding posts of a suitably calibrated ammeter, which reads the load in amperes direct.

To operate the instrument a lineman carries the small coil—weighing about two pounds—up the pole to the secondary leads and snaps it on, while a man on the ground reads and records the amount of current flowing. The use of this instrument will also show up miscalculations as to division of load which takes place in secondary network, no matter how carefully it may have been estimated.

To Change the Diameter of a Dynamo Pulley for Obtaining Synchronous Speeds.

Where it is difficult to obtain pulleys of exact relative sizes for synchronous operation of generators the diameter can quite easily be increased one-half an inch by means of a paper covering. To do this the pulley—no matter what material it is made of—should be thoroughly cleaned of all grease and oil and the surface roughed up by scraping or draw filing. Heavy manila paper cut to the right width is glued on to this surface, being careful to have the glue hot and not too thick. Press the paper firmly down on to the pulley face in starting and then draw the paper tight as the pulley is turned, pressing and pounding the surface carefully as each additional section is glued. When one complete cover is fastened to the face of the pulley the glue is applied to the exposed surface of the paper and the operation continued, being careful to see that no bubbles or wrinkles are left on the surface.

If it is desired to make a crown on the pulley, this can be done by gradually narrowing down the width of the sheets which are being glued. This glued paper addition to the pulley forms a substantial, lasting surface and makes a very good surface for the belt to drive upon.

Water and Electric Power in Isère, France.

Writing from Grenoble, France, in November, 1903, United States Consul Nason says: "Last year I wrote of the utilization of the power in the glacial and mountain streams of the Alpine region of France. The utilization of this force in distributing electric energy is transforming the conditions of labor and lifting Isère into one of the most important departments in France. It is estimated that the hydro-electric energy obtained through waters already 'harnessed' is equal to 75,000 horsepower, while the hydraulic factories, more than a hundred in number, in which the water similarly 'harnessed' is utilized directly, represent a horsepower rising from 20,000 in the year 1880 to 140,000 in 1900. By the end of this year the city of Grenoble will have installed its new system of electric lighting from a waterpower source 27 miles distant, in the valley of the Romanche. At the present time the electric cables are being laid throughout the city. These cables are two inches in diameter, tar covered, and all placed three feet underground and covered by a layer of tile plates. An abundance of light, heat and power at a greatly reduced cost will thus be available for distribution.

During the first half of the year the street-car lines from Grenoble to Sassenage, Uriage-les-Bains and Vizille, heretofore served by steam 'dummies,' were operated by electricity. At Vizille, the old historic chateau, with its lake and park—the work of the renowned Lesdiguieres 300 years ago, and whence issued the first flame of the French revolution—is now undergoing transformation at the hands of an English company and will be opened as a first-class hydro-electropathic establishment next season."

Constant-power-factor Regulator.

Arc-circuit regulation presents many difficulties, particularly series arc regulation. A constant-power-factor regulator is a piece of apparatus which has never been quite attained. Therefore, it is interesting to note that Malcolm H. Baker of East Liberty, Pa., has patented and assigned to the Westinghouse Electric and Manufacturing Company such a regulator to be used on alternating circuits, being especially intended for arc-lighting work.

For regulating alternating-current arc lamps in series, use has been made, among other things, of a transformer having a movable secondary coil adapted to assume various positions relative to a fixed primary coil, and a practically constant current has been sought to be maintained in the secondary circuit by thus altering the number of leakage lines of force between the coils. In practice, however, it is found that the power factor of a circuit of this kind is decreased as the load is decreased, so that at one-quarter load, for instance, the system would still be absorbing the full terminal potential of the circuit at the same operating current as at full load, and although the actual energy consumed would be less, yet it is evident that the conditions would not be favorable for economical commercial operation. The attempt to remedy the defects of this system by the use of contacts which are movable

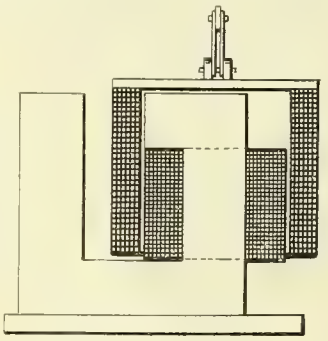


FIG 1. CONSTANT-POWER-FACTOR REGULATOR.—CROSS-SECTION OF MOVABLE AND STATIONARY COILS.

upon the secondary winding of the transformer is attended with other difficulties, such as that of a multiplication of the parts, a complication of the apparatus, and excessive sparking and wear where the movable contact travels over the various stationary contact points connected with the secondary winding.

The object of Mr. Baker's invention is to bring about constant-current regulation in alternating-current series circuits by a device which shall maintain a practically constant power factor at all loads, be automatic in action, and be free from moving electrical contacts or other complications.

A sectional view showing the parts in the position they occupy at approximately full load is shown in Fig. 1, and Fig. 2 is a side elevation showing no-load position.

Referring to the drawings it will be seen that a U-shaped iron core of suitable dimensions is provided, and upon one leg of the core are mounted two coils, the inner one of which is stationary and the other movable, the coils being so arranged that one of them may completely inclose the other.

The fixed coil may be taken as the primary coil of a transformer connected with some suitable source of supply, as shown in Fig. 2. The movable coil may be made the secondary of the transformer and be placed in series with a number of arc lamps or other electrical translating devices.

When the movable coil is in its lowest position, completely inclosing the fixed coil, the device is simply a static transformer of the open magnetic-circuit type. Any movement of the secondary coil away from the position described will result in carrying a portion of the secondary coil out of the direct magnetic field through the iron core, and this portion will to a great extent become inoperative so far as the action of transformation is concerned. If the two coils shall have been so wound that the secondary and primary voltages are equal when the movable coil is completely inclosing the fixed coil, and if the movable coil is then raised to

a position where half its turns are above and out of the magnetic field through the iron core, it is evident that the active turns of the movable coil are halved. If the movement be still further continued and the movable coil be raised until it is completely outside the magnetic field, there will be no action of transformation, and hence the secondary voltage will be zero.

As the active turns of the secondary coil are decreased in this way the local reactance of the fixed coil increases until at the position of complete removal of the secondary coil the primary coil is simply an inductance across the electrical source of supply of such amount that the current flowing is negligible. In other words, the action of the primary coil is the same as takes place in the primary of any static transformer when the number of turns of the secondary coil is varied.

In passing through the various steps from a position of completely inclosing the primary coil to a position of complete removal from the magnetic field the voltage of the secondary varies from a maximum to a minimum, as does the current of the primary. Now, since the apparent primary watts are also diminished in this way, the ratio of the true primary to the apparent primary watts constituting the power factor remains approximately constant.

It is possible to provide a mechanical force which shall so act upon the secondary coil as to carry it automatically into such a position with relation to the primary coil and the core, after any change of resistance takes place in the external circuit of the secondary, that the secondary voltage shall always be of such value as to maintain practically constant current. This mechanical device is illustrated in Fig. 2 as a weight attached to one end of a bent lever, the other end of which is secured by a link to the top plate or cap of the secondary coil.

The position which the coils occupy when the secondary completely incloses the primary is the position of full load. Should a lamp or other translating device be switched out of the external circuit the voltage in the secondary circuit will tend to drop and an impulse of repulsion between the movable coil and the fixed coil and core will be set up, this impulse at first of considerable value. When, however, other lamps are switched out and the secondary coil travels still farther away from the primary coil the repulsive effort diminishes. If, therefore, the mechanical force represented by the weight is to vary automatically so as to bring the secondary coil to equilibrium at a point where it will maintain constant current after changes in the resistance of the external circuit have been introduced, it is evident that the counterweight or force must act so as to increasingly assist the repulsive force by substantially the same amount as the repulsive effort de-

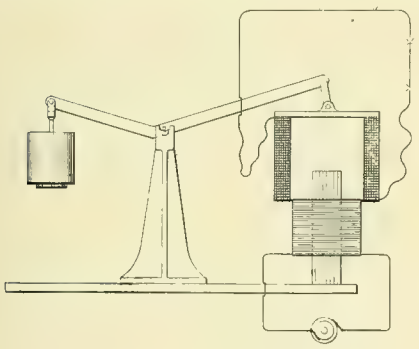


FIG. 2. CONSTANT-POWER-FACTOR REGULATOR.—GENERAL VIEW OF APPARATUS.

creases with increments of travel in the movable coil. The arrangement illustrated in Fig. 2 is one which meets these requirements. It will be seen that as the movable coil travels upward and away from the fixed coil the weight increases in effect, owing to the angle which is given to the lever. This angle is a critical angle and its value may be determined mathematically or experimentally.

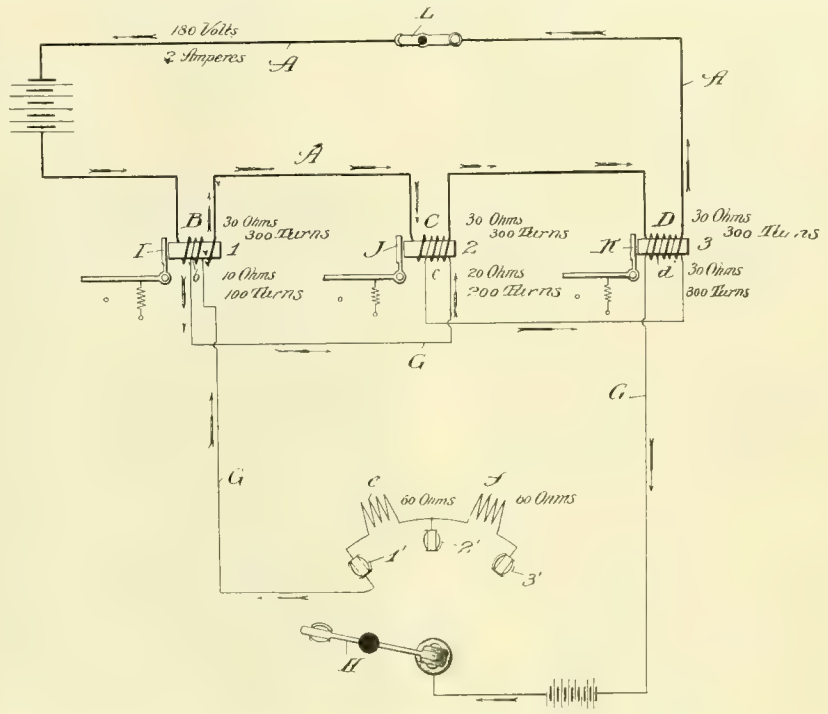
Western Union-Bell Litigation.

Everett W. Burdett of Boston has been appointed as a special master to review the matter of the dispute between the Western Union Telegraph and American Telephone and Telegraph companies. Judge Colt of the United States Circuit Court in Boston has ordered that the defendant account and report to Mr. Burdett such evidence as either party may request and that both parties produce before the master all deeds, books, papers and writings in their custody to be examined as the master shall direct. As readers of the Western Electrician are aware, the dispute relates to the amount of certain royalties, the Western Union company having been successful in its main contention.

Moodie-Small Selective Signaling System.

An ingenious method of selective signaling is one just patented by Kenneth Moodie and John S. Small, both of Chicago, and assigned to Richard H. Pierce of Boston and Samuel G. Neiler of Chicago.

Broadly speaking, the idea embodied consists in placing in one circuit a number of solenoids energized wholly or in part by windings in the circuit. In a second or operating circuit is a second set of windings, each one so arranged as to be able to neutralize the effect of the corresponding coil in the other circuit, when supplied with the requisite



MOODIE-SMALL SELECTIVE SIGNALING SYSTEM.—DIAGRAM OF CIRCUITS.

current. The electromagnets serve to operate local circuits for the devices which do the signaling. The system is adapted for telephone party-line signaling, for use with electrically operated semaphores, in block systems, electrical transmission in typewriting, etc.

A device embodying the invention may be constructed in any one of several ways. For instance, the coils in the primary circuit may be arranged in series, each coil having the same number of turns as every other and each one being supplied with a current having the same amperage as that flowing through the other main-circuit coils. When so arranged, the neutralizing coils interposed in series in the second or operating circuit will differ in number of turns from each other, and by any well-known convenient means affecting the operating circuit the amperage of the current supplied to the operating coils may be varied at will, so that a current may be supplied to any one of the operating coils, which shall serve to neutralize the electromagnetic effect of its complementary main-circuit coil without neutralizing others of the main-circuit coils. So, also, if desired, the main-circuit current may be so shunted that certain main-circuit coils will receive a current of different amperage from other main-circuit coils, in which event all the coils in each circuit may be of uniform number of turns, the amperage of the operating current being varied at will by the operator as before, to enable him to neutralize any of the main-circuit coils. So, also, the coils may be arranged in series or in multiple and the details of the windings may be varied in numerous ways familiar to a practical electrical engineer, and the amperage of the current may be varied by varying the voltage or by varying the resistance, or both.

Although it has been stated that the coils are so arranged with regard to each other than an operating coil will "neutralize" its complementary main-circuit coil or will have the "same number" of ampere-turns, it will be understood that it is only necessary to neutralize the effect of the main-circuit coil to such an extent as shall permit the armature spring or other force acting upon the armature in opposition to the pull of its magnet to draw such armature away from the magnet to any desired extent.

By referring to the accompanying diagrammatic view of the apparatus, its operation will be made clear. In the drawing, (A) represents what will be termed the "main circuit." For most uses of the apparatus this main circuit will be normally closed, as shown, thereby providing a continuous current flowing in the direction indicated by the arrows around the circuit and through the coils (B) (C) and (D). The coils may be simple solenoids or may be wound about cores.

The "operating circuit" (G) is normally open and is controlled by means of the switch (H), arranged to close the circuit at will through contacts (1') (2') and (3'). Arranged in the circuit (G) and between the contacts are resistances (e) and (f). Interposed in the operating circuit (G) are coils (b) (c) and (d) of different resistances. Coils (b) (c) (d) are so arranged that when the operating circuit is closed the current will flow through them in a direction opposite to that of the main-circuit current flowing through the coils (B) (C) (D).

With the parts arranged in their normal position, it may be assumed, merely for convenient illustration, that each of the coils (B) (C) (D) has 300 turns and offers a resistance of 30 ohms. Disregarding, therefore, any additional incidental resistance in the circuit, the total resistance in the circuit will be 90 ohms. If the circuit (A) is supplied with a current at 180 volts, it follows that with a total resistance in the circuit of 90 ohms there will be a current of two amperes, which will give 600 ampere-turns in each of the coils (B) (C) (D). Assume that (b) (c) (d) in the operating circuit have 100, 200 and 300 turns and offer a resistance of 10, 20 and 30 ohms, respectively, or a total resistance of 60 ohms. If, now, the switch (H) is closed to contact (1'), and thereby the circuit (G) is supplied with a current of 360 volts, a current of six amperes will flow in the operating circuit. This current of six amperes, passing through coil (b), having 100 turns, will give 600 ampere-turns, which will exactly neutralize the 600 ampere-turns in (B), which has 300 turns, and is supplied with a current of two amperes. It follows, however, that the operating current of six amperes supplied to coil (c), having 200 turns, will produce 1,200 ampere-turns, which will reverse the magnetism of core (2), and the same current will produce 1,800 ampere-turns in coil (d), which will reverse the magnetism of core (3).

If it is desired to release armature (J), the switch (H) is turned to contact (2'), throwing the operating current through resistance coil (e) of 60 ohms resistance, whereby the total resistance in circuit (G) is increased to 120 ohms and the amperage is reduced to three. This current of three amperes supplied to coil (b) will only produce 300 ampere-turns, which will be insufficient to neutralize (B); but this current of three amperes, passing through coil (c) of 200 ohms resistance, will produce 600 ampere-turns, which will neutralize the effect of coil (C) and will release armature (J), while the two-ampere current will produce 1,200 ampere-turns in coil (d) and will consequently reverse the magnetism of core 3.

While the control of but two local circuits for operating telephone bells or semaphores has been shown, it may be readily seen that the system could be made to apply to a large number of solenoids by having the necessary current-varying devices.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

Ohio Independent Telephone Association (annual meeting), Grand Hotel, Cincinnati, February 17th to 19th.

National Electric Light Association (annual meeting), Boston, May 24th to 26th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

THE practicable gas turbine seems to be still some distance in the future, but an English engineering journal describes briefly an adaptation of the idea which is interesting. It consists of a turbine operated by the exhaust of a gas engine. The turbine consists of a pair of disks, the one fixed and the other revolvable, the latter having a single ring of semicircular, under-cut pockets. The fixed disk is secured against the machined face of an intermediate casting provided with a saddle adapted to bear upon the heat-conducting ribs of an internal-combustion engine. The gas-engine piston is arranged to overrun a port admitting the exhaust gases to passages in the intermediate casting, and thence to the pockets in the revolvable disk. From these pockets the gases pass to an intermediate chamber, and then through an exhaust passage to the atmosphere. The circumference of the rotating disk is provided with ventilating vanes, suitably located to cause a suction of air, through specially arranged annular apertures, to the cooling jacket of the cylinder. No data are given of the economy and efficiency of this novel combination. Without further information one will be apt mentally to assign it to the vast chamber containing the curiosities of mechanics.

BEFORE a Swedish scientific society Mr. G. Granqvist recently read a paper on the thermic conductivity of electric-arc electrodes. His conclusions are of interest. Carbon arcs show in many respects great differences from arcs between metallic electrodes, these differences being striking when the arc is maintained by alternating currents. Whereas, for instance, no difficulty is encountered in producing carbon arcs by means of alternating currents if both electrodes are of carbon, or metal arcs in the case of one electrode being of carbon and the other of metal, it has so far been impossible to maintain an arc between two metallic electrodes by means of alternating current of ordinary voltage and frequency. As this seems to be due to the great difference in thermic conductivity of carbon and metal electrodes, the author has investigated the role incumbent on the thermic conductivity of electrodes with both direct-current and alternating-current arcs. In alternating-current arcs it is found that the state of equilibrium is alternately stable and unstable. In the latter case both the electrodes and the arc itself are found to be cooled, and if this cooling exceeds a certain limit, the arc ceases. The smaller the energy supplied in the stable state, and the greater the thermic conductivity of the electrodes, the higher will be the rate of cooling of the arc, and the shorter the unstable period, provided the arc does not cease. The thermic conductivity of the electrode is thus found to play a much greater part with alternating than with direct-current arcs.

MUNICIPAL TELEPHONY is not such a burning question in the United States as in Great Britain, but it forms a very live topic of discussion in Evansville, Ind., a prosperous city having over 59,000 inhabitants in 1900. In that city the Bell licensee company is unpopular, and an effort is under way to establish a municipal telephone system, or, at any rate, a system operated by a corporation in which the city shall be largely interested. This is a very bald statement of the case, for there have been suits and counter-suits at law, measures of various sorts by the city authorities, mass meetings and discussions, until the situation has become a complicated one. At present injunction proceedings instituted by a former judge are about to be heard in the Superior Court at Princeton, on change of venue, in which the right of the city to become a party to a "private-stock municipal telephone company" is in issue. It is now asserted that the sentiment in favor of the so-called municipal telephone exchange has materially diminished during the last few weeks, due somewhat to the signal illustration of the failure of municipal ownership and operation of the local waterworks. This plant has not paid the interest on the bonded debt nor a cent of revenue into the city treasury, and now, it is said, an engineering blunder is to cost the city $50,000 to make the plant serviceable. These facts are set up as arguments against municipal ownership and operation of any other public utility. It is charged that the three members of the board of control are each drawing a salary for giving the waterworks the amount of attention they can spare from their private business; that a superintendent and force of employes, holding position by reason of political service, all draw good salaries; that expert engineers living far away are frequently called into consultation, and that the most visible result of the efforts of the whole combination is the extravagant size of the fees charged. What reason, it is asked, with considerable force, is there to doubt that a municipal telephone exchange will not be conducted in the same way, with similar supernumeraries and like experience. It is pointed out, too, that a municipal exchange would labor under great disadvantage in being unable to give long-distance connections. On the whole, the idea of giving municipal telephone service is losing ground—and this is what generally happens, in this country, when the question of municipal ownership and operation of public utilities is given dispassionate study. But the telephone situation in Evansville is a peculiar, many-angled affair, and it is impossible to foretell the final outcome, which will be awaited with great interest.

ELECTRIC freight delivery in tunnels 25 to 30 feet below the level of the streets is a feature of the industrial life of Chicago that may be expected to be in service in less than a year's time. The preparations that are making for this work, utilizing the fine system of tunnels built by the Illinois Telephone and Telegraph Company, are interesting and form the subject of the leading article in this issue of the Western Electrician. The telephone system itself is of much interest, because it utilizes a large automatic exchange; it has been described in several articles previously published in this journal. But the freight-delivery development is of later date, and the first illustrated description of the work under way is given in this number. It is to be understood that the tunnels are in existence only under the streets of the downtown business district, but this busy center is pretty well covered, as is shown by the map. This is, of course, the portion of the city that is most congested by traffic teams. This district is surrounded by six large railroad freight depots, and all of these sources of present street traffic are reached or can be reached easily by the tunnels. Another conspicuous source of street congestion in the downtown streets is coal teaming, and it is apprehended that a great deal of this traffic can be done through the tunnels on the cars of a narrow-gauge electric railroad. The tunnels are comparatively deep-level ones, and it is proposed to bring goods from them to the basements of office buildings and other structures by elevators, although it is suggested that future buildings may be constructed with sub-basements or sub-sub-basements extending down to the tunnel level. Another promising possibility is the carriage of mail between the main postoffice, the downtown branch postoffices and the railroad stations. It is also evident that the newspapers might make use of the tunnels in sending their mail editions to the trains. In fact, it is apparent that the tunnel freight service proposed has manifold opportunities of great usefulness and that it ought to reduce materially the number of heavy teaming wagons on the downtown streets.

Physically, the project presents no obstacles or particularly new problems. It is simply an adaptation and expansion of the electric railway as already in use in mines. But it will be, of course, a much more comprehensive and carefully worked-out system than any mining installation. It will be a narrow-gauge railway system rather than a tramway. One particularly interesting feature is the adoption of the rack-and-pinion to furnish traction, the rack of this apparatus also doing service as one side of the electrical circuit supplying current to the motors. This combination is certainly a novel one, so far as we are aware. It economizes space and material. The rack is probably adopted because the small locomotive will not possess weight enough to pull the heavily laden cars by adhesive friction alone. The whole project is one of great interest, not only to engineers, but to all interested in municipal problems as well. It is rather remarkable that while Chicago is in a disgracefully backward state so far as its surface transportation is concerned, it led all American cities—and all other cities, in fact, with the exception of Liverpool—in the adoption of the elevated electric railway, while now it is blazing the way in a subterranean system of electric freight transportation.

Effect of the Baltimore Fire on Electrical Interests.

On February 7th and 8th one of the most disastrous fires in the history of the country occurred in Baltimore. For 27 hours the flames raged in the heart of the city, destroying its finest buildings and laying waste to property of a value variously estimated from $75,000,000 to $125,000,000. Firemen and apparatus from cities as far away as New York were hurried to the scene, but seemed to be unable to make headway against the flames until they had partially burned themselves out.

Electrical properties in the city received a severe blow along with the rest. The United Railways and Electric Company, which operated 354 miles of electric railway in and about the city, met with most serious losses. As soon as the flames reached the great power house there was a terrific explosion and the building and its machinery were wrecked and were soon a mass of flames. Of course all street-car service is stopped, for even if a temporary plant could be put into shape the streets are a mass of wreckage and wires of every description are in a tangle.

The power house of the United Electric Light and Power Company, an allied concern, was also destroyed. It was a large and expensive plant.

Telephone service was suspended, for many of the exchanges were burned. The building of the Maryland Telephone Company (Independent) was destroyed. The Mount Vernon Telephone Company lost its exchange, as did also the Chesapeake and Potomac Telephone Company (Bell).

Great credit is due to the telegraph companies for maintaining the service that they did under the conditions. The Western Union and Postal Telegraph-cable Companies' main offices were destroyed. Within 12 hours after the fire started both companies were helpless. By daylight on the 8th, however, there were linemen on the ground from Philadelphia, New York and Washington in charge of the superintendents and managers of these districts, and in less than six hours the Western Union company had established three offices—one at Camden station for the southern circuit, another on North Eutaw Street for the western business, and a third at the corner of Saratoga and North Streets for the northern circuit.

The Postal company, whose main office was in the Continental Trust Building, was forced to vacate its office, but before daylight the company had established quarters at Orleans and Fort Streets, where business was handled almost as smoothly as usual.

The volume of business handled was enormous considering the difficulty encountered by both companies in repairing their broken wires. Never was a body of linemen more handicapped. A short time after the flames began to spread all the electric-light wires were prostrated. When night came on the linemen were left in utter darkness. This did not deter them in their perilous work. The men mounted the poles and literally felt their way through the network of wires with death near at hand. Their remarkable task was rewarded later by a complete straightening out of all wires without a single accident to a lineman.

Chicago Automobile Show.

The third annual automobile show held under the joint auspices of the National Association of Automobile Manufacturers and the Chicago Automobile Club is being held at the Coliseum as the Western Electrician goes to press, the closing day being set for February 13th. The show this year is far ahead of any of the preceding ones held in Chicago, and many of the manufacturers and fanciers do not hesitate in pronouncing it the most successful ever held in this country. Every available space, even to the annex and galleries, is taken up, and the exhibits of automobiles and accessories display a marked degree of advancement for 1903. It is distinctly an American show, but few foreign ideas being displayed. All the large manufacturers are represented, and some of the fine cars on exhibition are conceded, in nearly every detail, to be equal to any of the foreign machines. The exhibits are tastefully arranged, and, with the profuse use of electric lights, presents an attractive picture. A more detailed account of the electrical exhibits will be given next week.

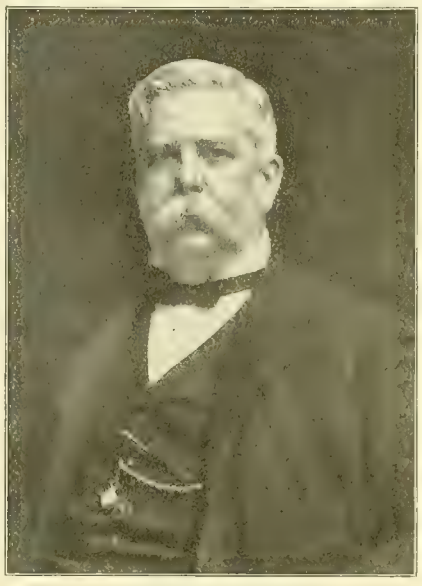
A 49-year franchise has been granted to the Illinois Central Electric Railway for the construction of tracks and operation of cars in the city of Canton, Ill. At least one mile of the railway must be in operation by December, 1905.

George Westinghouse.

Portraits of George Westinghouse are not frequently published, for Mr. Westinghouse is not a man who has sought publicity, although when he has had anything to say that he considered of general interest he has taken the straightforward course of expressing his views in a letter over his own signature in the public press. Readers of the Western Electrician will be interested in the accompanying picture, therefore, which is a late and excellent likeness. It is reproduced from the Electric Club Journal, the new organ for the Electric Club of Westinghouse employes.

At a recent dinner given in Pittsburg for the district managers of the Westinghouse Electric and Manufacturing Company, Mr. Frank H. Taylor, vice-president of the company, spoke in a feeling yet manly and judicious way about Mr. Westinghouse—his work and his characteristics. He described his chief as a mechanic, an inventor, a financier, a friend of labor, a tireless organizer and a founder of enduring industries, and among other things he said:

"Some of the peculiarities which have aided him



GEORGE WESTINGHOUSE.

to acquire his present position may be illustrated. For example, it is unusual for an inventive genius to be so perfectly open-minded to the inventions of others. I sometimes think he is as happy over the discoveries of other minds as though they were his own. He has found a means for the development of new inventions all his life. Great intellects have worked for him, been encouraged and protected by him. I name at random Shallenberger, Tesla, Scott, Parsons, Nernst, Ruud, Cooper Hewitt, Thomas, Davis, Bremer, Lamme, Wurts, Lange.

"His mind is constantly reaching out into the future, and after one has been much with him it becomes practically impossible to live altogether in the present, because there is brought to view at every turn possibilities of new things yet undeveloped which are to serve future generations at a time when the world has advanced far beyond its present stage.

"There is always present the evidence of good will toward everyone—a quick appreciation of the good points of other people. In the course of his life he has been forsaken by friends, who lacked courage to follow him, and in its main crisis he was greatly hampered by heart-breaking incidents of this kind. Yet no one has ever heard him say an unkind word of these men. His foresight is phenomenal. The industries in this country have grown up even faster than seemed wise to a great many who were associated with him. They did not see the value of what he was doing as clearly as he saw it, and time alone has justified the thoroughness with which plans have been laid, buildings designed and executed. Energy and expense have not been spared upon any of his works. They have been developed in such a way that they can be extended forever.

"No sooner had provision been made for this country than many of his closest friends were startled by a move upon Europe and the markets of the world. Some men have charged this move to a mere ambition to plant his name in Europe. They wondered that he should tax his resources and take upon himself the tremendous strain which has finally resulted in the great organizations and plants in England, France, Russia and Germany.

"The associates who questioned his wisdom did not have his foresight and did not see that these things were necessary for the protection of the initial developments in the United States. I give no importance to my own judgment in this matter, but Mr. Westinghouse knew that the foundations here would have been insecure had not the foreign field been entered during his period of maximum activity. We shall live to see all the effort justified, and the Westinghouse interests the world over fitting together and helping one another."

Chicago Street-railway Situation.

The tentative ordinance for the Chicago City Railway Company is still in the hands of the committee on local transportation. In considering the various provisions, with a view of reporting to the council, nearly all details have been disposed of, but some of the more vital points threaten a break in the conferences. A disagreement has arisen among the members of the committee in regard to the term of the ordinance and the large issue—compensation—is causing no end of trouble. John P. Wilson, special attorney for the city in the franchise-extension case, called the attention of the committee to Judge Tuley's recent decision in the Union Elevated Loop case, in which he holds that the city has no right to charge a direct money compensation for a street-car franchise. This has created the impression that if the judge's opinion is correct the insertion of a money compensation clause might vitiate the entire ordinance.

To facilitate its deliberations in arriving at a just solution of the compensation clause in the Chicago City Railway ordinance the committee has been gathering a wide range of statistics, including official documents, authoritative publications, reports of commissions and the statistics and reports of the United States census office on street and electric railways. From these statistics Alderman Bennett and other members of the local transportation committee have prepared the following table showing relative figures in various cities:

Company.	Receipts, Per Car mile in Cents.	Passengers Per Car-mile	Wages Per Hour in Cents.	Per Cent. Op Expenses to Receipts.
Boston Elevated	24.5	4.86	22½	69.06
Brooklyn Rapid Transit	24.3	4.52	21	58.50
Chicago City	14.5	3.85	24	55.20
Cleveland Electric		4.19	22	56.04
Denver City Tramway		4.80		57.00
Detroit United Railway		4.03	23½	56.64
International, Buffalo		4.25	18	52.01
Louisville Railway Company		3.63		69.00
Manhattan Railway Co., N. Y.	99.8	19.02		48.86
Metropolitan Street Ry., N. Y.	34.1		22½	48.40
Milwaukee E. R. & L. Co.		5.14	21	59.35
New Orleans Railway Co.		2.58		64.00
Philadelphia Rapid Transit Co.	23.6		19	47.36
Pittsburg Railway Company	24.7	4.91	21	57.00
St. Louis Transit Company	20.7	4.15	20	51.85
Twin City, Minn.		4.80	20	47.50
Third Avenue, New York	11.0	6.89	22½	48.00
Toronto, Canada				†55.50
United R. R. San Francisco		5.75	25	59.00
Union Traction, Chicago		5.08	24	57.00
U. R. & E. Co., Baltimore		5.66	14½ to 16	43.00
United Traction, Albany		7.65		67.00
Union Traction, Philadelphia	23.0	5.47	19	45.39
Washington Railway & Electric				52.06

*Includes electric lighting. †Includes taxes, not including paving.

The amount of compensation will, it is stated, depend upon the cost of operation and of reconstruction. The aldermen contend that the company's estimates of cost of operation have been too high.

New trouble has broken out between the Chicago Union Traction and its underlying companies. Unless some unexpected turn takes place in the situation, it is said, a majority instead of a minority of the stockholders threaten open rebellion against the receivers. The dividends due on the North Chicago Street Railway stock on January 15th are not paid, it is pointed out. New dividends on the West Chicago Street Railway Company stock are due February 15th. There is also complaint because the hearing before Master in Chancery Bishop has not yet begun.

Turbine Engine Competition.

Naval engineers have invited competition between two American steam-turbine manufacturers for the supply of turbine engines to drive the 4,000-ton scout ships for which estimates have been submitted to Congress. The naval engineers contemplate the largest installation of steam-turbine power ever placed on any ship. It is a question of weights, to be determined by the manufacturers' proposals, whether these vessels shall be given 16,000-horsepower turbines, affording a speed of 24 knots an hour, or whether it will be possible to place in their hulls 20,000-horsepower turbine engines, which will drive the vessels at a rate of 26 knots an hour. Rear Admiral George W. Melville, retired, ex-engineer-in-chief of the navy, has sailed for Germany and Great Britain to study turbine machinery.

Electricity in Gardening.

The Boston (Mass.) Market Gardeners' Association, with a membership of 150 market gardeners of Boston and suburbs, held its annual meeting recently, at which the use of electricity in various ways in the cultivation of truck gardens was discussed. President W. W. Rawson, [illegible] a paper, in the course of which he [illegible] ments are constantly being made in heating and fertilizing methods, and with the application of electricity to the soil [illegible] for electric lights, much greater improvement will be made in quality and quantity of crops." He pointed to the electric plow, electric automobile, private electric freight cars and rural telephony as among the leading possibilities [illegible] ket gardening.

Alternating-current Railway Motors.

The papers read at the last New York meeting of the Institute—"The Alternating-current Railway Motor," by Charles P. Steinmetz, and "Speed-torque Characteristics of the Single-phase Repulsion Motor," by Walter I. Slichter—were printed in full in the Western Electrician of last week. An abstract of the discussion that followed the reading of the papers is given herewith.

B. G. Lamme, Pittsburg: In September, 1902, I read a paper on the subject of the single-phase railway. In that paper I described primarily a single-phase-railway system and mentioned in the paper there were two types of motor suitable for such work. Both had the proper characteristics for railway work—one a straight-series motor and the other what is called the repulsion motor—and in that paper I described in a general way the series motor. This evening we have had a description of the other type of motor. The development since that time has been almost entirely in the direction of such a single-phase system, and the advantages of using alternating current seem to be thoroughly appreciated all over the world at the present time. The motors mentioned at that time were both of the commutator type, with closed-coil windings on the armature, like direct-current machines.

In the description of these motors I have always considered that there was one class of motor suitable for railway work—that is what we call particularly the series motor. By series motor I mean a motor with the series characteristics—one in which the field varies automatically with the change in load in the armature. These classes of motors could be subdivided into two classes, one of which would be called a straight series, the armature directing the field, and the other should be called a transformer series. This could be again subdivided into two classes—one with the transformer external to the motor and the other with the transformer in the motor. The second division is what is described this evening as the repulsion motor, and I have considered that that motor has the true characteristics of the series motor.

In a straight-series motor we can consider that there are two principal voltages—one voltage will be the one taken up crossing the field, and, as there is very little energy in the field, that can be considered as principally inductive. The other voltage will be taken across the armature windings, and in that case the commutated windings we have had described would be considered part of the armature windings.

The direction of improvement on such a motor is to increase the armature turns and decrease the field turns or decrease the armature turns compared with the field. The field turns can be decreased to any extent by proportioning the machine properly. For instance, if the air-gap is decreased a given amount the turns will be decreased; if the air-gap is larger you can also decrease the field voltage. Increasing the armature turns will do the same thing, so that that relation would be carried as far as desired, and any power factor desired can be obtained on a straight-series motor by some such means. In comparing published results, which do not give any data as to the proportioning of the machine, we can draw no proper conclusion, whether the design is good or bad, because it may be that a small air-gap is used to account for the result, or it is a very large machine. The real point, however, in such motors, to secure results, is a question of the increased turns in armature or decreased turns in field, or a high ratio of armature to field.

Coming next to the transformer type of motor, where you have the transformer type of motor in series with the field, such a motor will have the general characteristics of both a straight series and of the repulsion. In coming down to lower speeds, or even zero speeds in the transformer motor, we put current directly into the armature, and the amount must be equal to the current going through the field. In such a motor the current in the armature will not be exactly the current in the primary, unless it is extremely well designed.

Coming next to the repulsion motor, we put the primary of the transformer on the field core at practically right angles to the magnetizing or field winding. That winding acts as the primary to the transformer and the secondary on the rotating core. That motor would have very many properties of the transformer type of motor, and all of them will have very similar properties in a general characteristic.

In speaking of keeping the inductive volts as low as possible, there is one thing to be kept in view—the saturation of the machine must be kept relatively low. Saturation means high excitation, and that means higher induction, and therefore the alternating motor of either the repulsion or straight-series type is usually designed to run at low saturation, and at low saturation it will have torque characteristics better than an ordinary series motor, as that is partly saturated, and therefore the claims made in Mr. Slichter's paper, that the alternating motor had better characteristics, should be charged, to a large extent, to the unsaturated condition of the motor. We can make a direct-current motor with as good torque characteristics, but it requires an unsaturated machine.

In the design of the repulsion motor, for good performance, it is necessary to do the same thing as in other motors, namely, increase the ampere turns on the transformer element compared to the ampere turns on the field. I have gone over the curves in Mr. Slichter's paper and checked them back on the basis that the field excitation was all wattless and the armature non-inductive, and I find that the wattless component as the speed falls is represented by somewhat more than the exciting component, indicating that we could assume that the field was wattless, which is a condition which in the series motor would give similar performances. The results I get from that are not extremely accurate, because, in checking back over these curves in Mr. Slichter's paper [Figs. 8 and 11 in article of last week], there were inconsistencies, so that I could not get a good checking. For instance, taking note of the motor in Fig. 11, multiplied by the power factor and efficiencies, we should get the output; and multiplying the speed and torque we should also get the ouput; but they did not check at all—there were variations as high as 10 per cent. in the two, and that modifies the comparison. In Fig. 8 I find similar results—the curves do not check. In going over these curves and checking the power factors, especially in Fig. 11, I find that at 300 revolutions the wattless component is approximately 20 per cent. greater than it should be from field excitation alone, if you consider the field entirely wattless, and basing it on 500 revolutions, figuring the field as wattless at that point, then at the lower speed the increased wattless component corresponds to something like 20 per cent. more than would be accounted for by the field, indicating that the armature must be to some extent inductive.

Going back to the transformer type of motor, it is to be noted that the armature current would not, if this is a bad transformer, be equal to the current in the armature of the series motor, assuming a 1 to 1 transformer. Therefore, at starting, we would get in this armature a poorer starting commutation than we would in a straight-series motor. For the same current at starting slightly less torque could be obtained on this form than in the series motor, but for the same torque there is a greater ampere input. I have found in some cases as much as 30 per cent. difference in the two. I think it is reasonable to expect that, because the current, instead of being directly supplied to the armature of the brushes, is supplied to the transformer. That means for the same starting torque and same ampere input a motor of that type should either have a slightly less air gap to compensate for it, or should have a slightly larger section of air gap, which in itself means a larger machine.

In both the series and repulsion at starting we had the equal short-circuit at the brush as a secondary to the field. If both fields have equal strength, and we have equal armature, we should have equal short-circuit in both of them. The loss due to that is greatest at starting, but at higher speeds it becomes in either case of a value which need not disturb us. In starting it is a most severe condition. In any of these motors so far devised there is a very considerable loss in the short-circuit coil at starting, and in comparing that loss in the two motors I think it will be found that in practically all cases, with equal good design otherwise, in the repulsion motor that loss will be slightly greater. The difference may not be enough to amount to anything, but is in favor of the straight series motor. To avoid that, there have been several methods devised, but all of them are impracticable. One of the methods is to put the brushes in so that they reach to one bar and produce a short-circuit. In some of the German motors the brushes are as narrow as 0.2 of an inch. A brush of that width is too thin for commercial service. It will chip and splinter. On small motors I have tried brushes as narrow as a quarter of an inch, and on a rough commutator it is hard to keen them in service. I do not believe that brush will be successful on a street-railway motor. Another method which is proposed is what is called a "sandwich" winding—two windings, side by side, connected to different commutator bars, with a brush narrower than the width of one bar. Such types of windings have not proved successful on direct-current machines except in a few instances. They transfer the trouble from one point to another point.

We very often see rather high power factors accompanying machines of rather low efficiency. That is found with all kinds of alternating-current motors. The low efficiency, to a certain extent, accounts for the high power factors. We can increase the power factor in any motor by increasing the losses, and therefore a motor with low efficiency may show a high power factor. Take, for example, Fig. 11 of this paper. I find at about 300 revolutions that the power factor would be about four per cent. for the efficient load, which is as high as the direct-current motor. I am not giving that as a criticism of this motor, because all alternating motors of this type, commutated type, are somewhat more efficient than the direct-current; but I am giving an example of the power factor being complicated by the efficiency. Therefore, in considering the question of high-power factor, the efficiency should be looked at also.

Professor A. S. McAllister, Cornell University: Mr. Steinmetz, in his equations, shows how the repulsion motor may be operated as a generator. No curves are given for them, and as I have been doing some work with the repulsion motor, I thought it might be interesting to show these curves and introduce at the same time a simple graphical method to show why the motor acts as a generator, and also the graphical method for representing some of Mr. Steinmetz's equations. [Professor McAllister then displayed certain charts and drew some diagrams on the blackboard, explaining his charts.]

Mr. Steinmetz: I am pleased to say I agree with Mr. Lamme in considering the relative positions of the repulsion motor, the plain alternating-current series motor, and the alternating series motor fed by a transformer. I am pleased to see that Mr. Lamme has come to the same conclusion to which Mr. Eickemeyer and I came in this early work; that is, the only way to make an alternating-current series motor to operate at reasonably satisfactory power factor was to combine as high armature reaction as possible with as low field excitation as possible, then increasing the ratio of armature magnetism to the field, thus eliminating the current you cannot use; otherwise, you will strike a standstill. In this conclusion of Mr. Lamme we assume that the armature circuit is non-inductive. No electrical engineer has yet designed an alternating circuit traversed by alternating current which is really non-inductive. In the early work of Mr. Eickemeyer we made careful investigation on this subject by having the motor designed so that we could vary the relationship between the armature magnetic force and the field magnetic force, and we found, with that particular motor, using ratios somewhere between 3½ an four, that is, where the armature reaction was between 3½ and four times that of the field, we reached the best condition. That is to say, if the total induction increases the armature reaction beyond that we lose more by increasing the induction of the armature than we gain by increasing the induction of the field. With a short-circuit surrounding the armature, this point was reached at the lower value of armature reaction. However, that work was done at very high frequencies, that is, with motors where the polarity pitch was much less than they must be with the present frequencies, and undoubtedly with a change from these high frequencies of the early days to the frequencies considered here, which are about a quarter or less than those old frequencies, we can go to a further extent in this direction. However, I want to call your attention to the fact that there is an ultimate limit between the ratio of armature reaction and the field excitation; otherwise you could say you could, by making the armatures 100 times as strong as the field, get any unit of power factor practicable; but you reach a maximum point, and you cannot go beyond that without losing again.

The fact is, that the repulsion motor has inherently such a high power factor that even with a considerable air gap—an air gap which is impossible with the ordinary inductive motor—we can run to magnetic saturation and with large starting current. This magnetic saturation is approached and passed in part of the magnetic structure, in the base of the field and armature, and that causes the falling off, as we observe in the direct-current motor. It is not feasible to go to anywhere near such saturation as in the direct-current motor, but while we approach saturation—it is not necessary, but means a small motor.

The induction motor has been made a commercial apparatus only by going to the distributed winding, but induction motors are still built and operated with definite polar projections, but they are inherently lower in power factor than motors with the distributed winding. By applying the same principle to the repulsion motor, we get thereby a considerable decrease in the self-inductance of the circuits and thereby are permitted to get close to saturation, in turn reducing the size and weight. Such a winding, however, for a plain series motor is not satisfactory, because in the series motor, as our original investigations 10 years ago showed, it is essential to have a definite polar projection, to get good power factor, so that the motors we are considering, while they are a development of the same type, are of an entirely different mechanical structure. A motor which is a good series motor will make a very poor repulsion motor; the repulsion motor is larger, heavier and more efficient. You cannot take one and the same motor and run it first as one and then as the other and draw general conclusions, because the conditions of operation—the transformer feature introduced into the motor—require redesigning, a change of design, and throws out a relative comparison based on one particular design. [Mr. Steinmetz drew diagrams of several forms of motors and described them.]

P. M. Lincoln, Pittsburg: I take issue with the statement found in Mr. Steinmetz's paper, where he says, "Unlike the plain series motor, which can never return power into the line, the repulsion motor when reversed becomes a generator, consumes mechanical power as brake and returns electric power into the line, even at low speeds." I have never made any calculations on the question, but I have made observations on that particular point, and the observations were made on a car of about 40 tons, equipped with four 125-horsepower series motors. That car, when in motion at speeds not above four or five miles an hour, sends power back into the line, as indicated by a wattmeter across the motors. The wattmeter reverses the direction when the fields are reversed and current is turned on. That same characteristic has also been reproduced in shop tests, where a straight series motor has been used to feed power back into the shop circuit to which it is connected by driving it suitably by another motor. In that connection there is another characteristic of the series motor which seemed rather

surprising at first, and that is that it will build up invariably as a direct-current generator when the reverse switch is thrown and no power applied. In that case it acts just the same as the direct-current motors and can be used as in the well-known way of the brake. In fact, in connection with the car which I speak of, on one occasion the air brakes failed when the car was running at a high speed, and the emergency brake was thrown, and the car stopped very promptly, as when that same thing is done with a direct-current motor.

There is another question, and that is in reference to the speed-time curves of Fig. 10. I notice that Mr. Slichter has taken the comparative areas of the curves, the comparative inputs in alternating and direct current for the same car running the same distance as 0.72 kilowatt-hour for the direct and 0.685 for the alternating current. That is to say, the alternating current produced the same conditions, taking approximately five per cent. less power. In going over these curves, however, I find, roughly, that the rheostatic losses in the direct-current curve amounts to approximately 15 per cent. of the total curve area. Therefore, what I want to know is where the rest of those kilowatts are. He accounts for the difference of five per cent., whereas the curve seems to indicate that there should be a difference of at least 15 per cent., because the alternating-current motor does not include the rheostatic losses.

Mr. Steinmetz: That reference was to the plain series motor as used now on the railroads. It was not to the alternating series motor, which we had not considered at that time.

Mr. Slichter: Mr. Lamme criticised the value of the power factor at starting, 50 per cent. That is due to the fact that it is an early motor and one of poor efficiency, as shown by the value of only 80 per cent. In the early design we were afraid of sparking, and took precautions against it; in later designs we have not been so much afraid, and improved that efficiency, and with more experience more improvements can be made.

In answer to Mr. Lincoln's question, I will say that the point he referred to is due to the running-light efficiency of the direct-current motor and the alternating-current motor. The efficiency of the direct-current motor running light is considerably above the alternating-current motor used in this test, which, you see, is rather poor, and the statement is given to show that in the accelerating work this loss in the rheostats is avoided, and with motors of later design, looking to the future, if it is possible to obtain an alternating current of equal efficiency with the direct current, all the loss is avoided, which is summed up in the benefits of the potential control against the rheostatic control.

Ralph D. Mershon, New York city: As to the method of controlling the motors represented by the curves in Mr. Slichter's paper, he speaks of voltage control. I would like to know if the method of voltage control that he would propose to use on these motors is such as would be used commercially, and if he used that form of control in this particular case. I would also like to know the comparative weights of alternating-current motors, and direct-current motors, for the same work and approximately the same performance. Also the basis of acceleration or basis of efficiency, which are not given in the paper—the comparative bases on which these things are determined. I also ask as to the relative weights of the motor and the relative weight of the complete car equipment, including everything necessary for the control of the motor, both alternating-current and direct-current? Also, what voltage he would propose to use on the alternating-current motor? He says these motors can be run for high voltage. I ask how high, and what is the method of control in that case, particularly? I would also like to know, and think it is a point which will be of considerable importance in getting these alternating-current motors into service, whether this repulsion motor can be designed so as to be a good repulsion motor, and yet, reconnected, would be a pretty good direct-current motor? Taking, for instance, the existing large direct-current railway systems, it will be quite a little while before you can get people responsible for these systems up to the point of changing over any large portion of the road at a time. You will be able finally to get them changed over a great deal better in equipping some of the outlying sections; and in going from the direct-current to the alternating-current system during that gradual change of equipment, it would be of great advantage in a great many ways.

President Arnold: I will ask A. H Armstrong of Schenectady to reply to the points raised by Mr. Mershon.

Mr. Armstrong: I will answer the last question first; it is fresher in my memory; there is quite a list of them. I think Mr. Mershon was about right in asking if a repulsion motor could be designed, and at the same time operate as a good direct-current motor. That is just about the way it can be designed. You can make a good repulsion motor to operate on direct current, good enough to help you through a town along your right-of-way; but you cannot make a good repulsion motor and a good direct-current motor in the same structure, any more than you can make a good series motor, both alternating and direct; you have got to sacrifice one feature or the other; the preponderance of interest will determine which.

As to the potential of these motors, you can wind a good repulsion motor for 2,000 or 3,000 volts on the field without the use of transformers; the exact voltage is open to experimenting. We do not know anything about the effect of constant jarring and crystallization of insulation at high potentials on a railway car; but we could control that either in a compensator or resistance or some method like that, with a good potential in starting; there are a number of methods.

Mr. Mershon: You lose the advantage of the motor control.

Mr. Armstrong: Yes; but the motors would hardly be at high potential in service calling for frequent stops. If you stop once in five miles, the simple difference in efficiency in starting would have no effect on the general efficiency of the system as a whole. You would gain one or two per cent. in the average of the car or train, which would not compensate for the complication. You could consider 2,000 or 3,000 volts entirely feasible on the field of the motor without any intervening machinery. That, however, is open to experimentation and development. So far as the motor goes, it can be wound to that potential, but whether that motor would successfully withstand the shocks of railway service is a matter to be found out.

As to the weight of alternating-current motors and direct-current motors, I am sorry to say that is an open question. As you will appreciate, the question of the capacity of direct-current motors has been very carefully worked out by the different engineering companies during the last two or three years. Much time and labor have been spent in determining their exact capacities for a given piece of work, standards have been adopted and the matter has been worked down to a fine point with relation to direct-current motors; and to attempt to compare a piece of apparatus not yet in commercial service with a standard piece of apparatus, developed for 14 years, is hardly fair; and it is almost impossible to give a definite answer to the question. You might say, roughly, that the motor will weigh somewhat more than the direct-current motor, but just how much added weight there will be we do not know.

Mr. Mershon: How about the rest of the equipment?

Mr. Armstrong: That would depend on the method of control. If you use a high-potential motor, 3,000 volts direct on the field, your control should not weigh very much more. If you use a low potential and install a transformer of 100 kilowatts capacity in the car, you have the added weight of the transformer in addition to the translating apparatus.

President Arnold: I think the question of the destruction of the insulation or crystallization of the material used in the construction of high-potential motors has been pretty thoroughly answered in practice by the use of such high-potential motors abroad. For instance, the line operated in Italy with 3,000-volt motors has been operated for two or three years, and I have not heard that question used against it, that is, the destruction of the insulation under the motors and the crystallization of the copper or other metal parts. Possibly, some here may know of such deterioration, but I have not heard of it. That ought to answer the question. If they can build motors which can run successfully under that potential, we ought to be able to build motors in this country to do the same thing, and I believe we can.

Mr. Steinmetz: Comparing the present alternating-current motor of the plain series or repulsion type, with the highly developed direct-current motor, we find a somewhat lower efficiency in the alternating-current motor, and it has somewhat larger weight. However, my personal opinion is that the difference is altogether less than should be anticipated, considering the short time of the development of the one and the longer time of the development of the other. While at present and for some years to come, the alternating-current railway motor, as a new type of apparatus, will be handicapped by somewhat lower efficiency and somewhat greater weight, I do not consider this as inherent to the motor, but rather as more or less the result of a shorter development, and do not consider it impossible that they should come to equality with, or, even in some cases, superiority to, the direct-current motor; but that is merely guessing at the future. All that I can say is that I do not see any inherent reason why the alternating-current motor should be heavier or less efficient than the direct-current motor.

O. S. Lyford, Jr., New York city: I ask Mr. Slichter, whether the 175-horsepower motor described in his paper is of such dimensions that it could be placed on the ordinary interurban car truck with 33 or 36-inch wheels

Mr. Slichter: This motor is designed for locomotive work, and would not be of dimensions to go under a car having 33-inch wheels.

H. A. Wagner, New York: I will ask if the repulsion motor does not take much more copper on the field than the series motor, and whether, in reversing that motor, you propose to move the brushes or feed the current at different points?

Mr. Steinmetz: Answering the first question last, there are different ways of doing the same thing. We can change the point of entrance of the current in the primary wire without changing the brushes. We can feed into the primary winding at several different points in the repulsion motor and get the advantage of not shifting the brushes. With regard to the first question, whether it takes more copper in the repulsion than in the series motor, I may say that the repulsion motor takes more copper and less iron than the direct-current series motor takes, because the proportion of armature to fields are reversed as to the alternating-current series motor. I do not want to state positively, because I have not gone over the fields of the alternating-current series motor with sufficient care, or tested the ordinary current series motor with modern frequency, as to be sure, but my impression is it would be about the same as the direct-current motor. The plain series motor will have a smaller armature diameter than the repulsion motor, probably larger external diameter, more iron and less copper, but in general I do not expect there will be any inherent difference between the two types.

Wireless Danger Signaling Device for Ships.

A method of transmitting signals without the use of wires which shall be intelligible to anyone not having had previous training in any code is the object of a patent lately issued to Lee DeForest of New York. This device is especially designed to transmit and receive signals of danger between ships and the shore and between the ships themselves.

The emission of a series of waves by a space signaling transmitter will produce a continuous sound in a receiver, the tone of which will depend upon the frequency of the spark at the receiver. If, therefore, means are provided by which this frequency may be varied at the will of the sender, the tone of the sound in the receiver may be made to rise and fall, and this together with the duration of any particular tone as well as the order of succession of the changes may be made the basis of a set of signals.

One method of producing the oscillations in the sending apparatus is to connect an alternating generator with the primary of a transformer, the secondary of the transformer being in the oscillating system, which is connected with the two terminals of the spark-gap, the system also preferably containing a condenser connected across the terminals of the spark-gap. The terminals of the spark-gap are so mounted that they may have relative movement toward and from each other, increasing and decreasing the frequency of the discharge.

Any form of apparatus may be made to break the energizing current to the spark-gap, if desired, so as to combine breaks in the sound with the variations in tone, thus enabling a greater variation in signals to be obtained. The receiving apparatus employed for such a message may be any form of wireless-telegraph receiver which is self-restoring or automatic in its action, combined with an indicating instrument which produces an audible sound or other manifestation which varies in accordance with the variations in the spark frequencies.

In using this method for conveying warning signals it is designed that a sending apparatus shall be placed at the point from which it is desired to send the signals. This point may for purpose of illustration be assumed to be a location upon a shore from which it is desired to warn approaching vessels. In such case when the shore is not visible so that warning may be conveyed in that way this method would be employed and the sending apparatus being put in action would emit a constant series of waves produced by sparks, which vary in their frequency in accordance with a prearranged plan. In order that a vessel may avail itself of this warning it is necessary that it should be equipped with a wireless-receiving apparatus, in which case as soon as it comes within the field of the waves radiating from the sending antenna its receiver would emit a sound which would rise and fall in tone in correspondence with the character of the waves emitted. The variations characteristic of the various stations being known by means of a chart or table, the person receiving such signals aboard the vessel would know of his proximity to a particular station, and would thus be warned of approach to shore in cases where other means would fail. The use of this method of signaling is, however, not confined to communicating signals from shore to vessel, and, as has already been stated, may be employed to give warning of the approach of two vessels toward each other. By the use of a chart previously arranged such signals may be made to indicate the course which each vessel is pursuing, and will thus tend to prevent collision.

The Board of Supervisors of Saline County, Illinois, has granted a franchise to the Illinois and Kentucky Railroad Company of Chicago to operate an electric railroad in Saline County. The company proposes to run a line from Harrisburg to Marion, another branch to the Ohio River, and a line from Carrier Mills to Eldorado.

Overhead High-tension Distributing Systems in Suburban Districts.[1]

By George H. Lukes.

The problem of building up and operating a satisfactory distributing system for the suburban towns and villages surrounding a large city presents many peculiar difficulties. It is rarely the case that the engineer is given the opportunity to lay out a complete system which can be operated economically and safely with a reasonably low first cost. The problem is more often one of reconstructing existing systems, making use of as much of the old work as possible and at the same time making provision for future growth. Obstacles are usually encountered in the work. Many different interests have to be satisfied, and in some cases the engineer is compelled to use types of construction which are not desirable, but necessary under the circumstances.

The villages surrounding a large manufacturing city are of several different types. The oldest ones are located on the lines of steam railways radiating from the city and are residential in character. As transportation facilities are improved new suburbs are started at greater distances from the city. The older ones become more thickly settled and even grow to be cities themselves. Some of the villages are made up of people of moderate means, whose houses are fairly close together. Others are built up by wealthy people who buy tracts of land and build large houses, which they occupy but four or five months in the year. Later on the manufacturing suburb makes its appearance, consisting of a group of factories and a small business district surrounded by the houses of the workmen.

In the process of time electric lighting plants are erected in the larger villages and their pole lines are extended in time to the smaller villages near by to supply incandescent and street lamps. A large proportion of these small plants cannot be operated at a profit, and the result is a gradual deterioration in the stations and distributing systems, resulting finally in consolidations which brings large districts under the control of one company. It then becomes necessary to tie the various systems together, operating some of the stations as peak plants and turning others into sub-stations, thus taking advantage of the fact that the peak may occur in the summer in one village and in winter in another.

Suburban business is so scattered that the cost of underground work is prohibitive and the distribution must be made by overhead wires. Public opinion is, however, intense in its opposition to overhead construction. The suburbanite objects to the multiplicity and unsightliness of pole lines. He is in business in the city where the agitation against overhead wires has resulted in their being placed underground, and he refuses to believe that conditions are different in the country. In many communities local action has been taken compelling the use of joint lines by the electric-light and telephone companies. These have been erected and operated successfully in many cases without any great danger. Joint lines ought to be avoided if possible, and it is important that every effort be made to make the pole lines as unobtrusive as possible. The poles should be well painted with a dull color, such as a dark olive green; the wires should be kept taut and the connections made in a neat and symmetrical manner.

An overhead distributing system must be constructed so that the service will be reliable and not subject to frequent interruptions. The voltage regulation must be as good as possible and danger to life and from fire reduced to a minimum. This can be accomplished without adopting an extremely expensive method of construction. The great proportion of accidents and interruptions are caused by defects which are very easily guarded against, provided they are looked for. It is not the intention here to lay down rules for the construction of pole lines, but to draw attention to certain points which experience has shown to be often neglected.

Main Lines and Branch Circuits.—Main lines leading from stations should be on not less than 40-foot, and preferably on 45-foot poles. This gives plenty of room for additional circuits and makes it easier to cross above telephone and telegraph lines. The branch circuits can be on shorter poles, but it is not advisable to use poles shorter than 30 feet. Where branch lines are taken off the poles should be double-armed and buck-armed. Transformers, fuses, lightning arresters and other devices should not be installed on main lines where it can be avoided.

Poles.—In the middle West the poles available at present are Michigan white cedar and Idaho cedar. Michigan poles are better proportioned than western poles and are longer lived. Michigan poles should have a top diameter of not less than seven inches. If western poles are used, it is well to note that eight or nine-inch tops should be specified in order to obtain proper butt diameter. Michigan poles are sorted and sold under the specifications of the Northwestern Cedarman's Association, and it is therefore cheaper to buy under the above specifications and sort out to suit. Poles should be shaved, roofed and given one coat of paint in the yard. Poles are painted in order to improve their appearance, but the question of whether or not it adds to the life of the pole is an open one. In setting particular care must be taken to select the best poles for the corners, turns and ends of the line. If the line is on a highway that curves, set as many poles in a straight line as possible and make the turns on one or two poles, which can then be properly guyed. A line that changes its direction at every pole can never be held in position. Poles should be double-armed at corners, curves and ends.

Guying.—This is one of the most important features in pole-line construction and is often neglected. Corners, junctions and ends should be carefully guyed. Wherever the line changes in direction, even if the change is very slight, a guy should be placed. Patent guys and land anchors should be used with great caution and only on light work. The best guy is the old-fashioned one consisting of a guy stub, set at some distance from the pole with a galvanized iron anchor rod-bolted to a slug buried in the ground. Strain insulators should be inserted in the guy wire and care should be taken to make sure that the anchor rod and guy wire attached to it are grounded electrically.

Cross-arms.—The best cross-arms at present are made of southern yellow pine. They should be straight-grained, well seasoned, free from knots, and purchased unpainted. They are the first part of the line to give out. The action of the sun's rays causes the arms to crack on top and they soon rot around the pinholes. The usual method of treating is to paint them with white lead and oil, but in the West cross-arms boiled in carbolineum have been used to some extent. The matter of the proper dimensions and pin spacing for cross-arms has not received the attention it should, and it is high time that an attempt be made to standardize four, six and eight-pin arms for use on circuits up to 5,000 volts. The proper six-pin arm for such use should have approximately the following dimensions: Section, 3¼ inches by 4¼ inches; length, eight feet; spacing, between pins about 16 inches; between pole and pin about 22 inches. Cross-arms for junction holes should be of special size with greater distance between pins.

Insulators.—The ordinary deep-grooved, double-petticoated insulator has proved satisfactory on 2,000-volt incandescent and 4,000-volt arc circuits. It is perhaps advisable to use triple-petticoat insulators on 4,000-volt polyphase work.

Fuse blocks and lightning arresters are sources of trouble on pole lines. In some instances systems have been operated entirely without fuse blocks on the outside lines excepting, of course, the transformer blocks. The best plan is to install them on branch lines where there is a chance for trouble. Lightning arresters should be installed to protect groups of transformers and branch lines. They should be frequently inspected and the ground wires tested.

Transformers should be hung on double arms below the lowest arm. If they are of large size the arms should be extra heavy and bolted securely to the pole. Methods of bringing the primary wires down from the circuit to the transformer are various and all are open to objections.

It is usually impossible to keep a regular arrangement of circuit upon cross-arms for the reason that as the business grows circuits of all kinds are added. It is very desirable, however, that circuits be kept in the same relative position throughout their length in order to facilitate tracing. Houses should be, as far as possible, grouped upon three-wire secondaries, which should be carried alone on the lower arm. The installation of 200-400 volt, three-wire secondaries would facilitate this work wonderfully in scattered districts. The neutrals of three-wire secondaries should be grounded on the first pole away from the transformer.

All series alternating-arc lamps should be provided with absolute cutouts and high-voltage insulators in the lowering cable. Windlasses for raising and lowering lamps should be permanently grounded and an arc lamp when suspended from spanwires should be connected so that should it fall the lamp will not fall toward the windlass but away from it.

The importance of frequent inspection of pole lines cannot be overestimated. Old pole lines can be made very reliable, provided they are well guyed and weak points kept in repair. For inspection work, linemen of considerable experience are needed, because only long years spent in repair work give the ability to predict where trouble is likely to occur.

Accidents caused by overhead wires are remarkably infrequent, considering the number of miles of pole lines operated. They occur most often to electric linemen, less often to telephone linemen and very rarely to citizens. Accidents to linemen can largely be prevented by employing on live work only steady and tried men and using the inexperienced men and floating linemen on new construction work. Accidents to telephone linemen are mostly the result of want of care on the part of the men themselves. Accidents to citizens can be reduced to a minimum by care in constructing and maintaining lines.

The danger from fire is in the possibility of high-voltage current reaching buildings, first, through defective transformers, and secondly, through crosses between primaries and telephone wires. The first can be eliminated by grounding the secondary; the second can be made remote by proper co-operation between electric-light and telephone companies in the erection of junction poles and substantial construction. The danger from fire is somewhat overestimated and it is to be sincerely hoped that any restrictive regulations will not only be carefully considered before final action is taken but worked out in actual practice to determine whether or not their enforcement would introduce risks which would more than offset any advantage gained.

Discussion (in abstract).

H. B. Gear, Chicago: The suggestions made by Mr. Lukes that a standard cross-arm be adopted should receive general support. A cross-arm similar in dimensions to the one described in Mr. Lukes' paper, except that the distance between the pole pins is 25 inches, has been in use in Chicago for a number of years with excellent results. Many cross-arms are furnished by manufacturers for use on light and power circuits at voltages from 2,000 to 4,000, which are likely to cause trouble, owing to the narrow space between the pins, which will allow the wires to swing together in case they become a little slack.

Triple-petticoat glass insulators having an outside diameter of about 4½ inches have been in use in Chicago on 4,000-volt three-phase circuits for several years with excellent results. There is reason to believe, however, that the deep groove double-petticoat insulator, which is used on standard 2,000-volt work, would serve the purpose equally well as far as insulation is concerned. The advantage of having a distinctive type of insulator on the higher-voltage circuits is such, however, that the triple-petticoat insulator is used on these.

Accidents to linemen working on electric-light lines may be prevented in part by regulations requiring the men to use rubber gloves in handling live circuits, connecting transformers or replacing primary fuses. The suggestion of Mr. Lukes that only the most experienced men should be used on this kind of work is of very great importance. Much may be done also in arranging apparatus on the pole in such a way that men can work upon it without constant danger of injury. The use of an insulated stool for trimmers on series arc circuits is, no doubt, a wise precaution.

G. T. Hanchett, New York city: I regretted to note that the papers on overhead construction and distributing systems in suburban districts failed to refer to one of the most prolific causes of accidents and troubles on such lines, namely, the grounding of wires on trees. In a suburban town the average suburbanite is proud of the appearance of the town and insists upon the preservation of the trees in the street. The trees grow to large proportions and the wires have to pass through the trees and are secured in various ways; but with the growth of the trees from year to year the branches come in contact with the wires and produce serious grounds. I have seen limbs six and eight inches in diameter burned completely in two by wires, the limbs dropping on the street, and I have seen wires burned in two by the resulting arcs. I have failed to find any means entirely satisfactory to prevent that trouble. I hope that some discussion on this point will be had. I should be glad to hear of any means which have been successful to prevent this trouble.

W. C. L. Eglin, Philadelphia: I would reply to some of the criticisms on Mr. Lukes' paper and my own, as they are very similar papers. I regret I did not mention the subject of wires running between the branches of trees. We have made a great many experiments with various devices in keeping the wires from trees. All of these devices have failed. The last experiment we made consisted of a specially insulated wire with a rubber covering on the conductor and steel armor on the outside of the rubber. We assume that the steel armor would prevent the limb of the tree cutting the insulation. Unfortunately, the armor would come in contact and the insulation break down between the conductor and the ormor, endangering the lives of the men who are at work and make trouble on the circuit. The only method we have found practicable of keeping lines clear of trees is to get rid of the trees or cut down the limb, securing the consent of the owner. I believe this is a matter which should be taken up in a regular businesslike way. There is no use in avoiding that subject. You know you cannot get around the tree in some cases, and the thing to do is to go to the owner and make a proper settlement on a monetary basis. You will probably find the owner has no right to have the tree where it is. The case is easily settled when you get the proper legal position.

I differ with the views expressed on the question of gloves for linemen. As the result of our experience and of all our force, the consensus of opinion is that gloves should be prohibited, and we have so issued instructions, for the reason that the men depend on the gloves. They will not turn them in for inspection, and under those conditions we have more accidents with gloves than without them. We do not attempt to insulate the lamp, because of the difficulties of insulation. We prefer to ground things. For example, all lamps on iron poles are grounded before trimming. There is a connection attached to the pole which is hooked on to the lamp, so that the trimmer cannot possibly get a shock. We have found in accidents to employes that at least 75 per cent. are due to lamp trimmers.

Mr. Gear: As to the trees, there is only one answer; that is, cut the trees. However, you can run a good many lines through trees without serious difficulty. Our conditions in Chicago are worse than they would be in Philadelphia, or Brooklyn, or other places, where they operate two-phase or single-phase systems. We have a four-wire, three-phase system, in which the neutral is grounded, and the three-phase wire, at a fixed potential of 2,000 volts, is above the ground under all circumstances, and if it comes

[1] A paper presented at the meeting of the American Institute of Electrical Engineers, New York, December 18, 1903. Mr. Lukes is general superintendent of the North Shore Electric Company of Evanston, Ill.

against the tree or any obstacle of any kind, the current begins to flow at once. It was predicted when we first installed the system we would have a great deal of line trouble. We did have, perhaps, some trouble not common to smaller single-phase systems, or perhaps a little worse than with a system in which the neutral is grounded, but it is overcome by a little trimming of the small limbs of the trees or giving the wire a little more sag. I have seen some cases where the use of a porcelain tube, about two feet long, put on in such a way as to hold it against the limb, is of much practical value; but, in general, the best plan is, if possible, to do a little trimming on the tree, not necessarily to spoil the looks of the tree, by any means, but to trim the tree and put in quite high poles, so as to get above the trees. In cases where we have a large main line—I know a case where we have a main line which runs half a mile—five or six feeders and branch lines on the pole line—and it runs through trees for the entire distance. In that case we used 50-foot poles to get above the trees, and the gradual trimming off of some of the limbs as the trees grow. We are fortunate, however, in Chicago, in a way that no other large city is, that I have observed, and that is our city is laid out with alleys in nearly every block, and we, therefore, frequent the alleys, or most of them—with our pole lines. This, of course, takes us away from the trees, because they do not plant the trees in alleys, and it is also a very great convenience to us in not being interfered with by paving operations or by the objections of property owners who do not like unsightly poles in the streets. Therefore, as rapidly as possible, we are removing the pole lines from streets, and occupying all the best alleys. In many places we are able to run our main feeders from the station a distance of two or three miles in an alley which is perfectly continuous, and makes a clean, straight line. We have one transmission tie line between two stations which runs a distance of three miles in an alley, with a jog of not more than five or eight feet from a straight line at any point. We are, however, not always so fortunate. In some parts of the city, where the layout of the streets is less regular, it is necessary to do some underground work in order to get connection between the feeders of lines in the way we have to have them electrically.

George F. Sever, New York city: There are two interesting points to those engineers of municipalities who have control over high-tension lines in their districts, in Mr. Lukes' paper and Mr. Eglin's paper. These are the possible crossings of high-tension wires with telephone and signal wires. Recently I have had occasion to investigate three conditions bearing on this subject, and have been able to prevent the installation of high-tension wires, up to 22,000 volts, in proximity to telephone and signal wires—three very serious instances of proposed dangerous installations. In a little town where I spend the summer there is a 13,000-volt line railway, three-phase transmission line, running through the main street of the town, between the branches of trees, nipping off the ends of limbs and twigs and causing danger in many ways. In one instance this 13,000-volt line goes right through the telephone line, the telephone line being at right angles, and passes between the two sets of telephone conductors; the distance between a 13,000-volt line and the telephone wires being vertically about 12 inches. I consider that a most dangerous situation, and I think that the rules of the National Board of Underwriters, which were adopted a year ago at their meeting, and also accepted by the American Institute of Electrical Engineers, should be recognized by all members of the Institute in the installation of such high-tension lines. Keep them away from the signal wires, or move the signal wires.

Railway Service in New Jersey Cities.

The City Council of Hoboken, N. J., has directed the corporation attorney to draft bills to enable the city to condemn the street railways now in the public streets and to issue bonds to pay for them and giving the city the control and operation of the roads. Similar action has been taken at West Hoboken, where the corporation attorney is also directed to draft bills enabling the city to establish its own lighting plant. As a result, it is said, of continued complaints against the Public Service Corporation of New Jersey, General Manager Wheatley, who has been running the street-railway systems of Jersey City, Hoboken, Newark and surrounding cities and towns, has resigned. President Thomas N. McCarter has taken the management into his own hands and will be assisted by Colonel Edwin H. Hine, executive agent of the company. There has been much public criticism of late on account of cold cars, irregular schedules and bad treatment generally of patrons. Albert H. Stanley, who recently entered the service of the Public Service Corporation from Detroit, will take charge of the practical operation of the system. He has been directed to make radical changes. Unless there is a great and immediate improvement, it is said, many of the charters owned by the Public Service Corporation will be canceled by the cities in which its lines operate. This improvement is promised by the officials as soon as the various properties recently acquired can be properly systematized.

A company has been formed at Douglas, Ariz., for the purpose of establishing another electric-light and power plant. It has a capital stock of $60,000. H. C. Mayer is manager of the new company.

Development of the Transformer.

The first transformer used by Faraday in his historic experiments had for its magnetic circuit a closed ring of iron, but Ruhmkorff and others, in their early practical applications, employed a straight iron core within cylindrical coils. Varley, in 1856, pointing out the disadvantage of leaving the magnetic circuit open, gave it a closed path by bending back and overlapping the ends of the straight iron-wire core.

In the early days of electric lighting, Ferranti modified Varley's method by using, instead of iron wires, strips of sheet iron bent back and interleaved. Other engineers preferred to embed link-shaped coils in the recesses of a core built up of E-shaped stampings, afterward completing the magnetic circuit either with slabs of laminated iron or with strips interleaved with the ends of the projecting legs.

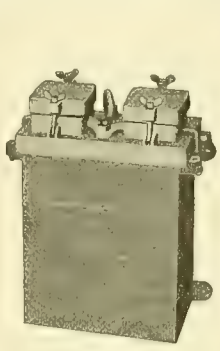


Fig. 1. Shell Type of 1889.

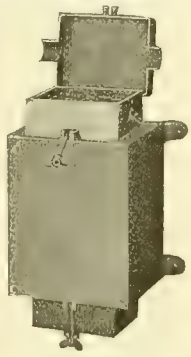


Fig. 2. Improved Style of 1889.

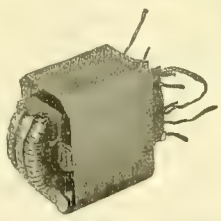


Fig. 5. Core of Type G.

Fig. 6. Type of 1895 with Concentric Windings.

DEVELOPMENT OF THE TRANSFORMER.

This construction gives the well-known "shell type" of transformer.

As early as 1888 the Thomson-Houston Company, predecessor of the General Electric Company, commenced the manufacture of transformers, with the A and the B types, both employing the shell type of core. The latter type is shown in Fig. 1. Notwithstanding the fact that these transformers represented the highest development in transformer construction of that period, the year 1889 witnessed the introduction of a new type known as type E (see Fig. 2), which embodied improvements in insulation and a marked reduction in core losses.

In 1890, with the experience gained from nearly 30,000 transformers installed, a new design, known as type F, was produced. The method of arranging the coils of this transformer is seen in Fig. 3. This embraced a much larger range of sizes than had hitherto been provided, and employed more modern methods of utilizing insulating material, while giving again a marked reduction in the iron losses. The shell type of core was still employed. Over 53,000 transformers of this design were installed within the six years following, the average size increasing during that period from 1.14 kilowatts to 3.2 kilowatts.

The earlier transformer systems were all operated at high frequency, and with the subsequent growth of low-frequency plants came a demand for suitable transformers. Many sizes of type-F transformers were operated at 60 cycles, but with objectionably high core losses. The type-G transformer was produced in 1894, and was specially designed for 60-cycle service.

The Thomson-Houston Company, under the inspiration of Professor Elihu Thomson, was among the first in the commercial use of oil-cooled transformers. The use of oil in transformers not only increased the value of the insulation and prolonged its life, but also provided a means whereby the heat generated within the core and windings would be conveyed to the surrounding case and readily dissipated into the air.

To employ the advantages thus afforded, the Thomson-Houston Company's type-B transformers were in 1889 provided with oil-tight cases.

With the type-F and type-G transformers the use of oil was again strongly recommended, and as the possibility of carrying a greater load with a given heating, and the lessened risk of damage from lightning became recognized, the use of oil gradually increased. Figs. 4 and 5 are views of type G, showing the oil-tight casing and the windings.

In 1895 the engineers of the General Electric Company made a thorough investigation of the relative merits of various forms of cores and methods of winding and insulating. In this investigation the designers had before them the consideration of lessened risk from accident as well as the greatest economy of construction and the proportioning of losses to give the highest economy of operation. As the result of this investigation it was found that the long neglected construction first used by Ruhmkorff, consisting of concentric cylindrical primary and secondary windings surrounding the iron core, gave a combination which was excellent for transformers of small and moderate capacity. This construction was particularly advantageous in that the insulation between the high and low-potential windings could consist of an approximately cylindrical tube of simple construction.

The result of these investigations is the type-H transformer. (See Fig. 6.) This type of transformer, as now developed, was described in the Western Electrician of April 25, 1903, page 332.

Comparing the core-type and the shell-type designs of a given size, it will be found that the former has a much lower voltage per turn of wire and a far greater number of turns in series. Consequently

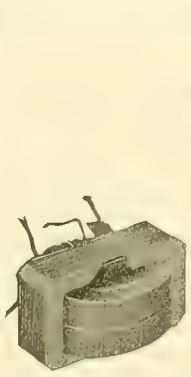


Fig. 3. Core of Type F.

Fig. 4. Oil-cooled Type of 1894.

each layer of wire may be of considerably greater length without increasing the voltage between layers over that found in the corresponding transformer of the shell type.

After carefully scrutinizing all cases of transformer trouble, it was concluded that breakdowns within the windings of oil-immersed transformers were generally due to moisture absorbed by the fibrous insulations before being immersed in oil. In some cases water had become mixed with the oil and was absorbed by the windings. To overcome this difficulty there was developed a system of treatment by which the coils, first dried in a vacuum, are thoroughly impregnated with a specially prepared waterproofing compound, which, liquefied by high temperature, is forced under heavy pressure into every interstice of the windings.

Simultaneously with the developments which led to the introduction of the type-H transformer, the subject of transformer iron was investigated with regard to the effects of variations in chemical analysis, treatment during manufacture, and special processes of supplementary treatment. The object sought was not only an improvement in the initial quality of the iron, but particularly a freedom from that "fatigue" or aging, the serious nature of which was even then recognized. These investigations and the special processes developed from them have resulted in materially lower specific losses, a remarkable constancy, and a degree of uniformity in commercial production hitherto unknown.

Great improvements of late years have been in the matter of reducing the core losses in transformers. In the early days of transformer manufacture this subject was given very little attention, the losses being thought too small to deserve attention. That this was a mistake will be shown by the following table, all the figures for which were based for comparison on 60-cycle measurements. The figures show core losses in watts.

Type.	600 Watt.	2,500 Watt.	7,500 Watt.	[illegible] kw.
B (1888)	140 Watts	290 Watts		
E (1889)	11	17		
F (1890)	47	104 "	250 Watts	
G (1894)	28	76 "	[illegible]	
H (1896)	25 "	48 "	125 "	370 Watts
H [illegible]	2 "	45 "	[illegible]	[illegible]

English and American Manufacturers.

From Birmingham, England, under date of January 16th, "Canadian" writes to the London Electrical Review as follows: "Notwithstanding the general cry of 'bad trade,' it seems that the English manufacturer is not going to shift himself to improve matters. I am in want of a small telephonic apparatus, and, if able to procure same, should be able, in a short time, to place orders for large numbers of them. I have written to several firms on the matter, and explained what I want, but the gist of all the replies amounts to 'We have only got our regular lines.' Is there any firm in England that is open to go a little bit out of their way to secure orders? If so, I should be glad if you, sirs, would act as medium, and [illegible] me should they send in answer to this. In my own country I could get what I want made quick enough. The difference between English and American manufacturers is, that the latter say, 'Tell us what you want,' and the former, 'This is what we've got.'"

The city of [illegible] the construction of an [illegible]

Exciting a Generator.

By H. M. Phillips.

Although the method recently employed by the writer to excite a generator that refused to build up its magnetism is one that has never been brought to his attention before, it has no doubt been used by others, as it is one that would readily occur to almost any electrician under similar circumstances. The peculiar action of the machine in question may be of more general interest than the manner in which the trouble was overcome.

Two small compound-wound generators were run in parallel. They were of the standard four-pole type, well built and of modern design. The armatures were provided with form-wound coils and with commutators of ample size, and there were two carbon brushes to each pole of the machine. All connections were made in the usual manner. Three-pole switches for the equalizer connection connected the machines to the switchboard. Both machines were driven from the same jack-shaft, clutch pulleys being provided. The shaft was driven from a gas engine. One of the armatures had been sent to a reliable shop for repairs and when replaced refused to generate. The writer was called upon to remedy the trouble.

Everything appeared to be in first-class condition, the connections were properly made and contacts good. Magneto tests showed no trouble of any kind. The brushes when first inspected were not set exactly true and did not fit the commutator perfectly, though they were not in particularly bad condition. They were, however, carefully adjusted and fitted before any attempt was made to run the machine. After the first trial, which was a failure, the commutator was sandpapered, although this appeared unnecessary, as it had been turned and sandpapered in the shop a few days before. A reversal of the connections to the shunt field was equally ineffective. The shunt-field was then disconnected and separately excited from the other machine, which was in service. Under these conditions the machine came up to voltage; the switch was thrown in and the machine made to carry nearly its full load without showing trouble of any kind. After shutting down an attempt to make the machine excite itself was as unsuccessful as before. This trial was repeated several times, reversals of field connections and of magnetization having no effect.

A Weston portable voltmeter was procured and attached directly to the brush-holders with the following result: With both armature and field-circuit open the armature would generate about four volts from the residual magnetism of the field. When the circuit through the shunt-field was closed the voltage would drop either to zero or very nearly to it. This appeared to indicate that the field-circuit was wrong, but repeated reversals of the shunt-field brought no change in the result. The brushes were tried in different positions and with strong pressure on the commutator without any improvement.

Having tried the ordinary methods without success, current from the machine in service was led through the series coil of the one giving trouble. This was effected by means of wire jumpers placed on two poles of the three-pole switch so as to make a circuit through the equalizer while the armature circuit was left open. The first trial was made with the shunt field-circuit also open, and nearly 14 volts were indicated under these conditions. When the shunt-field was closed a momentary drop of a few volts was observed, but the voltage immediately after began to rise slowly and continued to do so till full voltage was obtained. The three-pole switch was then closed and the machine allowed to carry the load for a few minutes. It was then shut down and could not be started again till current was thrown on the series field as before. Another trial was then made, and this time was successful, although the machine excited very slowly and a stiff pressure on the brushes was necessary while it was picking up. After a few more trials the machine would generate as well as its mate or as most other generators.

The writer believes that a poor contact between brushes and commutator is the most frequent cause of trouble in getting a generator to excite, and the action of the voltmeter already described would seem to indicate that that was the trouble in the case mentioned. It is to be regretted that a trial was not made by holding the voltmeter leads directly on the commutator, as it might have been possible to obtain positive information in that way. On the other hand, when all the facts are considered it seems almost impossible that a poor contact could have existed. There were four brushes on each side of the circuit; one contact on each side would of course been amply sufficient to cause the machine to generate. The brushes were carefully fitted to the commutator and the commutator was freshly turned and sandpapered. The brushes were given a very heavy pressure on the commutator during part of the trial while they were able to carry nearly the full load of the machine, when it was separately excited, with very light pressure and without sparking or heating. No oil film could have caused the trouble, for trials were made directly after the commutator and brushes had been gone over with dry sandpaper. If resistance was the cause of the trouble, it must have been quite high to produce a drop of nearly four volts with the current that would flow through the 110-volt shunt-field with only a rather small fraction of a volt pressure. It may be added that the writer has had considerable experience with generator troubles and that none of the ordinary causes of trouble was overlooked.

Ingenious Burglar and Fire Alarm.

Captain Hurd of Chicago, who is interested in the electric burglar-alarm system described in the Western Electrician of November 7, 1903, has an ingenious model for demonstrating the possibilities of the device. The alarm works upon the opening of any of the concealed circuits about the house, vault or any article to be protected. Immediately upon opening one of these circuits by opening a door or window, taking a picture from the wall, or the like, an alarm bell is rung inside of a small steel box, itself protected by one of the circuits. The model represents a section of a house with window, door, picture on the wall, and numerous other things, each protected by one of the circuits. Push-buttons throw the circuits into operating effect, and others (known only to the owner of the building, of course) stop the ringing of the bell. Open the door of the little model and the alarm starts, and nothing will stop it unless the proper button is pushed. If the picture be taken from the wall, another circuit is opened, ringing the bell. The fire alarm works by the expansion of a piece of metal, which, carrying a small contact point, is thrown out of connection by a very small expansion of the metal.

The device may also be set so that anyone tampering with the locks will operate the alarm, but the owner of the house coming home late at night, if he can find the proper button, can let himself in without disturbance and then reset the alarm.

If it is necessary to have a window open during the day that particular circuit is rendered inoperative by one of the push buttons. Upon leaving the building the circuits are all set, and if the window has been forgotten its circuit is, of course, open, and the bell will ring at once, apprising the person leaving the building that all is not secure.

Horses Killed by Stray Electric Current.

A stray electric current from the plant of the Missouri-Edison Company in St. Louis recently entered the stables of the National Brewing Company adjoining and did considerable damage among the 52 head of valuable horses. Two animals were killed outright and several others had to be destroyed, while all the horses were badly shocked and were so nervous and frightened that they could not be worked for a number of days.

General Manager S. B. Pike of the Edison company explains the accident as follows: "The current from our plant adjoining the stables is transmitted through the wires on the pole, down which a ground wire runs. This current must in some way have come in contact with the ground wire, and then it was easy for it to find its way through the wet earth to the stable, and over the wet concrete and boards to the bodies of the horses. The voltage, of from 500 to 1,000, was sufficient to kill a horse, although it might not have seriously hurt a man. The death of some of the horses and the practical lack of injury to others may be explained by the difference in the thickness and arrangement of the bedding in their stalls. As soon as the current entered the ground wire the disarrangement was apparent in the plant, and the current was shut off. That accounts for the fact that the shock was so short."

Another Electric Railway for Cuba.

Local and American capitalists propose the construction of an electric railway extending from Cienfuegos, Cuba, into the interior, a distance of 30 miles or more, which would give rapid transit between Cienfuegos and several important villages in the sugar-producing belt, these towns now having very inadequate communication with the port at Cienfuegos. United States Consul Baehr states for the information of American dealers in electric and railroad supplies, that the Cienfuegos, Palmira and Cruces Electric and Power Company, with headquarters at Cienfuegos, has been organized to carry the project into effect, that a charter has been applied for and obtained, and that only a short time will elapse before the beginning of active work on the grading of the road. If this enterprise is carried to fulfillment, as seems reasonably certain, it will not only give employment to a large number of laborers who now find steady work only during the sugar-grinding season, but will contribute in no small degree to the material upbuilding of this section of Cuba. Cienfuegos has steam-railroad communication with Habana, Matanzas, Cardenas, Sagua la Grande and Caibarien on the north coast, with Santa Clara in the interior, and thence, since the completion of the new Cuban Central railroad, with Santiago.

The Value of a Trademark.

By Foree Bain.

Almost every manufacturer is confronted with two problems—first, to produce his product; second, to dispose of it. Each of these propositions dominates a number of minor considerations peculiar to the business.

It costs many enterprises as much to dispose of their product as it does to produce it.

To create a steady and lasting demand, the article to be sold must have merit. The public must be made aware of its existence and impressed with its value. Advertising, properly directed, will accomplish this result. A trademark is the rivet that binds the customer to the manufacturer—the chain that links advertising announcements together. It is a means by which advertising of the past is made available for the present.

A trademark is a sign, symbol, mark, figure, picture, device, numeral, letter, word, name, or combination of any or all of them, used by a manufacturer, producer or vender of a commercial article, and indicating primarily, either by its own meaning or by association, the original ownership or place of manufacture, producton or sale of the article to which it is applied. It is a notice to the public showing origin of the product to which it is appled. It must be clear and well defined.

A trademark is inseparable from the business or good will with which it is associated. It must be exclusively the property of the proprietor or his jointly with others. It has been aptly defined as one's commercial signature.

Property in a trademark comes from the common law, and not from the statute. The registration of a trademark is not a grant, but it is prima facie evidence of ownership. The trademark privilege is extended, by the common law, to persons engaged in promoting the commercial industries of the country, to enhance and promote such industries and to protect the public against fraud and deceit.

The selection and adoption of a word, symbol, phrase, picture or other device for a trademark requires careful, expert consideration. There are a great number of such devices that cannot be legally and exclusively appropriated, and such a selection would be unfortunate.

Every manufacturer should adopt a trademark, or several, if he desires, for the different classes of goods which he produces, and he should then have his mark or marks properly registered.

Onawa Still in Trouble.

Onawa, Iowa, continues to realize that a municipal electric-light plant is not always the unmixed blessing that public-ownership advocates proclaim. A dispatch from that place to the Sioux City Daily Tribune, dated February 6th, gives the following information: "Owing to the large expense for coal, some $800, incurred for the months of November and December last, at the electric power house, the city fathers at their last regular meeting discussed the matter of shutting down the plant if business at that end of the line does not become better. The coal now used costs $2.10 a ton, but even at that cheap price it is said that the plant has run considerably behind this winter. This is not due to want of public patronage, but rather to former delinquents in not paying their bills as promptly as is necessary. The patrons who are now behind will be called upon shortly to settle with the city collector, the council having so ordered, if light from the power house is to shine any longer in their homes."

Trolley Plans for the Adirondacks.

Plans are being perfected, it is said, for an extensive system of electric lines between Adirondack resorts. Paul Smith, a veteran of the Adirondack region, states that next summer will see the beginning of construction work in the North Woods. The first step in the projected enterprise will be the building of a line connecting Upper St. Regis Lake and Lake Clear with Paul Smith's. The power for the proposed road will be taken from Franklin Falls in the Saranac River, 20 miles away. It is understood that the plans provide for the connection of Saranac Lake with all the villages thereabouts, as well as with Schenectady. Most of the destructive forest fires of the North Woods region are due to sparks from locomotives on the existing steam roads; in view of this the State Railroad Commission is said to look favorably upon the plans of the electric-traction promoters, with the hope of entirely replacing the steam locomotive.

The new power plant of the Metropolitan Street Railway Company in Kansas City, Mo., is nearing completion. The generators and one of the two 5,000-horsepower engines have already been operated, and the plant is about ready to furnish ample power, for all purposes—motive, light and heating. When the plant is in working order more cars will be put on the electric lines.

Indiana Telephone Items.

The annual meeting of the Richmond Home Telephone Company was held February 2d. The officers of the company were re-elected. The company has enjoyed a remarkably prosperous year. The report showed that it had made a handsome increase in its earnings. There were 409 new telephones installed during the year, making the total present number 1,970. It is expected that the 2,000 mark will be reached by March 1st. The company put up new construction during the year to meet the increased demands. There is now a full copper circuit to Fort Wayne, giving excellent service. Steady employment is given to 44 persons, which number will be increased in the early spring. The average time required during last year to answer a call was 3.33 seconds. The best average of any operator was 2.36 seconds. These tests were made with a stop-watch from time to time all over the city without the knowledge of the operators. It is stated that there are now 3,502 Independent telephones and 508 Bell telephones in operation in Wayne County.

The telephone companies operating in Indiana are growing so rapidly that the cataloguer cannot keep up with the new subscribers. Many companies have adopted the plan of publishing in the local papers the names of the new subscribers and the number of their telephones. By this plan patrons can clip the list out and keep the directory up to date.

The Central Union Telephone Company has just issued a telephone directory for South Bend and Mishawaka. It shows 1,000 telephone connections in South Bend and 125 in Mishawaka. Francis Lawton, Jr., who came from the East, has succeeded N. J. Pendergast as local manager.

The officials of 14 Independent telephone companies operating in Henry County held a meeting at Newcastle last week for the purpose of perfecting an organization which will have for its purpose the general extension of county lines, the exchange of service, mutual benefit, hearty co-operation, etc. The meeting was held behind closed doors, but it is known that one other purpose is for united effort to fight competition. There are in the county about 4,000 Independent telephones in use. Dr. Garrett of Cadiz was elected president and George Walls of Knightstown secretary.

The Mechanicsburg Telephone Exchange Building was burned on February 1st. The system will be out of business until rebuilt. Jacob Zeikle is manager.

The Cumberland Telephone Company of Marion County is preparing to make important improvements. A meeting of the company officials was held at Cumberland last week and plans were outlined for an extensive improvement. The concern was organized over a year ago with a capital of $10,000 and already has a satisfactory service in the town of Cumberland and in the farming community. It has direct free service with the New Telephone Company of Indianapolis, and it is expected that the proposed extended rural service will be on the same basis. In a short time Indianapolis people will be able to talk directly to the farmers of Warren Township with the same ease that they talk inside the city limits. A new exchange will be built in Cumberland and considerable money expended in extending the lines. William Gale is president and F. W. Wiese secretary. F.

Telephone News from the Northwest.

The Western Wisconsin District Independent Telephone Association has been formed at Sparta, Wis. It is planned to form similar associations throughout the state. J. G. Schweizer of LaCrosse was elected president.

The Minneapolis council has passed an ordinance extending the time for telephone wires to be put underground to December 31, 1904.

The Rock County Telephone Company will add about 15,000 feet of cables at Janesville, Wis., during the coming season.

Contracts are let for the construction of a telephone line from Leader, Minn., to Hazel Dell for the Cass County Farmers' Mutual Telephone Company.

The Dunn County Telephone Company has been incorporated at Ridgeland, Wis., with a capital of $10,000.

The Tri-County Farmers' Telephone Association has been formed at Bath, Minn., to build from Ellendale to Hartland, with branches in various directions.

The Monroe (Wis.) Telephone Company has just added a new board of 100 capacity, giving the exchange a total of 600 capacity.

The Northwestern Telephone Exchange Company at Austin, Minn., announces that all subscribers having telephones at their places of business will be give a free wire to their homes. There has been an Independent telephone exchange started at Austin recently.

The Wright County Telephone Company of Waverly, Minn., has been incorporated with $50,000 capital stock.

The County Board in St. Paul has refused the offer of the Northwestern Telephone Exchange Company to furnish service to the county offices for half price. The County Board ordered the company's instruments out last May, but they have remained, pending a possible adjustment.

C. A. Walker has been granted a franchise for a telephone line in Pine River, Minn.

The Tri-State Telephone and Telegraph Company has contracted with the Winona (Minn.) Telephone Company to furnish long-distance service from the Twin Cities by the first of August. The line will be built down the river, touching the cities along the route.

The Rosedale and Worthen Telephone Company of Alexandria, S. D., has been formed to build long-distance lines.

The Home Telephone Company of Deadwood, S. D., has been incorporated to build long-distance lines through the Black Hills and into Wyoming.

The Norwood-Young America Telephone Company contemplates installing a local exchange at Waconia, Minn.

The Shelby County Mutual and the Marne and Elkhorn Telephone Companies are seeking entrance into Harlan, Iowa, either by franchise or by connection with the local company, the Harlan and Avoca Company.

The Kellogg (Iowa) Mutual Telephone Company has formed an organization with the various lines centering in Kellogg for running the local exchange. A. H. Braley was elected president and W. R. Morgan, secretary. R.

Michigan Telephone Matters.

Quincy is becoming quite a center for rural telephones. There is now one line in operation, covering a distance of 15 miles, with over 100 subscribers. Five other lines are already started, all headed for Quincy, and will be in operation as soon as the weather will permit of completing the construction.

Fire destroyed the Citizens' telephone exchange at Reed City on the night of January 27th, together with other buildings, including a general store and grocery. The loss is $20,000.

An extension of the system of the People's Telephone Company of Wayne from Carleton to Stoney Creek is being made. Stoney Creek is about three miles distant. A connection will be made with a line to Scofield.

The Co-operative Telephone Company of Detroit is about to inaugurate an important move in the offering of residence telephones for $1 a month. In order to provide funds for improvements, the company has filed a mortgage in favor of the Detroit Trust Company for $40,000 to secure a like issue of five per cent. bonds for extending the service. Cables have been ordered and will be laid in the public lighting conduits, so as to supply residence service to the First, Second and Third Wards. The service of this company has been with business houses exclusively. The $1 rate for residences will apply until a large number of subscribers make the service cost more. The maximum rate, under its franchise, is $24 a year for residences, and $48 for business telephones. The company has 1,100 stockholders, all of whom are residents of Detroit. This company has the only Independent system in Detroit and gives exclusive state-line service with the Independent companies out in the state. W.

NEW COMPANIES.

A telephone system is to be installed at Middletown, Ill., by J. C. Lloyd, P. J. England and Thomas Dorgan, who are the incorporators of the Middletown Mutual Telephone Company.

Articles of incorporation of the Sunset Telephone and Telegraph Company of San Francisco have been filed in Riverside, Cal. The company is capitalized at $1,000,000 and has George Lass, John I. Sabin and Louis Glass as directors.

A telephone system will probably be installed soon at Norborne, Mo. The Norborne Telephone Company, recently organized by N. P. Evans, Newlan Conklin, D. A. Mansur and others, has been incorporated with a capital of $15,000.

The Tampico Farmers' Mutual Telephone Company at Tampico, Ill., has been incorporated and will operate a system of telephones. The capital of the company is $4,000. and the incorporators are W. A. Moloney, A. O. Hunter and E. B. Cummings.

TELEPHONE MEN.

E. Orr has been appointed superintendent of the Standard Telephone Company at Waukon, Iowa.

D. A. Matthews of St. Paul succeeds A. C. Whidden as assistant treasurer of the Northwestern Telephone Exchange Company.

W. W. Lyon, representing the Cumberland Telephone and Telegraph Company of Nashville, Tenn., is arranging for the establishment of a telephone exchange at Ashland City, Tenn.

Halford Ensinger has been appointed local manager of the Bell Telephone Company at Crawfordsville, Ind. Mr. Ensinger succeeds Miss Eda Hullett, who will remain as chief clerk. The Bell company contemplates radical improvements in Crawfordsville and vicinity during the summer.

L. G. Bowman has left the North Electric Company of Cleveland to accept the position of general manager of the Eastern Telephone Manufacturing Company of West Chester, Pa. The latter company has a well-equipped factory and is manufacturing everything pertaining to magnets and common-battery work. It expects to build up a first-class business with first-class apparatus.

Current for Telephone-call Bells.

An inquirer in Indiana writes to the Western Electrician to ask the difference between alternating-current and pulsating-current ringing bells in telephone work. A brief answer to this question may be of general interest to beginners.

Party-line bells are usually operated by an alternating current. A difference in the alternating current exists chiefly in the number of alternations, or, rather, the cycles of the alternating current vary, and the ringing apparatus is adapted to respond only to certain frequencies. In pulsating-current bells the current projected over the line is either of a plus or minus sign broken up into short impulses. Thus, there might be 1,000 impulses. The signal-receiving apparatus is then so constructed that it will only respond to currents of a certain sign, either plus or minus.

Say the A telephone is arranged for responding to currents of a minus sign. The armature of the signal receiver in the A telephone is normally held in a position which it would assume if a current of the plus sign passed through it. Now, when a minus current intermittently passes through the windings of the A bell, the armature is alternately attracted from its resting position and caused to strike a gong and to strike a gong again upon the current ceasing to flow through the armature being drawn back into its resting position.

The first method of signaling is usually known as a "different-frequency system," while the second is generally called the "plus-and-minus biased-bell selective-signaling system."

Germany Grants Patent Rights to Prof. Pupin.

Patent rights have at last been granted in Germany to Professor M. I. Pupin, Columbia University, for his system of impedance coils in long-distance telephony. The Allgemeine Electricitäts Gesellschaft and the Guilleame Cable Works, two of the most powerful industrial concerns in Germany, and also the German postal-telegraph administration were arrayed against Professor Pupin in the litigation, which has been going on for three years. On February 6th, after a 74-hour session, the Imperial Patent Office came to the decision in favor of Professor Pupin.

Most of the brilliant legal and engineering talent available was engaged in the battle. Pupin's successful challenging of occasional statements made by the German experts—a procedure unheard of in that country—excited mingled indignation and admiration. The Germans opposed the American's demand for a patent on the ground that the load-coil system has always existed as a possibility, and that a man ought not to be permitted to patent a mere application of a physical law. The system is already in use on the government telephone lines between Berlin, Frankfort-on-Main, Strasburg and Königsberg. It will also be introduced on the lines projected between London, Paris, St. Petersburg and Rome.

Profit-sharing Telephony in Cleveland.

The outcome of the system of profit-sharing instituted by the Cuyahoga Telephone Company of Cleveland, through the efforts of its president, F. S. Dickson, will be noted with interest. In a letter to all employes of the company, dated July 21, 1903, President Dickson said that, in order to maintain the best service to patrons and consequently to increase to the utmost the earnings of the company, untiring vigilance would be necessary on the part of everyone employed by the company, no matter what his capacity. In order to encourage extra effort by the employes it was decided that one-fifth of the surplus earned between July 1 and December 31, 1903, should be divided pro rata among the employes. Now, that the six-month trial is over, the result seems to be satisfactory. The company is pleased by increased receipts, while the employes divided the sum of $4,154.69 as their share of the profits, an average of about one-third of a month's salary to each. The employes have given all the aid asked and each now takes a personal interest in the affairs of the company. It is probable that the plan will be continued in operation.

Women in German Telephone Service.

At the present time 4,000 women are employed in the telephone service of the German Empire. In Berlin alone 1,000 women are engaged. These positions are so popular and the number of applications is so large that the number of accepted and qualified women whose names have been registered in the order in which they were considered is so large as to supply occupants for any possible vacancies that may result in the course of the next few years. Only physically strong girls are admitted to the service. They must possess a good character and be of respectable families. They must be between 18 and 30 years of age and [illegible] or widows without children.

New England Money in the Telephone Business.

The Boston Post of recent date says: "The American Telephone and Telegraph Company has always had a big and unique problem on its hands. With each succeeding year the problem grows bigger to the company and more interesting to the public. The question is how to raise funds for new construction each year. That sounds simple enough, but when one considers that the capitalization has more than doubled within the last four years, from less than $100,000,000 to nearly $200,000,000, and that it has almost all come from the limited field of New England, the nature of the problem can be more readily grasped. It is a peculiar fact that nearly all of the money for the development of the telephone business all over the country has come from New England. Even the incorporation in New York and the listing on the New York Stock Exchange did not avail to help the situation any in this respect. New York investors have little desire to buy telephone stock. They did take a little last year when it was at its extreme low point, perhaps 20,000 shares, but this has since been sold in the Boston market again. For the most part demands for new construction each year have been met by increase of the capital stock, but there was so little buying power in New England last year that there is talk of a bond issue for the coming year to raise a part of the necessary money, though that is a matter not decided as yet."

Of course, taking the whole country, considering the Independent and Bell licensee companies, New England capital put into the telephone business is much less than that from the rest of the country; but it is true that the parent Bell company has been peculiarly a New England institution, so far as stock ownership is concerned.

GENERAL TELEPHONE NEWS.

Material is arriving from the United States for the construction of the new telephone system at Hermosillo, Mexico.

A charter has been granted to the Newkirk Home Telephone Company of Newkirk, Okla. J. H. Smock, J. H. Thompson and Guy Stovall are principally interested. The capital stock of the company is $5,000.

At a meeting of the council of Anaheim, Cal., preliminary steps were taken toward granting a telephone franchise to the Home Telephone Company. The franchise will likely be offered for sale at the next meeting of the council.

It has become necessary to employ a number of special policemen from the Brighton Park station, Chicago, to guard the wires of the Chicago Telephone Company, for that company reports that for weeks the copper strands have been disappearing, cut from the poles by thieves attracted by the value of the material as scrap.

Eastern capitalists have purchased the property of the Lawrence Telephone Company, having exchanges at Ironton, Ashland, Catlettsburg and Russell, Ohio; Rush, Ky., and minor other points. Local owners say the deal was made through brokers, and they do not know the purchasers, but it is asserted that the Central Union Telephone Company is the purchaser.

Announcement is made by the Illinois Tunnel Company, successor to the Illinois Telephone and Telegraph Company, that service through the automatic telephones now in use or to be put in will be free until April 1st. Charges made for calls upon the new system since the installation will be canceled. President Wheeler explained that the company's motive is "to educate the public to the use of this business-men's exchange."

The Central Union Telephone Company has recently disposed of one of its toll lines west of Rockford, Ill. The line is located between Rockford and Pecatonica, Ill., and was purchased by the Winnebago County Telephone Company. The exchange at Pecatonica will be almost entirely rebuilt. A new switchboard of larger capacity will be installed and several additional trunk lines will be added to the exchange. A large number of overhead wires will be replaced by underground cables.

Independent telephone operators of Northern Illinois met recently at Aurora to effect an organization which will have as its territorial boundary on the south the Illinois River. Meetings of the association will be held quarterly and the matter of long-distance extensions and a standard toll tariff will be taken up at once. The next meeting will be at Rockford, Ill., on call, when a constitution and by-laws will be adopted. The officers elected for this year are: President, E. R. Conklin of Aurora; vice-president, W. C. Landon of Rochelle; secretary, R. H. Gibbons of Rockford.

The Sunset and Home Telephone Companies at San Diego, Cal., will not be merged, it is said. Col. J. M. C. Marble of the former corporation declares that the rumors which have been circulated to that purport are unfounded, and says that if the suit now in court to determine the rights of the trustees to hold all the stock should be decided against the Home Telephone Company there would still be a holding firm known as the Home Trust Company, which would retain control of all the stock and preserve the present organization. An official says that the company will be ready to operate in San Pedro by the first of April.

BOOK TABLE.

THE LOCALIZATION OF FAULTS IN ELECTRIC-LIGHT AND POWER MAINS. By F. Charles Raphael. London: Electrician Printing and Publishing Company (New York: The D. Van Nostrand Company). 1903. Pp. (5¾ by 6⅜ inches), 205, with 112 illustrations. Price, $3.

This, the second edition of this book, is a revision made necessary to keep pace with the modifications in the methods of distribution, and, as was the case in the first edition, it is intended to be as much of a practical handbook as possible. Beginning with definitions and short but clear descriptions of the different testing instruments in common use and the more simple tests, the way is cleared for the more difficult tests which have to be made on large distributing systems. Chapters II. and III. deal with "Insulation Testing of Low-pressure Networks During Working" and "Insulation Testing of High-pressure Mains During Working." Numerous methods are given by which this may be accomplished. Methods of fault localizing follow, all the most approved means being described, and the central-station operator will encounter no difficulty in finding examples which will fit the conditions of his system. General notes concerning the application of the methods of testing described are an important addition to the book. One chapter is given up to "Fault-signaling Networks," the ingenious system introduced by Mr. Agthe and Dr. Kallmann of Berlin. In order that the reader need not be confused on the mathematical parts, which consist only of arithmetic and algebra, a chapter is given to explain the algebraical steps in the derivation of the formulas used in the different methods of testing described.

Indiana Magnetic Springs.

Water as a magnetizing agent would seem to be an impossibility, yet a hydrographer of the United States Geological Survey has made experiments upon the water of Cartersburg Springs, Ind., which go to show that magnetic properties do exist in the water of those springs. According to a communication in the Literary Digest, the knives and needles experimented upon were first tested thoroughly to see that they had no residual magnetism. A knife was placed in the water for five minutes and at the end of that time it was said to pick up non-magnetic needles without difficulty. Needles dropped upon the bricks saturated with water from the springs quickly took on magnetic properties. That the magnetization is due to the water and not to local conditions about the spring is proved, it is thought, by the fact that the same results are arrived at by taking some of the water in a glass and performing the experiment at a distance from the spring. The question arises—Is it possible that magnetic oxide of iron may be dissolved in the water? If so, the phenomenon may be explained in that way.

Safety Derailing Switch.

Writing to a daily newspaper in Chicago, a resident of Detroit, Mich., says: "I have been in your city for some time on business, and since my arrival have noted quite a number of accidents to trolley cars by being run into by railroad trains, and I desire to call your attention to a simple device which is used in my own city of Detroit for preventing such accidents. It is a simple track switch, which is always held open by a spring or other device, and is placed some distance from the railroad crossing, so that a trolley car will be run off the straight track into the switch, which stops at the curb, unless the car is stopped before reaching the switch. When the car stops, the conductor goes in advance and raises a lever, which throws the switch to the straight track, so that it will be seen that if the brakes fail to work on the car it is only switched off, and not permitted to go to the crossing. This simple device has been in use in Detroit and Cleveland for 10 years, and I am advised by the superintendent of the electric railroad that there has never been an accident at any crossing where this device has been placed."

Fire-engine Trolley-car Truck.

A trolley-car truck for transporting fire engines to distant fires at a high rate of speed has been tested in Chicago. The truck is designed to be drawn by a trolley car and its platform stands 18 inches from the ground. The fire engine is easily run up an incline on to the truck, and when in place two gates are closed, which serve to hold the engine in position. The test was made at Seventy-seventh Street and Wentworth Avenue and the Chicago Fire Department expresses its approval of the new truck for transporting engines quickly to distant fires with which the apparatus in the vicinity is unable to cope.

In detailing his plan for the beautifying of Grant Park on the Lake Front in Chicago, John C. Olmstead, the Boston landscape architect, recently took occasion to say that the Illinois Central Railroad Company would operate its suburban-train service by electricity. Until this change is made, he asserted, great difficulty would be encountered in the growth of grass and shrubbery in Grant Park, owing to the gases and cinders from the locomotives.

CORRESPONDENCE.

Great Britain.

London, January 26.—I have made reference on several occasions to the work of the engineering standards committee and its sub-committees. One of these latter deals specifically with the standardization of generators, motors and transformers, and is composed of both manufacturers and consulting engineers. This sub-committee has worked hard for several months with regard to the standard rating of electrical machinery. In order more clearly to ascertain the opinions of everyone interested in this branch of the industry a large number of circulars has been dispatched and the replies thereto have indicated a considerable difference of opinion with regard to certain details of great importance. These specially relate to the standardization of motors, both of the alternating and continuous-current types, and in order to avoid protracted negotiations through the post it appeared that the best solution of the difficulties would be for all interested to confer. Consequently arrangements have been made to hold a conference of consulting engineers and manufacturers upon these questions to-day or to-morrow.

The electric-lighting troubles of the St. Marylebone Borough Council (London) continue to be a source of anxiety to the taxpayers and of amusement to those not directly concerned. As reported in these notes, the last stage reached by the council was the promotion of a bill in Parliament to obtain the necessary borrowing powers to purchase the portion of the company's undertaking within its area. In the mean time several influences have been hard at work to defeat this project. Before the bill can be allowed to proceed a taxpayers' meeting had to be called to approve of the bill, but before this could be held two offers were received—one from the existing supply company as to running the undertaking upon terms, and another proposal from a company at present having no connection with the affair. The taxpayers' meeting was held a few days ago and a stormy affair it was, resulting in a decided negative as to proceeding with the bill. There the matter stands for the present, the general feeling apparently being that a compromise should be come to with the company.

Last year a large number of bills were being promoted by local authorities which would enable them to undertake the wiring of premises for the electric light and so set up competition with the local contractors. These latter formed themselves into a strong association and by dint of determined opposition succeeded in having the objectionable clauses expunged. This year there has been a noticeable absence of this tendency on the part of the municipal authorities. In one case, however, resentment is shown to the previous action of the contractors and a bill was introduced on the same terms as before. The contractors, following their usual custom, have objected and threaten opposition, to which several members of the particular Borough Council refuse to give way. The result will be interesting to watch.

Mention was made last week to the proposal to introduce a surface-contact system in Musselburgh (Scotland), a large suburb of Edinburgh. Dr. A. B. Kennedy, the traction expert, has now reported to the council in its favor, and this opinion remains to be confirmed by the local authority.

A statement has been issued with regard to the work which is being carried out by the postoffice authorities in connection with the laying of underground telegraph mains to the north of England. Experimental cables have been in use for some time, but the one between Warrington and Birmingham has now been replaced by a permanent cable which is laid in a three-inch cast-iron pipe and contains 103 wires encased in lead. The wires may, if necessary, also be used for telephone purposes. A large number of other important towns in the Midlands and North Midlands will also shortly be similarly connected.

Dublin Castle, the official residence of the Viceroy of Ireland, is to be equipped with some 3,000 electric lights. The installation includes the state apartments.

In December, 1902, it will be remembered that a couple of deaths took place at the Fulham (London) public baths, the rails of the corridors of which had become charged through defective electric wiring. At the inquest no blame was attached to anyone, but after this long interval it is stated that the local authority will take legal proceedings against the wiring contractors in connection with the affair.

Mr. Hoadley, the borough electrical engineer at Maidstone (Kent), has experimented largely with Nernst lamps and now has a large number in use for street lighting. The last 100 of the one-half-ampere size he found to have an average life of 598 hours—longer than has hitherto been obtained.

G.

New York.

New York, February 6.—The Technology Club of New York, representing the alumni of the Massachusetts Institute of Technology, at their annual banquet last night filled the glasses of the guests with what was termed "liquid sunshine." The "liquid-sunshine cocktails" were made luminous by the application of minute quantities of radium, but were not drank until all lights had been extinguished

in order to give the full illuminating effect. Later, radium paint, prepared by Lester D. Gardiner, illuminated the banner and played a leading part in a series of experiments which were grouped under the title of "Having a Little Fun with Science." There was no attempt made to introduce any new wonders of radioactivity, but Mr. Gardiner had prepared a series of entertaining demonstrations of what can be done with radium in the way of amusing spectators. The "liquid sunshine," which was drunk without apparent disturbance of the diners' digestive organs, was the novel feature of the dinner which abounded in surprises. President A. R. McKim of the club introduced Charles Neave of the General Electric Company as toastmaster, and then followed toasts by many prominent men. Mr. Gardiner explained the composition of this novel drink. A portion of esculin, a fluorescent chemical, was dissolved in each glass of water. In the glass was a tiny tube containing a minute portion of radium. The radium, acting on the esculin, caused the contents of the glass to glow in the darkness. Then appeared in the darkness several skeleton jumping jacks. The luminosity of these and other toys which Mr. Gardiner introduced was explained in a little speech, in which he said: "I now call your attention to radium paint, so-called; this is merely a new form of our old friend, luminous paint. It has been found that radium exceeds it in luminosity, and when radium can be manufactured in commercial quantities there is no doubt that a production which can properly be called radium paint can be made." The recipe for "liquid sunshine" has been given as follows: One part of sulphate of quinine; 50,000 parts of water; stir until dissolved in a glass; insert a tube of radium until sufficient radioactivity is developed to cause the water to throw off violet or ultraviolet rays; drink it as you would sauterne or champagne.

The Electric Railway Test Commission of the Exposition, St. Louis, 1904, held its second meeting in this city a few days ago. The commission consists of J. G. White, chairman; H. H. Vreeland, James H. McGraw, George F. McCulloch and W. J. Wilgus, and all were present. A great deal of work was accomplished in furthering the plans for an elaborate series of tests of electric-railway equipment at the exposition. The work has been divided into four main divisions, namely: City and suburban equipments, interurban equipments, heavy traction equipments, and new systems of electric traction.

Radioactivity was one of the subjects discussed at the meeting of the New York Academy of Science held recently. Dr. George B. Pegram of the department of physics in Columbia University, told of the result of a year's work with radium, and illustrated by means of a little instrument of his own design the difference in the force, or penetrative power, of the radiations.

At a meeting of the Greater New York Canal Association the matter of the substitution of electricity for mules as motive power on the Erie Canal was considered. The plan was not favored, though definite action will be deferred until a later date. The association recognized the necessity of improved methods of towing, but desired to study the various systems of towboat propulsion before making decision. O.

New England.

Boston, February 6.—Although the state board of railroad commissioners reserved final decision in the novel case brought before it relative to the franchises granted in Pittsfield to the street-railway company there, and revoked by the newly elected board of aldermen, there were some decisions at the hearing given by the board, on points sought to be made in evidence, which were distinctly favorable to the company. Chairman Jackson ruled, for instance, that the petitions for such franchise were legally framed and properly before the board of 1903, and the franchises had been legally granted; also that some technical omissions in the plans and petitions did not operate to prevent the approval of the plans before the state board at this time. The railway authorities are hopeful, therefore, that their contention will be sustained in toto, and that the revocation will be overruled by the commissioners, as prayed for by the company's officials.

Judge Colt of the United States Circuit Court has denied a petition recently presented for the appointment of a receiver for the Wareham and Buzzard's Bay Street Railway Company. This petition was brought by the American Electrical Works and the Augusta Trust Company, unsecured creditors, whose claims aggregate about $20,000.

Cohasset and Scituate, which have a large number of wealthy summer residents, who are opposed to the invasion of the trolley lines proposed for these towns, have decided adversely upon the petition of the Norwell, Scituate and Cohasset Street Railway Company for a franchise. In each of these places the situation is presented of the overruling of the desires of local merchants and all-the-year residents by the selectmen in deference to the wishes of the summer contingent.

The Newton Street Railway Company has petitioned the railroad commissioners for authority to issue $250,000 coupon bonds, bearing interest at five per cent., par value $500 each, the proceeds to be used for additional extensions and equipment.

The Legislature has been asked to reopen a matter which concerns all the shore resorts along Massachusetts Bay from Boston to Gloucester. It relates directly to the proposition to grant a franchise for the operation of trolley cars through Manchester-by-the-Sea, as the people who have summer homes there delight to call their retreat. The project, however, is known as the North Shore railway, and it means connecting lines along the route near the ocean. In the past there have been strenuous fights against the plan, and they will probably be renewed.

All but about 50 shares of the $950,000 stock issue of the Edison Electric Illuminating Company was taken by the stockholders when the time limit on rights expired on February 1st.

In marked contrast with the situation elsewhere in New England, the Boston street-railway system was run on schedule time during the unusual snowfalls of January throughout this section.

In one of the cases pending this week in the courts in Boston against the Boston Elevated Street Railway Company for damages to property by reason of the noise of the elevated trains, the defense was raised regarding holdings in the vicinity of the Dudley Street terminal, so called, that the property had been enhanced in value to such an extent by its conversion from a residential to a business property, on account of the changed character of the section near the station, as to be actually improved rather than harmed, and that no damages ought to be awarded. Real-estate experts were called, who testified in harmony with the road's contention. The jury, however, awarded the plaintiff damages to the extent of $6,933.

The Northern Maine Seaport Railway Company has filed articles of incorporation at Augusta, Maine, the promoters intending to operate a road by electricity from LaGrange, on the line of the Bangor and Aroostook steam railroad, to Belfast, which is on the line of the Maine Central railroad. It is proposed that the trolley lines shall serve as connections between the two railroads, with two spurs to tidewater also, one in Stockton Springs and the other in Searsport. The length of the road and branches will be 60 miles, and the company is capitalized at $360,000.

Plans are under way at Glastonbury, Conn., for the creation of a storage basin and the establishing of an electric power plant on the stream that runs through the southern part of the municipality. Two power houses are in contemplation and an expenditure of about $300,000 is involved in the carrying out of the scheme. The promoters intend to sell electricity for light, power and traction purposes.

Fire in the basement of the central station of the Western Union Telegraph Company at 109 State Street, this city, did considerable damage yesterday to cables and wires and cut off all communication with the outside world from the main office, crippled the stock exchange and newspaper service, and for a time threatened the safety of scores of employes. Workmen of the Edison Electric Illuminating Company had been at work for some time putting in extra circuits for the supply of current to operate motor-generators in place of batteries. Suddenly there was a flash and flames soon burst from the conduits and set fire to the woodwork. It took several days to restore the service to its normal condition. B.

Dominion of Canada.

Ottawa, Ont., February 6.—The Canadian Westinghouse Company is about to open an office in Winnipeg, Manitoba. Mr. Scribner, late of Seattle, Wash., will be the manager.

At the coming session of the Dominion Parliament a company, in course of organization, will apply for a charter to construct an electric railway from Ottawa to Buckingham, thence up the Leivre River to a point on the line of the proposed Grand Trunk Pacific railway, and on to James Bay. The names of those interested, it is understood, comprise Ottawa and Montreal capitalists.

A project is under way to connect with the city of Quebec, by means of an electric railway, a number of parishes surrounding that city. A company has been formed and application will be made to the provincial Legislature for a charter. The object of the company is to carry freight as well as passengers. Work will be started upon the proposed line as soon as the charter is granted. The capital of the new company will be placed at $100,000.

The Sherbrooke Heat, Light and Power Company has made a proposition to the council of the city of Sherbrooke, Que., that if the company is granted a contract for 15 years it will give a reduction on the flat rate of 16-candlepower lamps from $6 to $5 and an equal share of the net profits. It is expected that this proposition will be turned down, as the municipal-ownership party claims that as the company is only able to pay four per cent. there would be little left for division. It is understood that if the electric company does not accept the city's offer of $200,000 for electric-light and gas plants that a company will be formed and electric light supplied the city at a minimum figure.

It is announced that the Ottawa and New York railway, operating between Ottawa and Tupper Lake, N. Y., is to be converted into an electric road during the current year. This is confirmed officially by General Manager Gays, who states that the estimates for the proposed change are now being prepared. When this proposal is carried into effect the Ottawa and New York railway will be the first steam road in Canada to operate its lines by electricity. A line operating out of Ottawa is very favorably situated for introducing the experiment of running its passenger trains by electricity. In and around the city of Ottawa there is an abundance of electric power developed, and a great deal more which can be utilized at any time. Mr. Gays says that his road proposes to get power at Cornwall and at Massena Springs, N. Y., there being at the same time waterpowers all along the line which can readily be used. He hopes to have the proposed change from steam to electricity effected this year.

The paper of Dr. Stanfield relating to electrothermic production of iron and steel, which was read before the convention of the Canadian Society of Civil Engineers at Montreal, enlarged upon the commercial possibilities of the electric process. He stated that the question of the production of iron and steel depends entirely upon the relative cost of fuel and electrical energy. Where cheap fuel is obainable electrical energy would not compare favorably, owing to its higher cost, but where electricity can be produced under favorable circumstances there is the possibility that in certain cases where crucibles are now used to fuse material, in order to protect it from the gases present in an open-hearth furnace, the electrical method will be adopted. W.

Southeastern States.

Charlotte, N. C., February 6.—Representatives of the Bay Shore Terminal Company of Norfolk, Va., are endeavoring to place $150,000 worth of receiver's certificates for the proposed extension.

B. A. Troutman of Mooresville, N. C., is the promoter of a stock company which expects to build an electric-light plant in that town.

The Virginia Passenger and Power Company of Richmond and Petersburg, Va., has stopped all work on the Appomattox River. It is hinted that Mr. Gould wishes to curtail the expenses of the company this year. Over $1,500,000 was the original amount intended for improvements.

The Newport News (Va.) Shipbuilding and Dry Dock Company contemplates the building of an electric plant for manufacturing electrical equipment for ships.

The Southern Kentucky Interurban and Traction Company is said to be contemplating the building of an electric line from Hopkinsville to Franklin, Ky.

A new dynamo with a capacity of 1,500 lights has been installed for the electric-light company of Chester, S. C., by the General Electric Company.

The Newport News (Va.) and Old Point Railway and Electric Company, at an adjourned meeting of the stockholders, elected the following directors: W. J. Payne of Richmond, C. B. Orcutt of New York, G. A. Schmelz of Newport News, Samuel Register of Richmond, L. P. Stearnes of Newport News, F. W. Darling of Hampton, and John B. Kimberly of Old Point. The directors then elected officers for the ensuing year as follows: President, William J. Payne; vice-president, George A. Schmelz; treasurer, Henry L. Schmelz; secretary, D. C. Zollicoffer; general manager, H. H. Carr.

The Louisville (Ky.) and Southern Indiana Traction Company is offering to float $250,000 five per cent. first-mortgage gold bonds, to be used in building into Louisville. The common stock of the company is $2,000,000 and the preferred stock is $1,000,000.

The Georgia Railway and Electric Company of Atlanta reports a gross income for the last year of over $1,412,000, which is an increase of over $380,000 for the year preceding.

It is reported that Meikleham, Dunsmore & Ackerman of New York have agreed to take $2,000,000 of the stock and bonds of the Great Falls Power Company, which, it is said, will shortly begin the work of developing the Caney Fork Falls, near Nashville, Tenn., where a minimum of 2,000 horsepower is available. The concern proposes to supply power and light to many towns in Central Tennessee.

Lane Bros. & Co. have the contract for building an electric line for the Albemarle Soapstone Company of Virginia.

The Southern Street Car Manufacturing Company has bought a site near Ensley, Ala., for the new plant soon to be erected. L.

Texas and Mexico.

Austin, Texas, February 4.—A number of representatives of the Temple and Belton Interurban Electric Railway Company, which has been organized to build an interurban electric line between Temple and Belton, Texas, will arrive this month from Pennsylvania for the purpose of investigating the situation with the view of ordering the work of construction commenced. Samuel Watts of Belleville, Texas, is [illegible]

The Wills Point (Texas) Electric Light Company has been organized with a capital stock of $10,000 for the purpose of installing and operating an electric-light and power plant. The incorporators are O. L. Johnson, Charles E. Brown and W. B. Rogers, all of Wills Point.

The Corsicana Traction Company has increased its capital stock from $100,000 to $125,000. It is

reported that the company will make important improvements and will extend its system at Corsicana, Texas.

The Cisco Electric Light Company has been organized at Cisco, Texas, with a capital stock of $10,000 for the purpose of installing and operating an electric-light and power plant. The incorporators are W. A. McSpadden, Aaron L. Mayhew and Abner L. Mayhew, all of Cisco.

It is reported that the falls of the Colorado River at Marble Falls, Texas, are to be utilized for generating electric power for an electric plant to be installed in that city.

Surveys are being made preparatory to the commencement of construction work on the new electric street-railway system in Vera Cruz., Mexico. Weetman, Pearson & Son are interested in the proposed improvement.

Dell Linderman has applied to the Mexican government for a concession to establish an electric-power plant at El Rosario, state of Sinaloa, Mexico, for operating the machinery of mines. If the application is granted he will be authorized to utilize water from the Plomosas River.

The Guggenheim Exploration Company will install considerable electrical machinery at its mining property, situated at Santa Barbara, Mexico. An electric-power plant will be installed for operating the company's narrow-gauge railroad and to run the machinery of the mill.

Governor Pimentel of the state of Oaxaca, Mexico, has been making an exhaustive investigation of the waterpowers of that state with the view of encouraging the establishment of electric-power plants. Accompanied by an engineer, he has visited the mountainous districts and directed a preliminary survey of the principal streams. He recently inspected the northern slopes of the mountains, where he made a study of the possibilities of uniting a number of the smaller streams with the view of affording waterpower for generating a large amount of electrical energy. It is stated that there is ample waterpower, if properly directed, to provide the necessary electrical energy for operating the machinery of many industrial plants and mines throughout the state.

It is stated that the Mexican Light and Power Company will soon let the contract for 2,000 steel towers to be used in the construction of its transmission lines from Necaxa to the City of Mexico and to El Oro, a total distance of about 150 miles.

Preparations are being made by the Mexican Tramways Company for the early construction of important extensions of its electric-railway system in the City of Mexico. Hon. Charles Stanhope is president of the company.

H. F. Gomferd of San Francisco, Cal., is in Leon, Mexico, investigating the situation with the view of establishing an electric street-railway system to operate over the principal streets. H.

Michigan.

Detroit, February 6.—The Clark space telegraph company of Detroit has received permission from the pastor of a Birmingham church to conduct experiments from the top of the church spire. A plant is being installed at Birmingham by the Clark company.

President E. M. Hopkins, Secretary Frank Wescott and John P. Hopkins of the Grand Rapids and Ionia Electric Railway Company, at a recent meeting at Grand Rapids, arranged for the first move on the proposed interurban line. It is stated that ground will be broken as soon as the weather permits. The route between Grand Rapids and Lowell, which has not yet been decided, will probably be via Cascade.

The Quincy council has granted a franchise to the Toledo and Michigan electric railroad for the use of Chicago Street. Work was commenced on the line west of Quincy last fall, and the promoters claim that the line from Adrian to Coldwater will be completed next summer.

The proposition to grant a heating and power franchise in Lansing to John H. Chase and others, which was submitted to a vote of the people, was carried by a majority of 35. Nearly 600 votes were cast.

General Manager Merrill of the Detroit, Ypsilanti, Ann Arbor and Jackson electric road recently rigged up a car to cut the ice in the center of the track, and after running it a day it was pronounced a great success. The road has had to contend with severe ice and sleet storms that have prevailed near Ypsilanti. In some instances ice formed in the center of the track so high as to strike the motor cases on the larger interurban cars. President J. D. Hawks of the company issued a circular to the men congratulating them on their efforts to keep the road open in spite of unprecedented conditions of weather. The new flange cutter helped greatly to cut the ice, he said.

With just 20 contracts, the current available at the Bay City electric-lighting plant for commercial purposes is taken up. Superintendent Fitzhugh will make a few changes which will permit of a few more contracts. The demand for the municipal electric-light current has given an impetus to the $50,000 bonding project, which is to be voted on at the coming election.

The Sault Edison Electric Company has filed amended articles of incorporation increasing its capital stock from $57,000 to $150,000. C. G. W.

Indiana.

Indianapolis, February 8.—The recent revision of fares on the lines of the Indiana Union Traction Company has brought forth numerous protests and there are indications of trouble in enforcing it. At Alexandria the City Council has taken up the matter. The franchise in that city provides for a five-cent fare anywhere in the city and to and from Orestes, three miles west. Despite this clause the fare to Orestes, where a large glass factory is situate, has been raised to 10 cents. The council has demanded that the five-cent fare be restored.

The Richmond City Council has passed an ordinance requiring the Richmond Street and Interurban Company to sell tickets for its city lines on its cars. At present the company sells six tickets for 25 cents, but declines to allow purchases to be made except at the company's office.

The Vincennes, West Baden and Louisville Traction Company has asked for a subsidy of one-half of one per cent. from the townships of Vincennes and Harrison, in Knox County. This will amount to $50,000. The election will be held on March 12th.

The Louisville and Southern Indiana Traction Company, which operates the street-railway systems in New Albany and Jeffersonville and the interurban line between the two cities, has secured a lease on the Big Four Bridge for an entrance into Louisville, with a terminus at Third and Main Streets, in the heart of the business portion of the city, and is now ready to build. With its leased and owned lines, amounting to 23 miles, the company will serve a population of 270,000.

A franchise has been granted for a second electric line into Clarksville, a suburb of Jeffersonville, which will be built this year. As planned, the road is to run from New Albany to Arctic Springs, east of Jeffersonville. From a scenic standpoint the route will be equal to any in the country.

The City Council of Aurora has ordered the Aurora Gas and Electric Light Company to discontinue lighting the city after February 15th, when the present contract will expire. The company was also instructed to have all electric-light poles removed from the streets within 20 days after the expiration of the contract. Aurora will then be in darkness unless the courts are invoked for a restraining order.

A new electric-lighting plant will be erected at Cicero, Ind.

The Indiana Trust Company, receiver, has recommended that the equipment for the East Chicago electric-light plant be improved.

The Indianapolis Board of Public Works will receive bids until February 15th for a 10-year contract for electric lighting of the city. The requirements call for 1,600 arc lights, 2,000 candlepower each, and 500 incandescents of 50 candlepower each. A surprise has been sprung in the shape of a proposition made to the city by Mr. G. E. Fisher, representing the Fidelity Construction Company of Detroit, to build a modern municipal lighting plant, to operate it for 10 years, and then turn it over to the city at a merely nominal cost.

The commissioners for the Indiana Industrial School for Girls are advertising for bids for the construction of a power house and the equipping of the schoolhouse and the five cottages with electricity. The appropriation is $150,000. E. M. Johnson is secretary. F.

Northwestern States.

Minneapolis, Minn., February 6.—The Minnesota Central Railway Company is being organized by J. J. Allen of Minneapolis and others. It is planned to build an air line from Minneapolis to Duluth which will be operated by electricity. The road will be of standard gauge.

The Stillwater (Minn.) Gas and Electric Company will build a dam at Apple River, Wis., and later erect a power house. The company will make improvements costing about $200,000.

An electric line is being surveyed between Green Bay, Wis., and Manitowoc. It is probable that the road will be built by the Knox Construction Company.

A franchise was voted at Parkersburg, Iowa, to the Marshalltown Electric and Interurban Railway Company. Clarksville will vote a franchise also.

The city of Sturgeon Bay, Wis., has bought the electric-light plant. The council has decided that an election to ratify the action is unnecessary.

Bids for the installation of a municipal electric-light plant at International Falls, Minn., are advertised for.

T. A. Marshall will rebuild his electric-light plant at Keithsburg, Iowa.

The city of Greenwood, Wis., may be bonded for $5,000, in order to carry out some contemplated improvements on the electric-light plant.

J. L. Kiichli and others of Minneapolis will apply for a franchise this month for an independent interurban line to St. Paul, to be built by the Minnesota Power and Trolley Company. It is stated that $2,000,000 will be spent this season by the company.

The city of Marshfield, Wis., may buy the present electric-light plant or build a new one. A committee of the council is investigating the matter.

Black River Falls, Wis., has bought the waterpower of the Owen Lumber Company for the purpose of using the power for the electric-light plant.

The Milwaukee (Wis.) Electric Railway and Light Company and the Milwaukee Light, Heat and Traction Company are planning the expenditure of $2,000,000 this season in improvements, including new general offices, central car barns, enlargement of the power houses and extensions of the system.

A perpetual electric-light franchise has been voted by West Allis, Wis., to the Milwaukee Light, Heat and Traction Company.

The new electric-light plant at Seward, Neb., has been finished and will be put into commission shortly.

The Central Electric Company has leased its plant to the La Crosse (Wis.) Gas and Electric Company, and both systems will hereafter be operated by the latter company.

The Knox Construction Company announces that the line from Green Bay, Wis., to Fond du Lac will be completed by July 1st.

During the last year the gross earnings of the Twin City Rapid Transit Company amounted to $4,063,938 and the net earnings to $2,185,888. The company carried 80,844,592 passengers. A seven per cent. dividend was paid on preferred and six per cent. on common stock.

Filiatraule & Nelson have opened for business at 119 West First Street, Duluth, Minn. They will carry a line of electrical supplies and automobiles.

A municipal electric-light plant may be installed at Montgomery, Minn.

The Maxwell (Iowa) Telephone Company will put in an electric-light plant at Maxwell.

C. A. Frueauff, who bought in the property of the Lincoln (Neb.) Traction Company, has tendered the money, $1,160,000, for the plant, and will be given possession unless the company pays the amount of the lien under which the property was sold. R.

Rocky Mountain States.

Salt Lake City, Utah, February 4.—The Boise (Idaho) Transit Company's entire holdings have been purchased by I. W. Anderson and other Philadelphia capitalists, and a new company has been organized, with Mr. Anderson as president and Charles A. Hutchison as general manager. The new company will immediately begin improvements of the system, and, besides the extensions under contemplation, a number of new cars will be purchased.

Articles of incorporation of the Greeley and Northern Railroad and Utility Company, with headquarters at Greeley, Colo., have been filed. George J. Spear is named as president and George H. Sethman as vice-president and general manager. It is the intention of the incorporators to begin their system in Greeley and extend the line a distance of about 25 miles over a rich agricultural region to a connection with the Burlington railroad. Freight will be transported on this line to the railroad for shipment. The company will also establish a number of power plants from which small towns will be furnished with electrical power for lighting and other purposes.

Among the equipment to be used by the company which is about to begin the construction of an electric system between Salt Lake and Ogden, Utah, will be passenger coaches 50 feet in length and each equipped with four 56-horsepower motors. The cars will have a smoking compartment, vestibules and toilet rooms and will be heated by an electrical process.

The Rambler Telephone Company has decided to build a line from Laramie, Wyo., to Tie Siding, a distance of 18 miles, at which point the line will be connected with an extension of a telephone line from Fort Collins, thereby establishing direct communication with Northern Colorado towns. G.

Pacific Slope.

San Francisco, February 4.—The electrical work on the new Belasco Theater is being done by the electrical department of the Joshua Hendy Machine Works.

The M. Levy Company has secured the contract for the electric wiring of a six-story office building to be erected by C. A. Buckley on Market Street, near Spear. The work is to cost $1,330.

J. H. Henry of San Jose, who is interested in the system of street railways in that place, was in San Francisco last week.

C. Downing of Hanford, Cal., was in this city last week. He is connected with the electric-power system of Hanford.

The Reynolds Electric Supply Company has been incorporated in this city with a capital stock of $10,000, all fully subscribed.

The annual meeting of the stockholders of the United Gas and Electric Company was held last week. A rumor is current in electrical circles that the Standard Electric Company, which is under the same control as the United, will soon be acquired by the California Gas and Electric corporation.

Mortimer Fleishacker, of the American River Electric Company, states that the American company's new plant, near Placerville, has been in successful operation since the start, and that his company will be furnishing power for not less than 10 gold dredges in the Folsom district within the coming 12 months.

The stockholders of the Mutual Electric Light Company are pretty generally paying the assessment of $1 per share, which was declared delinquent on January 25th.

Work has been commenced on the electric plant to be constructed at Athena, Ore., and will be hurried to completion in order to have the plant in

operation as soon as possible. C. A. Barrett is one of the prime movers.

It has been practically decided to go ahead with the preliminary work for the erection of an electric-lighting plant at Long Beach, Cal. The matter has been referred to the Board of Public Works with instructions to engage the services of an electrical engineer to take charge of the work.

Eastern capitalists have purchased the holdings of Messrs. Kirk, Barnett and Elan, who are interested in the construction of an electric railway to run from Milton to Walla Walla, Wash. Preliminary plans for the work are now being perfected.

At the last meeting of the county commissioners of Seattle, Wash., several franchises were granted providing for the construction of electric railways in and around Seattle. One of the franchises is for the construction of an electric line to run from Renton to Tolt, and was granted to W. H. Lord and William Entwistle.

Miller & Miller of Portland, Ore., are contemplating the construction of a power plant on the Thomas Place, near Bull Run. Water will be taken from Badger Creek for generating power.

At the last meeting of the Board of Supervisors of Suisun, Cal., it was decided to grant a franchise to construct and operate an electric road from Fairfield to Vacaville, and March 7th has been fixed as the time for receiving bids. A.

Seattle, Wash., February 4.—T. H. Crawford of Union, Ore., is asking for a franchise for the construction of an electric railway in Union County. The present plan is to construct a large waterpower and electric plant on Cathering Creek. It is proposed to run a motor line from Hot Lake to Union, a distance of six miles. Hot Lake and the Cove are then to be connected with a branch which will run through La Grande. The entire undertaking means an outlay of $600,000.

It is reported that Frank Scott of Centralia, Wash., is making preparations to petition the city for an electric railroad to Chehalis, Wash.

Recent reports from the East indicate the successful financiering of the projected electric railroad from Chesaw to Curlew. W. C. Peary wires from Indiana that on his return the survey will be rushed and work commenced.

The Columbia Gold Mining Company at Kettle Falls, Wash., has shut down its works and will improve them and install an electric plant.

The Chamber of Commerce of Portland, Ore., has been petitioned by the citizens of Mayfield to build an electric line from the Cowlitz River into that town. The citizens propose to put up 40 per cent. of the money needed for the venture.

The City Council of Waterville, Wash., has entered into a 15-year contract with George H. Gray & Son of Entiat to furnish electric light and power at $50 per horsepower a year, the city to use 50 or more horsepower. Entiat is on the north side of the Columbia River, about 15 miles from Waterville.

The work on the big electrical plant of the Athena Electric Power Company on the Walla Walla River, near Athena, Ore., has been commenced.

The Prosser Falls and Electric Light Company has applied to the City Council of Prosser, Wash., for a franchise to furnish that city with electric lights. P.

PERSONAL.

T. B. Redmond, who has been superintendent of the Saginaw Valley Traction Company, in Michigan, which operates 80 miles of electric lines in the vicinity of Saginaw and Bay City, has been made superintendent and manager of the East Moline and Watertown (Iowa) interurban line in place of Stuart Wise, who goes to Boston to take the place of chief engineer in the office of Blood & Hale.

Max von Recklinghausen of New York lectured on January 21st before the Camera Club of London on "Mercury-vapor Lamps and Their Application to Photography." Before the lecture James Swinburne, the well-known engineer, who presided, was photographed by the light of two 60-volt, three-ampere Cooper Hewitt lamps, placed four feet from the subject, the time of exposure being half a second.

William Mavor, chairman of the finance committee of the Chicago City Council and a leading member of the committee on local transportation, was stricken with apoplexy on February 8th while the committee on local transportation was in session in the City Hall considering matters relative to the Chicago City railway franchise. Alderman Mavor is serving his eighth year in the council and is looked upon as the leader of the municipal legislative body. His condition at this writing is considered serious.

George Stewart Johnson, vice-president and general manager of the Grand Rapids Railway Company, died at his home in Grand Rapids, Mich., on January 30th. His death was the result of a second operation for a tumorous growth. Mr. Johnson was 53 years of age and was highly esteemed by buisness men and citizens of Grand Rapids, where he had lived all his life. The funeral took place February 2d and all cars of the street-car company were stopped for five minutes at 2 p. m. Directors of the company officiated as pallbearers.

William T. Banallack, who for the last 11 years has been electrical inspector for the Michigan Inspection Bureau and prominent in the social and Masonic circles of Detroit, has resigned to accept an offer from the Western Factory Insurance Association, an organization of 32 fire-insurance companies. His title will be that of special agent, his field taking in Michigan, Illinois, Indiana and Ohio. His headquarters will be in Chicago. Mr. Banallack will leave for his new field on March 1st. He is president of the National Electrical Inspectors' Association, which held its last annual meeting in New York.

Announcement is made by the New York, New Haven and Hartford Railroad Company that N. E. Smith, superintendent of the telegraph department of the road, will also have charge of the telephone service of the company. This means, it is understood, the retirement of B. A. Kaiser, who has had supervision of the telephone system, with an office at the terminal station in Boston. Upon the consolidation, Mr. Smith's headquarters will be in New Haven. The use of the telephone has superseded the telegraph in many ways in the practical railroading of the company, except in the train-dispatching service, where it is utilized only in an auxiliary or subsidiary manner and in cases of emergency.

ELECTRIC LIGHTING.

The city of Clinton, Miss., has voted a bond issue of $10,000 for the erection of an electric-light plant and construction of a system of waterworks.

Holbrook & Son of Juliaetta, Idaho, are contemplating an electric-light system in Kendrick as an extension to their plant at Juliaetta, which they are now building.

A company in which A. M. Cummings of Fairmont, W. Va., is interested is said to have secured a franchise for the construction of an electric-light plant and telephone system in Bridgeport, Ala.

The electric-light and power plant at Hannibal, Mo., is to be enlarged and improved, the city having recently voted $100,000 for this purpose. A. M. Nippert is superintendent in charge of the plant.

The Fall Mountain Electric Light and Power Company of Bellows Falls, Vt., will extend its system to the village of Saxtons River, about five miles distant. The company will furnish street and residence lights and power.

Incorporation papers have been filed by the Virden Electric Light Company of Virden, Ill. The object is the furnishing of light, heat and power. J. N. Hairgrove, U. G. Tucker and C. W. Carr are the incorporators.

L. W. Goodman of Kansas City, Mo., is at the head of the Lees Summit Electric Lighting Company, which has recently been incorporated with a capital of $10,000 to build an electric-light plant at Lawton, Okla. T.

The Wilson Cypress Company of Jacksonville, Fla., contemplates the installation of an electric-lighting plant at its mill. In addition to illuminating its own buildings, the company will furnish light to the Selden Cypress Door Company.

The Citizens' Electric Light, Ice and Telephone Company has been incorporated, with headquarters at Douglas, Ariz. The company is capitalized at $75,000 and proposes to acquire electric-light and power plants, telephone systems, water systems, cold-storage systems, pipe lines, etc. D. A. Richardson and W. G. McDonald are interested.

S. D. Pickett and associates of Jacksonville, Fla., are about to begin the development of a waterpower and the construction of an electrical transmission plant near Albany, Ga. It is said that 15,000 horsepower can be developed. The city of Albany will contract with Mr. Pickett for power for its electric-light plant. Other industries will be established in connection.

A company to be known as the Columbus (N. J.) Public Service Company was recently incorporated in New Jersey with an authorized capital of $1,500,000. The company proposes to make and distribute light, heat and power. The incorporators are Horace S. Gould, H. O. Coughlan of New York, Joseph M. Mitchell of Newark, B. S. Lantz of Brooklyn and Louis B. Dailey of Jersey City.

ELECTRIC RAILWAYS.

Arrangements have been concluded, it is announced, for the building of a third-rail system between Elmira and Corning, N. Y. A private right-of-way has been secured, and only one grade crossing will be made.

The Board of Health at Cleveland, Ohio, at its next meeting will adopt a resolution making it a violation of the law to overcrowd street cars. The limit will be the number that can be seated and a reasonable number standing, but no crowding will be permitted. The Board of Health claims the conditions that prevail in Cleveland cars at certain periods of the day are a menace to health, and Mayor Johnson and the city law department declare that the board has power to regulate the condition of the cars just the same as it can regulate the sanitation of public buildings. Sanitary officers will be expected to enforce whatever rules are made.

A company of Portland (Oregon) capitalists has secured title to land on the sides of Mount Hood, on which it proposes to erect a large electric-power plant for the operation of an electric road to the top of the mountain. The falls of the Sandy are located on the property where, it is said, an inexhaustible waterpower can be obtained. The grade to the top of the mountain is one of the easiest ascents in the country, and it is thought that a smooth rail would enable electric cars to make the climb with more ease than do the cars on the cog-wheel line up the steep Pike's Peak.

Traffic reports of Chicago elevated roads for January show up rather poorly, which, the managers generally agree, is due largely to the closing of the theaters. The severe cold weather during the month is also thought to have interfered with traffic. The Metropolitan Elevated shows a decrease of 358 passengers from the daily average of 112,771 for January last year. The others do not show a decrease, but are not up to the usual increase. The Northwestern Elevated carried a daily average of 70,204 passengers against 68,266 last year, and the South Side Elevated shows 87,601 against 86,637 the previous year.

AUTOMOBILES.

Inquiries recently made by the House of Representatives concerning the number of vehicles of all kinds maintained at government expense are said to have disclosed the fact that the United States government owns just one automobile. It is employed in Secretary Cortelyou's department and is an electric vehicle used principally in carrying mail to and from the Bureau of Standards, located in the suburbs of Washington.

The Appellate Court has decided against the city of Chicago in the suit brought by members of the Chicago Automobile Club to determine the validity of the city ordinances requiring that owners must secure a license to operate their automobiles and display a number. In the decision the court said: "The speed of the automobile may be regulated and reasonable safety appliances, such as gongs and brakes, may be required; but to compel one who uses his automobile for his private business and pleasure only to submit to an examination and to take out a license is imposing a burden upon one class of citizens in the use of the streets not imposed upon others."

POWER TRANSMISSION.

The Capital City Light and Power Company of Santa Fe, N. M., has taken the preliminary steps looking to extending its transmission lines to the city of Albuquerque and Las Vegas. It is proposed to furnish those places with light and power for municipal and commercial purposes. The plans of the company contemplate the construction of a large electric-power plant at the Pecos River falls, situated 14 miles from Santa Fe. Among those interested in the company are Colonel W. S. Hopewell of Santa Fe; J. C. Bonner of Toledo, Ohio; J. W. Miller of Denver, Colo., and A. R. Gibson of Santa Fe.

SOCIETIES AND SCHOOLS.

The third annual convention of the Southern Supply and Machinery Dealers' Association will be held at Old Point Comfort, Va., April 12th to 14th, in Hotel Chamberlain. A successful meeting is anticipated, as the membership of the association has increased materially during the last year. A cordial invitation is extended by the association to all supply dealers, whether they be members or not, to be present. The office of the president of the association is at Knoxville, Tenn.

TELEGRAPH.

The annual report of President Clowry of the American District Telegraph Company for the year ended December 31, 1903, shows revenues from all sources of $577,677, a decrease of $32,366, and net revenue of $100,377, a decrease of $10,341, with a deficit of $11,019 for the year. President Clowry says that the revenues of the company were affected by the distinctly unfavorable local conditions which prevailed throughout the year. The loss is largely in earnings from messenger service, and has, as far as possible, been offset by reductions in the expenses, aggregating $22,025.

SPACE TELEGRAPHY.

Space-telegraph messages are said to have been successfully exchanged recently between Chicago and St. Louis by the system invented by G. S. Piggott of Chicago, which was briefly described in the Western Electrician of August 8, 1903. Mr. Piggott's system does not require the use of long poles to elevate the antennæ above surrounding obstructions, as was shown by demonstrations conducted by him in August last.

The states of Amazonas and Para, Brazil, have contracted with a private company for the use of the Marconi space-telegraph system in their respective territories, and each of these states has granted

[illegible] of 150 cars, equal to about $37,500 [illegible] about $75,000, for 15 stations. Any [illegible] beyond this number are to be paid for above this amount of subsidy. The federal government has granted permission for the necessary experiments, stations, etc. It is stated that the company will be organized and financed in the United States.

PUBLICATIONS.

The Mica Insulator Company is issuing a little booklet giving the 1904 price list for micanite, linotape, empire cloths and papers and M-I-C compound. Micanite commutator insulation is made in sizes and shapes to fit any of the standard railway motors built by the large concerns.

A counting-room calendar issued by the Empire Wire Company of Cleveland is especially valuable, as it bears on the back a table showing the average price of copper in each month for the years from 1883 to 1903, inclusive. In looking over the table it is interesting to note that the highest monthly and yearly averages during that period were respectively 18⅝ cents a pound in April, 1899, and 17.8 cents a pound in the year 1899. The lowest monthly and yearly averages were 9⅛ cents a pound in July and August, 1895, and 9.54 cents a pound in 1894.

The C. and C. Electric Company of New York city has recently issued two bulletins, Nos. 147 and 149. No. 147 gives a list of some of the users of type "M. P." generators and motors and also a list of the principal installations of C. and C. generators and motors. Bulletin No. 149 is devoted to multipolar dynamos and motors, type "M P." These machines are all direct-current, covering standard sizes and ratings. There are also several direct-connected generating sets of small capacity shown. Detailed descriptions of all the different parts of the machines are given in the bulletin.

Motors for crane work form the subject matter for bulletin No. 40 of the Crocker-Wheeler Company of Ampere, N. J. The machines are all of the enclosed type and range in capacity from 1½ horsepower to as high as 60 horsepower. Three sizes of controllers are shown for the operation of the various sizes of motors, the resistances being built of separate sections of iron and mica. The bulletin is well illustrated, showing all the different types and the methods of mounting and connection to the crane. Dimension diagrams also serve to aid in ordering.

Field clay conduits are described in a folder which may be had upon application to C. J. Field, 29 Broadway, New York, or F. B. Badt & Co., Chicago. This product is manufactured at Brazil, Ind., and also in various clay territories in New York, Ohio and Pennsylvania. The size of the duct holes has been standardized at 3⅜ to 3½ inches in different types. A handy chart in the folder shows at a glance the construction cost in cents a duct-foot for any given number of ducts in a conduit subway by means of three curves representing street construction of cobble or macadam, granite or paving brick on concrete base and sheet asphalt, respectively.

A list of plants operating Wood single-phase alternators in the United States on December 1, 1903, is contained in Bulletin No. 1051, issued by the Fort Wayne Electric Works, Fort Wayne, Ind. This list is given by states, alphabetically arranged as regards the towns or cities in which the plants operate. Two types of single-phase alternators, one 60 and the other 140 cycles, are also shown. These machines are built in standard sizes from 25 to 400 kilowatts, and are almost without exception used for lighting work. Bulletin No. 1052 is descriptive of a multiple alternating-current street arc-lighting system. The bulletin contains some really good information on apparatus and installations of this system of street lighting which was perfected by the engineers of the Fort Wayne company and which is especially designed to fill the demand for a simple and inexpensive method of lighting small towns or isolated sections of large places. The subject of enclosed versus open arcs is also given considerable space, showing the comparative light distribution of the two methods.

The first number of the Electric Club Journal of Pittsburg is dated February, 1904, and it forms a creditable and pleasing magazine. The Electric Club has been organized to provide a means for the effective co-operation among the men of the Westinghouse companies, and the new monthly periodical is intended primarily for the members of the club and as an adjunct to the educational work of that organization. However, it is anticipated that other young engineers will be interested, and the privilege of subscribing is extended to non-members of the club. It is promised that a majority of the articles will be written about Westinghouse methods and apparatus by men who are responsible for Westinghouse practice. The first number contains 55 reading pages and is well illustrated, the frontispiece consisting of a handsome portrait of George Westinghouse. There are articles by Frank H. Taylor, Charles F. Scott, W. M. McFarland, F. D. Newberry and others, two of them devoted to the new alternating-current series motor. The publication committee consists of Mr. Newberry, editor; J. H. Smith, business manager, and Mr. Scott, member from the board of directors.

MISCELLANEOUS.

The German government, after long experiments, has ordered turbine engines to be constructed for the German third-class cruiser Merkur (formerly the Arcona, of 2,373 tons' displacement) and for a torpedo boat.

A franchise has been granted to the Garfield Electric Company to operate a grain and stock-ticker service in Chicago. This company will be the first corporation to use the tunnels of the Illinois Tunnel Company for its wires.

A Kansas newspaper correspondent states that since the closing of Topeka saloons Kansas City whisky houses have been shipping liquor to Topeka in 16-candlepower electric-light bulbs. A number of drinking resorts are said to be supplying their customers with bulbs filled with whisky.

Dr. George F. Kunz of New York city, special agent of the United States geological survey, has been appointed commissioner of the radium exhibit at the St. Louis Exposition, and has been authorized to prepare and procure the necessary material, comprising radioactive substances of all kinds, and also exhibits to illustrate the action of radium compounds, ultraviolet light and Roentgen rays upon mineral and chemical substances. This exhibit is to be made by the United States geological survey in the United States Government Building in St. Louis. There will be a second exhibit of radium and radioactive substances in the Mines Building.

Peter Thornley, an Englishman, is said to have invented a new type of steam engine which may be a factor in steam-locomotive construction. In railroad locomotives the steam is not admitted until the piston has moved some distance in the cylinder. This leaves a large vacuum to be filled before the steam can commence to do its work. Thornley has so devised the valve of his engine that steam is admitted at the very commencement of the stroke, and is so easily adjusted that the expansive force of the steam allowed to enter is just sufficient to drive the piston to the end of the stroke. The engine is said to be very simple in construction and it is asserted that the saving of fuel is 25 per cent.

Naval constructors will watch with deep interest the first trip across the Atlantic by the Victorian, the first of the Allan Line's new turbine steamers for transatlantic service, now nearing completion in Belfast. Great modifications and alterations in the turbine system to suit the Atlantic requirements are being employed by Mr. Parsons, the designer of the turbine, in the equipment of the Victorian. The widespread arrangement of the propellers, three in number, each on a separate length of shafting, and the rapidity with which the power can be directed upon each of the shafts, separately and in any direction, is expected greatly to assist the ship's maneuvering power. A space-telegraph apparatus is fitted on board between the decks. Turbine steamers on the Clyde and in the cross-channel service are said to have proved a great success, chiefly because they insure more comfort to passengers in rough water.

Experiments in the manufacture of rubber from a weed which grows principally in Utah and Idaho have been in progress for several years by John Beck, a wealthy mine owner of Salt Lake City. It is now asserted that the experiments have proved satisfactory and the discovery is considered of commercial value. A company is now forming for the manufacture of the rubber. The plant contains a white substance, which, when extracted and heated chemically, is said to form a substitute for rubber. Experiments have been made in various parts of Utah with a view of growing the plant, and it was found that it could be cultivated as readily as corn or wheat. Several thousand acres are to be devoted to growing the plant. However, there have been so many substitutes for rubber that have failed to "make good" that the result of the present attempt will be awaited with some incredulity.

A method of reducing or entirely suppressing the synchronizing or equalizing currents which flow between single or multiphase alternators is described in a patent recently secured by a Bohemian inventor. In the arrangement employed for securing these ends the alternators are connected to the primary windings of a pair of transformers placed between the alternators, and of which the secondary windings are connected together. The windings are arranged so that normally the magnetic effects of the currents in the primary and secondary windings balance each other. In the case of a larger number of alternators a corresponding number of transformers is used, all the secondary windings being connected together in series. For three-phase machines, three-phase three-core transformers are employed, and in each case the primary windings of the transformer and the armature windings of the generator have a common neutral point.

The new White Star liner Baltic, now in course of construction, will, it is said, possess at least 47 different kinds of electrical appliances for reducing perils at sea, for cooking, navigating purposes, and for the general convenience of passengers. The ship will make her first trip next summer. The moment another ship enters the "magnetic field" of the Baltic the needle of the instrument points toward the vessel approaching or being overtaken. Even the rhythmic beats of an unseen steamer's screws are registered by means of the delicate apparatus. Another safeguard is an electric contrivance to show if the ship's lights are burning properly. An electric log for ascertaining the speed of the ship and an electric lead for ascertaining the depth of water are also on the list. Another electric novelty registers all signals, including steam syrens, a record that might prove of great value in a trial of a maritime case in court.

A Viennese invention provides a method of and means for automatically regulating the consumption of energy in a system of electric traction. The current is supplied by a compound-wound generator, of which one field winding is in connection with a separate exciter, while the other is in series with the mains leading to the motor. These two windings are arranged in such a manner that they act in opposition, so that the voltage of the generator is varied automatically in a contrary sense to the main current, which avoids the necessity for employing starting resistances in the main motor. The motor field may be separately excited by a battery with a reversing switch and rheostat for adjusting the strength of the field as required. In applying the invention to electric railways, independent generators are employed for supplying the separate leads of a number of line sections, on each of which not more than one train is running at the same time.

TRADE NEWS.

The Adamant Porcelain Company has acquired the plant of the Broadway Pottery Company at Broadway, Va., where it will manufacture electric porcelain supplies. John E. Rollor is president of the company.

Sealed proposals are invited until February 23d for certain electric-light wiring in the United States Treasury Building, Washington, D. C. Drawings and specifications may be obtained upon application to the secretary of the treasury.

It is stated that Indiana capitalists have been corresponding with the Commercial Club of Louisville, Ky., with a view to investing $250,000 in the establishment of a plant for the manufacture of electrical machinery of all kinds in Louisville.

Sealed proposals are invited until April 12th for furnishing the Bureau of Printing and Engraving with a quantity of electrical supplies, a list of which, together with specifications, will be furnished upon application to William M. Meredith, director, Washington, D. C.

The Machinery and Electrical Company of Los Angeles, Cal., has applied for incorporation for the purpose of manufacturing and dealing in machinery, engines, boilers, dynamos, electrical supplies, etc. The capitalization is $250,000, and the petitioners are Hugh T. Duff, W. B. Woodill, W. F. Gibbs, C. F. Baker and F. C. Armstrong.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until March 1st for furnishing the navy yards at Norfolk, Va., Charleston, S. C., and Port Royal, S. C., with a quantity of electric blowers, electric fans, electric traveling cranes, etc. Blank proposals will be furnished upon application to the navy pay offices in the cities named.

The Shanahan Trolley and Specialty Company has been incorporated with a capital stock of $50,000. The headquarters will be at Utica, N. Y., where the company will manufacture an automatic trolley catcher, the object of which is to catch a trolley pole after the wheel has jumped the wire. The directors are T. B., J. D. and J. G. Shanahan, H. P. Snyder and E. S. Van Valkenburg.

The New York Herald of February 6th says: "A meeting of the creditors of John T. Hunt, who did business as Zimdars & Hunt, electrical contractors at 127 Fifth Avenue, who made an assignment on Thursday, was held yesterday at the office of Goeller, Shaffer & Eisler, 207 Broadway, and a committee was appointed to make an examination and report a basis of settlement. The liabilities are about $50,000 and the assets are estimated at from $28,000 to $30,000."

A company for the exploitation of the aluminothermic process of welding, called the Goldschmidt Thermit Company, has been formed in this country. The company proposes to conduct business in connection with the chemical and tin-smelting works of Th. Goldschmidt, Essin-Ruhr, Germany. The president of the company is Dr. Hans Goldschmidt of Essen-Ruhr, and the vice-president and treasurer, E. Stütz of New York. The offices of the company are located in the Wall Street Exchange Building, New York city.

BUSINESS.

The Central Electric Company of Chicago is sending out a circular which quotes attractive prices on American Circular Loom flexible conduit, for which it is sales agent. The company especially requests that anyone who is in the market for this class of material should write for quotations. Attention is also called to the fact that the company is sales agent for the Edison primary batteries, formerly Edison-Lalande batteries, and that it car-

ries a complete stock of these batteries and is prepared at all times to make prompt delivery.

The bulk of the pole business is usually crowded into the time when all kinds of coarse freight are just starting to move and everyone wants cars at once. The consequences are well known—everyone has to wait. However, the Maltby Lumber Company of Bay City, Mich., reports that trade is already improving, and if things keep up it will have done as much business before March 1st as it usually does by the 15th of April. Apparently its customers are taking a step in the right direction. The whole affair is something like Christmas shopping. While the quality of the stock shipped does not vary, "first come is first served."

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) February 6, 1904.

750,793. Selective Signaling System. Garrison Babcock, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed July 17, 1903.

Included in the circuit is an electrically operated signaling instrument whose controlling circuit includes switch contacts adapted to be brought into electrical connection to send a current impulse in one direction over the line and to be electrically disconnected upon the actuation of the instrument to send a current impulse in the reverse direction over the line. A plug-seat switch has contacts included in the controlling circuit for the signaling instrument.

750,807. Telegraph Apparatus. John E. Carney, Montgomery, Ala. Application filed February 24, 1903.

In a telegraph instrument is a permanent magnetic system having one of its poles divided into two pole-pieces of like polarity. An armature is pivoted on one of the pole pieces and is free to play between the other pole-piece and the other pole of the magnetic system. A winding, when energized, modifies the action of the permanent magnetic system.

750,811. Oil Switch. William H. Cole, Watertown, Mass., assignor of one-half to Welles E. Holmes, Watertown, Mass. Application filed April 29, 1903.

Below the level of the oil, openings in the side of the casing are provided for, and terminal wires, which are connected to switch contacts on the inside of the casing. The portion of each wire immediately inside of the casing is stripped of its insulating covering and buried in cement or similar material, whereby the oil is prevented from working its way along the wire by capillary attraction.

750,818. Trolley Harp or Fork. Fred P. Crockett and Osro P. Johnson, Kalamazoo, Mich. Application filed April 4, 1903.

Details are described of a trolley harp having forks extending upwardly for carrying the journals of the trolley wheel.

750,825. Automatic Trolley-line Reel. Charles F. Davy, Mohawk, N. Y., assignor of one-half to H. M. & M. M. Scofield, Mohawk, N. Y. Application filed March 19, 1903.

An automatic trolley catcher comprises a casing, a spring-actuated reel mounted in the casing, having a ratchet-wheel portion and a spring-actuated dog pivoted to the casing, and adapted to engage the ratchet wheel and hold the reel against operation. A tripping lever pivoted to the casing and adapted to overhang the reel has a line-eye for the trolley cord and a catch adapted to engage with the dog to release the latter.

750,835. Telephone Transmitter. Ernest B. Fahnestock, New York, N. Y. Application filed December 2, 1901.

In a telephone transmitter is a microphone, comprising an annulus with an inwardly projecting flange; a pair of flexible-disk covers secured at their outer edges to the flange, a pair of sound diaphragms secured at their center to the disk covers, and electrodes mounted on the inner side of the disk covers. Means are introduced between the sound diaphragms and electrodes, whereby the motion of the sound diaphragms will be communicated to the electrodes.

750,840. Well Drill. Christopher C. Fox, Higginsville, Mo. Application filed October, 8, 1903.

The drill shaft is mounted inside of an open-bottomed bucket and is driven by two motors mounted on the shaft inside the bucket, one for driving it in one direction, the other for the opposite direction.

750,845. Switching Apparatus. John S. Goldberg, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed November 26, 1902.

Combined with a pair of contact springs are actuating means for deflecting the springs to cause a change in the electrical connections. A second pair of springs, adapted to be deflected upon the reverse actuation of the deflecting means are made of stiffer material than the first pair of springs.

750,876. Electric Plant for Charging Storage Batteries. Joseph B. Meriam and Mark B. Crist, Cleveland, Ohio, assignors to the Meriam-Abbott Company, Cleveland, Ohio. Application filed July 25, 1902.

In an electric charging plant, for storage batteries, are combined a gas engine and a dynamo adapted to be operated as a motor for starting the engine. An electromagnetic switch controls the sparking circuit, the switch having its coil in the main circuit of the dynamo and storage battery, and operating to open the sparking circuit if the main circuit is broken. (See cut.)

750,889. Gas or Vapor Electric Lamp. Henry N. Potter, Pittsburg, Pa., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed May 28, 1901.

A tube of glass contains an anode of iron, and a cathode of mercury at or near the opposite ends of the tube, the tube having a small bulb just above the cathode.

750,890. Gas or Vapor Lamp and Apparatus Connected Therewith. Max von Recklinghausen, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed March 27, 1902.

Supporting and surrounding a gas or vapor electric lamp is a metallic box or casing at the end of the lamp containing the negative electrode, and means for regulating the admission of air into the box.

750,891. Gas or Vapor Electric Apparatus, Max von Recklinghausen, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed December 8, 1902.

Within a transparent container is a positive electrode of any suitable material, and a negative electrode of mercury, a part of the container adjacent to the mercury being coated inside and outside with metallic material, the outer band being electrically connected with the positive electrode.

750,892. Gas or Vapor Electric Apparatus. Max von Recklinghausen, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed October 17, 1903.

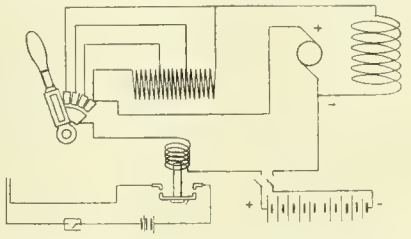
A box with compartments for containing a cooling liquid surrounds the electrodes to keep the temperature normal.

750,894. Electric Arc Lamp. Joseph A. Rignon, Berlin, Germany. Application filed April 11, 1902.

An insulating plate forms a partition between the socket portion and globe portion of the lamp. Electrode supports are pivotally mounted on the insulating plate and extend into the globe portion. A solenoid projects from the plate into the socket portion, while a movable core within the solenoid is supplied with a pivotal connection with both of the electrode supports.

750,938. Alternating-current Wattmeter. Charles A. Brown, Chicago, Ill. Application filed July 24, 1900. Renewed June 24, 1903.

The device is supplied with an armature and an equal number of pressure and current coils inductively related to the armature, the coils being disposed about a common



NO. 750,876.—PLANT FOR CHARGING STORAGE BATTERIES.

path of the magnetic flux produced by each. One of the current coils is opposed in magnetic effect to one of the pressure coils, the polar axes of the coils lying transversely to the plane of the armature, whereby two field poles of unequal strength are produced and movement of the armature is secured.

750,939. Process of Measuring Watts in Alternating-current Circuits. Charles A. Brown, Chicago, Ill. Application filed November 19, 1900.

Two energizing circuits carry currents adapted to produce magnetic fluxes, following substantially the same magnetic path. An armature operates in inductive relation to the circuits.

750,940. Alternating-current Motor. Charles A. Brown, Chicago, Ill. Application filed July 13, 1903.

A short-circuited winding is placed on the field core. A continuation of the core upon the inside of a shell completes the magnetic circuit through the core, the shell being adapted to rotate between the core parts to intercept the magnetic flux flowing therethrough. Means are provided for creating a single magnetic field through the core parts and the part of the shell between the core parts.

750,947. Electric Controller. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 16, 1901.

Essentially the device consists of an operating handle, a double-break switch, a blow-out coil between the two pairs of contacts of the switch, and a strip of magnetic material having its ends in line with the core of the coil, the switch contacts being located between the ends of the strip and the ends of the core.

750,966. Surface-contact Electric Railway. John H. Guest, Brooklyn, N. Y. Application filed February 26, 1903.

In a sectional-contact electric railway, a power circuit-closer comprises a number of laminated brushes beveled at their ends and a co-operating wedge-shaped contactor adapted to enter the spaces between the beveled ends in a direction parallel to the laminations and by a wedging action to separate them so as to create a series of individual contacts.

750,971. Switch for Series Arc Circuits. Caryl D. Haskins, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 22, 1902.

Main-circuit terminals and branch-circuit terminals are connected in series with the switch. Normally closed main contacts connected with the main terminals co-operate with a movable diamond-shaped piece carrying contacts connected with the branch terminals and adapted to enter between and separate the main contacts. (See cut on next page.)

750,972. Means for Controlling Electric Boosters. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 31, 1900.

Combined with a booster is a propelling electric motor, automatic circuit-breakers in the booster and motor circuits, respectively, and auxiliary tripping devices for the booster circuit-breaker, controlled by the opening of the motor circuit-breaker.

750,991. Railroad-signaling Device. Joseph R. Marchesseault, Meriden, Conn. Application filed November 13, 1902.

In the system are a pair of trolley rails and a pair of traffic rails, all divided into insulated sections, each trolley-rail section and the adjacent traffic-rail section being of equal length and terminating at the same point in the length of the roadbed. The trolley-rail section and corresponding traffic-rail section at one side of the roadbed are arranged in staggered relation with the trolley-rail section and traffic-rail section at the opposite side of the roadbed, and one end of each trolley-rail section is electrically connected to the adjacent end of an advance traffic-rail section, while the adjacent trolley-rail section is connected at one end to the adjacent end of a rear traffic-rail section.

750,993. Electric Switch. George Monson, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 25, 1901.

Details are described.

751,007. Telltale Register. William H. Pratt and Alexander J. R. Fiego, Lynn, Mass., assignors to the General Electric Company, Schenectady, N. Y. Application filed June 24, 1901.

An electrically controlled register comprises an operating magnet, a retractile armature, a counter intermittently operated by the armature, an electric meter, a switch operated thereby, and means by which the switch closes circuit through the operating magnet after a predetermined movement of the meter.

751,012. Fuse Box. Robert H. Read, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 1, 1901.

Inclosing the fuse is a fuse chamber having a discharge vent intersecting a part of the fuse, the vent being divided into a number of discharge paths of small diameter relatively to their length, terminating in enlargements at the points of outlet. Metallic heat absorbers are placed at the points of outlet.

751,013. Signal Device for Searchlight Projectors. Robert H. Read, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 2, 1901.

A signal device for searchlights comprises a refractory shell to cover the arc, slidingly mounted on one carbon. An operating handle on the outside of the drum connects and disconnects the shell with the operating device.

751,015. Electrical Measuring Instrument. Lewis T. Robinson, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 10, 1902.

Embodied in the invention is a magnetic field and a return element mounted therein, the field and element being relatively adjusted to subtend more than 90 degrees between positions of maximum and minimum flux through the return element.

751,016. System of Electrical Distribution. Nelson W. Rogers, Mount Vernon, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed February 9, 1903.

In an electrical distribution system are combined a multiphase circuit with a work or consumption circuit containing one or more translating devices, and a gas or vapor electric apparatus having positive electrodes and a common negative electrode. Each positive electrode is connected to a separate terminal of the supply circuit, and the negative electrode is connected with one side of the work or consumption circuit. Compensating coils also connect with the supply circuit at one end and at the opposite end with the opposite side of the work or consumption circuit. (See cut on next page.)

751,021. Automatic Signaling System for Electric Railways. Harry B. Snell, Cement City, Mich., assignor to the Snell Electric Signal Company. Application filed April 25, 1903.

A ratchet-wheel device has two sets of teeth. The wheel is operated in either direction through the agency of the armatures of electromagnets. Line wires from the main trolley circuit operate the setting magnets, successively, indicating the position of the car.

751,028. Means for Extinguishing Electric Arcs. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, New York, N. Y. Application filed August 1, 1902.

An electric switch consists of a fixed member having contiguous portions of conducting and non-conducting materials, respectively, and is supplied with a relatively movable member having a conducting portion adapted to make contact with the conducting portion of the fixed member. A mass of fused quartz carried by the movable member is arranged to interrupt the path of an arc or arcs which tend to form as the conducting portion of the fixed and movable members.

751,029. Lamp Socket. Julius C. Tournier, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 30, 1900.

Details are described.

751,046. Plate for Storage Batteries. Joseph Bijur, New York, N. Y. Application filed March 30, 1902.

Active portions having one or more grilles embody strips extending in one general direction and cross-members supporting the strips. The cross-members

are narrower at their ends, where the strips join the cross-members, whereby the junctures between strips and cross-members are strengthened, and the destructive crowding effect of the layer of active material diminished.

751,048. Signal System for Electric Railways. Charles P. Breese, Norfolk, Va., and Adoniram J. Wilson, Westfield, N. J., assignors to the Hall Signal Company. Application filed May 5, 1902.

The principal features of the system are a continuous feed conductor and an intermediate supply conductor for each block for conveying the current from the feed conductor to any car in the block.

751,071. Signaling Apparatus. Edwin L. Grauel, Rochester, N. Y., assignor to the National Telagraphone Company, Rochester, N. Y. Application filed March 19, 1903.

An apparatus for sending electric impulses over a line for signaling consists of a shaft turned by a crank and provided with a core which projects beyond the shaft and carries a commutator.

751,081. Coin-controlled Telephone Apparatus. Sherwood J. Larned, Chicago, Ill., assignor to the American Telephone and Telegraph Company, New York, N. Y. Application filed December 3, 1903.

The coin is controlled after being put into the slot by three electromagnetically controlled stops operated by the telephone operator.

751,084. Electric Switch. Ernest A. Lowe, Plainfield, N. J. Application filed January 17, 1902.

The improved electric insulating joint described comprises a metal coupling piece or plate clamped at its ends between sheets of insulation, and exterior plates of conducting material provided with suitably located offsets or shoulders, adapted to compress the insulation around the edges of the coupling piece.

751,087. Colored Sign Lamp. Walter Lytton, Chicago, Ill. Application filed May 4, 1903.

Different colored liquids are successively circulated around the bulb of the lamp, changing the color of the light.

751,100. Electromagnetic Ore Separator. Ellen M. Oviatt and Alexander Dean, Denver, Colo. Application filed May 3, 1901.

A pair of electromagnets is so arranged that the south pole of one is adjacent to the north pole of the other. Revoluble pole members are arranged to be moved in the magnetic circuit. A non-magnetic belt carries material to be separated under the influence of the magnetic field. (See cut.)

751,103. Telephonic Call Instrument. John D. Peachy, East Orange, N. J. Application filed January 6, 1903.

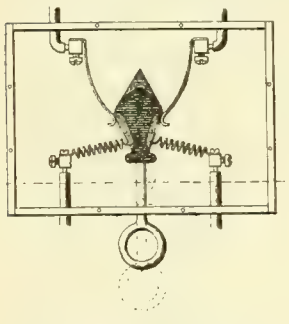
A series of contact points are electrically connected with a register, the individual points being adapted to successively contact with the receiver hook as it rises and close electrical connection with the register, whereby a record will be effected on the register preliminary to a conversation over the line.

751,120. Electrical Controller and Brake-operating Device. Walter W. Tice, Rahway, N. J. Application filed April 7, 1903.

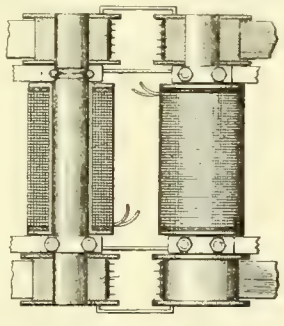
The mechanical features of the controller are described.

751,150. Electromagnetic Ore Separator. Alexander Dean, Denver, Colo. Application filed December 13, 1902.

Cranks rotatively seated in a magnet core and having outwardly extending arms, carry a delivery apron ar-



NO. 750,971.—SWITCH FOR SERIES ARC CIRCUITS.



NO. 751,100.—ORE SEPARATOR.

NO. 751,354.—INSULATED TACK.

ranged to traverse one of the pole members, and an apron arranged to traverse the other pole member, the latter apron being provided with means whereby material conveyed by the delivery apron and subject to magnetic attraction, is attracted.

751,174. Electric Switch. William F. Irish, East Orange, N. J. Application filed July 23, 1902.

Combined with a switch blade is an operating lever adjustably applied on either side of the pivotal point of the switch. A weighted lever presses the operating lever against the switch blade, having means for shifting the point of application of the operating lever with relation to the pivotal point of the switch blade.

751,175. Third Rail for Electric Railways. Lloyd G. Johnstone, New York N. Y., assignor of one-half to Jacob Arens, New York, N. Y. Application filed October 10, 1903.

The device consists of a current-conducting rail, angle irons at either side, cushioned springs supported by the angle irons, and a contact plate supported by the cushioning springs above the conducting rail, the under side of the contact plate being adapted to contact with the rail when depressed.

751,179. Process of Electrolytically Purifying Juices. Alexander Kollrepp, Berlin, and Alfred Wohl, Charlottenburg, Germany. Application filed June 10, 1902.

For purifying sacchariferous solutions, the process consists in the electrolysis of these solutions under addition to the same of saccharate of lead. The deposits obtained by this process are transformed by means of alkali and sacchariferous solutions, in order to again employ the reagent in this process.

751,191. Electric Motor. Hiram P. Maxim, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed March 12, 1903.

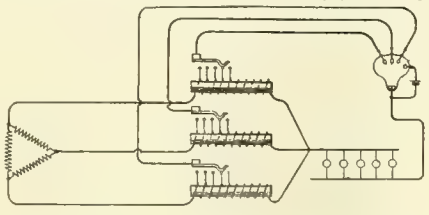
The motor frame comprises two end-to-end shells, one of which surrounds the armature, and is provided with pole-pieces and coils, and the other of which surrounds the commutator. End plates with centering shoulders and bolts for clamping the shells and end plates together, and to suitable hangers, are the other features.

751,193. Electrical Alarm Device. Burnett Menkin, Philadelphia, Pa. Application filed July 30, 1901.

Normally open first and second circuits contain means for making and breaking the first circuit. An electromagnetic-contact device included in and controlled by the circuit, is adapted automatically to make and break the first circuit and also to make and break the second circuit.

751,227. Electric Cut-out. William H. Verner, Pittsburg, Pa. Application filed August 28, 1902.

Binding-post holders secured in the base are supplied with binding posts reversibly mounted. Extended portions formed upon the binding posts engage in the post



NO. 751,016.—MERCURY-VAPOR RECTIFIER.

holders, and means carried by the post holders engage the extended portions for securing the binding posts within the block.

751,243. Motor Truck. William L. Austin, Philadelphia, Pa., assignor to Burnham, Williams & Co., Philadelphia, Pa. Application filed July 6, 1903.

In a motor car having two four-wheel trucks a motor is geared to each axle, one wheel of each axle being secured, and the other being loose upon the axle.

751,271. Apparatus for Heating Air or Liquids to a Constant Temperature. Victor Eltz, Abbazia, Austro-Hungary. Application filed June 18, 1902.

Connected in the circuit is a heating coil. A column of liquid metal forms the terminal of one side of the circuit and is exposed to the heat rays. A terminal for the other side is placed vertically above, a float resting upon the column. A contact supported by the float is normally in electric connection with the latter terminal, and constantly conductively related to the first terminal, whereby the dilation of the liquid column under the influence of excessive heat tends to break the contact with the second terminal and open the circuit.

751,294. Apparatus for Electrically Transmitting and Receiving Messages. Arthur T. M. Johnson, Highbury, England, assignor to himself, and Edwin Joseph Richardson, London, England. Application filed June 6, 1902.

An electrical transmitting instrument has a secondary winding and means adapted to produce electrical impulses in the secondary winding at different rates. A number of receiving instruments, each comprises an electromagnetic device having its terminals arranged to receive electrical impulses sent from the transmitting instrument. Master and secret-message reeds of different pitch are adapted to be respectively operated by the electromagnetic device when the same is energized by electrical impulses of corresponding pitch.

751,298. Trolley. James Kelly, Pittsburg, Pa., assignor of one-third to James Croak, Pittsburg, Pa. Application filed July 11, 1903.

The axle of the trolley wheel is journaled in a harp which in turn is mounted on a second harp.

751,304. Electric Vacuum Discharge Tube. Michel Krouchkoll, Paris, France. Application filed May 26, 1902.

Combined with the main tube are capillary tubes, threads or minute fragments of glass being suitably disposed within the main tube for the purpose of regulating the degree of rarefaction.

751,321. Electric-light Fixture. John J. Miller, Pittsburg, Pa., assignor of one-half to Henry Braun, Allegheny, Pa. Application filed May 21, 1903.

A shell or casing having a longitudinal slotway carries electric conductors. A contact and lamp-carrying block are longitudinally movable within the shell, and have a portion projected through the slotway.

751,344. Telephone Receiver. Lewis Sands and Charles C. Cadden, Cleveland, Ohio, assignors to the Williams-Abbott Electric Company, Cleveland, Ohio. Application filed March 6, 1903.

A support of insulating material carried by the receiver within its casing has apertures and terminals within the apertures. The support has a second set of apertures through which terminal wires of the receiver's electromagnet are passed into permanent connection with the terminals within the first apertures. The receiver's cord is provided with end tags adapted for insertion within the apertures and electrically connect with the terminals therein. Binding screws pass through the supporting block into engagement with the end tags of the cord.

751,353. Electric Blanket. Frank K. Singer, Wheeling, W. Va. Application filed September 8, 1903.

An electric blanket or similar covering is composed of an intermediate layer of flexible material and two layers of wire laid in independent lines, rows, or windings on opposite sides of the basic layer, with the lines on one side in parallel coincidence with and exactly opposite to the corresponding lines on the other side. A set of stitchings secures both opposite layers of wire to the intermediate flexible base, and an outer covering for the wires is added.

751,354. Insulated Wiring Tack. Donald G. Smart, Grand Rapids, Wis. Application filed January 5, 1903.

A single metallic shank having an elongated metallic head is provided with downwardly turned ends and a correspondingly shaped insulating auxiliary head having a socket to receive the shank and downwardly curved ends, the ends of the auxiliary head depending below the corresponding ends of the metallic head, and the upper surfaces of the insulating ends being in contact with the under surface of the shank head. (See cut.)

751,363. Printing-telegraph Receiver. James D. White, London, England. Application filed June 19, 1903.

Electromagnetic means serve to rotate the cylinder carrying the tape to be perforated; also the hammer which furnishes the necessary impact.

751,411. System of Lighting by Gas or Vapor Electric Lamps. Henry N. Potter, New Rochelle, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Original application filed May 28, 1901. Divided and this application filed February 26, 1903.

In a system of lighting by gas or vapor electric lamps, the lamp is connected in series to the secondary of a transformer. A heater, an interrupter, and the primary of the transformer are in shunt to the lamp. An automatic switch interrupts or opens the shunt circuit.

751,412. System of Lighting by Gas or Vapor Electric Lamps. Henry N. Potter, New Rochelle, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Original application filed May 28, 1901. Divided and this application filed February 26, 1903.

A heater is situated in proximity to the lamp. A transformer has both its primary and its secondary in series with the lamp and its primary in series with the heater. An electromagnetic coil common to the lamp and heater circuits, and a combined switch and circuit interrupter adapted to be operated by the coil, whereby the last-named apparatus will be operated intermittently during the starting period of the lamp, and will afterward permanently open the heater circuit when the lamp begins to operate, are the other features.

751,413. System of Lighting by Gas or Vapor Electric Lamps. Henry N. Potter, New Rochelle, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Original application filed May 28, 1901. Divided and this application filed April 30, 1903.

A transformer with its secondary in series with the lamp is situated in a normally open circuit, including the transformer primary and a suitable interrupter. Thermostatic means close the open circuit when the lamp has been heated sufficiently to become conductive.

751,414. System of Lighting by Gas or Vapor Electric Lamps. Henry N. Potter, New Rochelle, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Original application filed May 28, 1901. Divided and this application filed April 30, 1903.

The lamp is provided with a heater for vaporizing the mercury till the vapor becomes conductive.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on February 8, 1904:

357,280. Electrical Distribution. Wirt B. Harvey, Memphis, Tenn.

357,293. Electric Cutout. Oliver B. Shallenberger, Rochester, N. Y.

357,295. Commutator for Dynamo Electric Machines. George Westinghouse, Jr., and Albert Schmid, Pittsburg, Pa.

357,296. Electric Railway Signaling. George Westinghouse, Jr., Pittsburg, Pa.

357,337. Telephone Support. Samuel Rosenblatt, New York, N. Y.

357,359. Telephone Transmitter. William C. Barney, New York, N. Y., assignor to Josiah C. Reiff, New York, N. Y.

357,372. Electrical Fare Box. Walter A. Crowdus, Dallas, Texas.

357,374. Electro-Magnetic Motor. William H. Darling and Leo Bock, Jr., New York, N. Y., assignors of one-third to Gardner P. Harrington, New York, N. Y.

357,385. Switch and Holder for Incandescent Electric Lamps. William Hochhausen, New York, N. Y.

357,416. Electrical Burglar Alarm. Gustav Schleicher, Mount Vernon, N. Y., assignor of one-half to Edward G. and John C. Schleicher, Mount Vernon, N. Y.

357,452. Telephone Transmitter. Francis Blake, Weston, assignor to the American Bell Telephone Company, Boston, Mass.

357,516. Electro-Magnetic Attraction Device for Cars. John B. Atwater, Chicago, Ill.

357,538. Spring-jack Switch. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.

357,539. Metallic Circuit for Multiple Switchboards. John A. Seely, New York, N. Y., assignor to the Western Electric Company, Chicago, Ill.

357,540. Local Battery Circuit for Multiple Switchboard Systems. John A. Seely, New York, N. Y., assignor to the Western Electric Company, Chicago, Ill.

357,550. Galvanic Battery. Sidney A. Chase, Evart, Mich., assignor of one-half to William R. Mapes, Evart, Mich.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, FEBRUARY 20, 1904 No. 8

German Electrolytic Bleaching Plants.

For more than a century chlorine has been used for de-colorizing organic material and has been extensively used for bleaching purposes. About 100 years ago it was noted by Cruikshank that when an electric current was passed through a cell containing electrodes and a solution of salt, caustic soda was formed at one electrode, while chlorine was set free at the other. About two decades later it was suggested by Brande that a bleaching solution could readily be obtained by electrolyzing sea water. About 20 years ago a commercial system for producing bleaching liquor was devised by Hermite, using electrodes and passing current through a solution of magnesium chloride, or a solution of common salt, either of which gave excellent results. This process has been used extensively in this country as well as in Europe. Other processes were brought out by Woolfe, Imhoff and Kellner, the last named designing special apparatus for producing sodium hypochlorite. The apparatus designed for the two latter systems of producing bleaching liquor have been extensively installed by Siemens & Halske of Berlin, Germany.

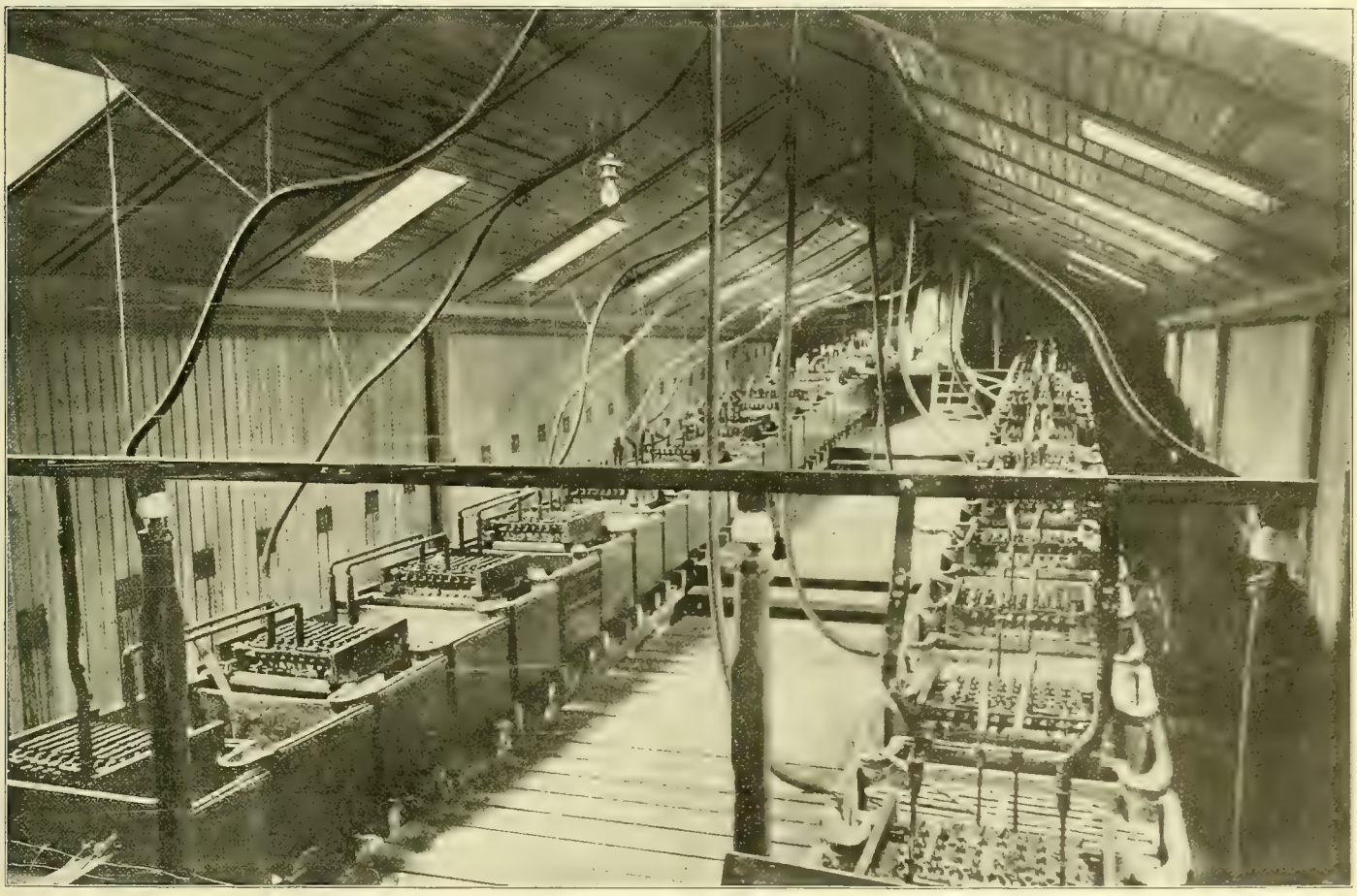


FIG. 1. GERMAN ELECTROLYTIC BLEACHING PLANTS.—INSTALLATION AT BILLINGSFORS, SWEDEN.

Fig. 1 shows a plant for producing bleaching liquor as installed by the Elektricitäts Aktiengesellschaft, formerly Schuckert & Co. of Nuremberg, Germany. Fig. 2 (next page) shows the latest form of this apparatus as manufactured by the Siemens-Schuckert Company of Berlin, while the plant illustrated in Fig. 1 is one located at Billingsfors, Sweden, and supplies a sufficient quantity of bleaching liquor for 32,000 pounds of soda and spruce cellulose a day. The electrolyzers are large troughs, separated into a number of compartments, and in these compartments are bipolar electrodes.

The new apparatus of the Schuckert system noted in Fig. 2 consists of troughs of stoneware, and the electrodes are of special construction, in some cases platinum-iridium wire being used. The salt solution enters at one end of the cell and travels in a zigzag path, being continually mixed by the hydrogen gas, so that no pump is found necessary for producing circulation. A cooling coil is provided in each cell, through which a stream of water is passed.

The trough in the Schuckert system is 2.5 meters in length and 0.6 meter high. The current used is from 50 to 150 amperes at a pressure of 110 volts. The former current is required for 400 liters and the latter for 1,200 liters of bleaching solution. From five to 20 kilograms of active chlorine is produced in 10 hours, according to the amount of current used and size of apparatus employed.

Another illustration on the next page (Fig. 3) shows the construction of a German cell for the production of bleaching liquor by electrolysis as constructed in Saxony by Haas & Stahl. This apparatus was designed by Drs. Oettel and Haas and shows the tank for the finished bleaching liquor; also the cooling coil at the right for holding the temperature below 24 degrees Centigrade. The electrolyzer consists of a small rectangular box, divided into small compartments by a number of vertical carbon electrodes, arranged in grooves. The electrolyzer may be noted in the center of the wooden box which holds the salt solution and the cooling coil. There are two holes at the lower edge of the electrolyzer, opening into each of the small compartments, and the solution passes through the perforations in the electrode and issues from the lower end of the electrolyzer containing active chlorine of about three grams per liter. It will be noted by the illustration that small canals are provided at the top of each compartment, through which the solution flows, emptying at one end of the side piece which runs along the length of the electrolyzer. A circulating current is set up in the liquor as soon as the electric current is turned on and the hydrogen set free, the solution passing into the electrolyzer through the holes at the bottom and overflowing at the top. This unit is designed to take about 75 amperes at a pressure of 110 volts, producing one kilogram of chlorine from a salt solution with the consumption of about five kilowatt-hours.

Chicago Automobile Show.

Electricity was well represented at the Chicago automobile show of 1904, which was held at the Coliseum last week under the joint auspices of the National Association of Automobile Manufacturers and the Chicago Automobile Club. The show was a success, surpassing in a marked degree any of its predecessors. In point of artistic decoration, attendance and number of exhibitors it exceeded the recent New York show, according to the statements of persons who attended both. The activity due to foreign competition in New York, however, was lacking, there being but two foreign exhibits of automobiles present, those of Benz & Co., Mannheim, Germany, and A. Darracq & Co., Paris, France.

A striking feature was the novel and artistic array of electric signs employed by the exhibitors as a means of attracting attention. There were at least 125 of these signs, representing many original ideas.

Space had been arranged by the management for 252 exhibits, and all were filled, but as several of the larger manufacturers occupied a number of spaces, the actual number of exhibitors was about 200. Of this number, 26 were electrical exhibits. It is but fair to say that the electrical automobiles attracted as much attention as those of other types. Six well-known manufacturers who devote special attention to electrical machines had exhibits. These were: Electric Vehicle Company, Hartford, Conn.; Studebaker Brothers Manufacturing Company, South Bend, Ind.; Woods Motor Vehicle Company, Chicago; Pope Motor Car Company, Indianapolis, Ind.; National Motor Vehicle Company, Indianapolis, Ind.; Holson Motor Patents Company, Grand Rapids, Mich. These companies report numerous sales and assert that, outside of the touring car, the electrical vehicle will soon be conceded the most practicable automobile for light city use and for heavy trucking on city streets. Society was attracted by the fine carriages, broughams, victorias and landaus, and, from the number of sales made in this class of electrical vehicles, it is apparent that the [illegible]

carriages in use in Chicago and vicinity is steadily increasing. All those who manufacture both electric and gasoline automobiles are agreed that business in the electrical line during the last year has increased by a much larger percentage than that of the gasoline vehicle. A. M. Welch of the sales department of the Studebaker company stated that business in electrical cars during December and January just passed was equal to four times that of the first 11 months of 1903. It is pointed out that until recently the plain and self-evident superiority of electric vehicles had not been impressed upon the

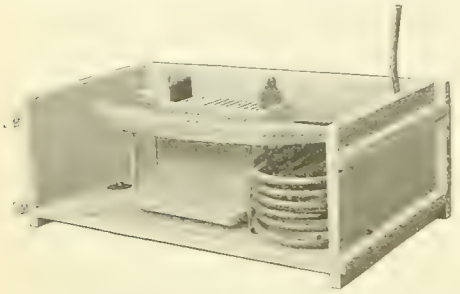


FIG. 3. GERMAN ELECTROLYTIC BLEACHING PLANTS.—A RECENT CELL (PAGE 145)

public mind, and the prospective purchaser was not quite sure precisely what sort of service he desired, or could secure, from the several contrasting types. Now, however, the public has learned to draw a sharp distinction between the ponderous car which is chiefly intended for a touring machine, and the simple electric wagon or carriage which demonstrates its usefulness and readiness every hour of the day. Summing up the experience of manufacturers and users for the last two years, it can be said that the electric vehicle is the only motor car that is absolutely clean, noiseless and odorless, and that it comes nearer the ideal in automobile construction than any other yet produced, except, probably, for use as a touring car.

The Holson Motor Patents Company of Grand Rapids, Mich., exhibited a four-ton electric truck which attracted probably as much interest as any other vehicle at the show. The truck was the first one of its kind ever built, and had just been completed. It is propelled by four "gyroscope" motors, one in each wheel, and the system was favorably commented upon as a solution of the horseless-truck problem. An illustrated article, descriptive of this interesting hub-motor system, is given on another page of this issue.

In the exhibits of the companies mentioned was variety enough to satisfy anyone. There were heavy trucks, light delivery wagons, runabouts, handsome private buses and a full line of fine carriages. The vehicles were equipped with the latest motors and storage cells, with improved controlling apparatus, nearly all having four forward and from two to four backward speeds. The speeds of the cars range from three to 18 miles an hour.

One of the vehicles which attracted attention was a fine Columbia town carriage in which electricity is utilized in many ingenious ways. There are incandescent lights for the outside lamps, and inside

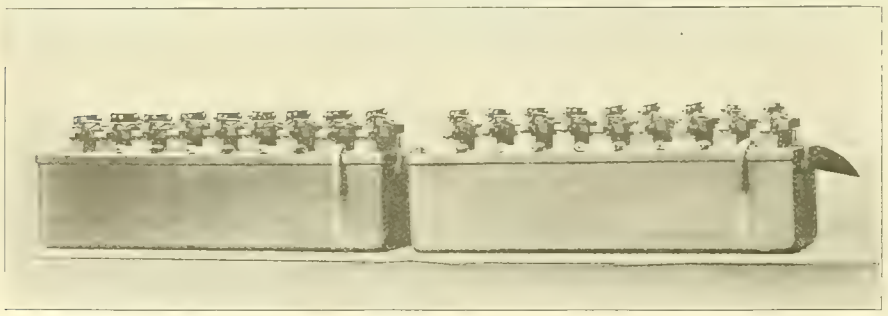


FIG. 2. GERMAN ELECTROLYTIC BLEACHING PLANTS.—LATE FORM OF APPARATUS (PAGE 145)

for reading in the carriage. There are signals connecting with the driver's seat, cigar lighters, and, if desired, electric heaters for winter and electric fans for summer.

One notable instance in the construction of gasoline automobiles for the 1904 market has been the large engines, giving more power to the car, to meet the increased demand for high-speed cars. The general tendency is to perfection of detail, simplification of control and suppression of noise. The pressed-steel frame has effectually crowded out the tubular frame, but not the armored wood type, which continues to be used by many prominent firms. Like their electrical competitor, gasoline and steam cars have come in for a large share of business during the show and many cars were sold.

Automobile accessories and supplies were exhibited in great variety, and many new and useful devices were offered for sale and for the inspection of visitors. The entire gallery and part of the main floor and annex were taken up by these exhibits.

The list of electrical exhibitors at the show is as follows:

AUTOMOBILES.

Electric Vehicle Company, Hartford, Conn.
Studebaker Brothers Manufacturing Company, South Bend, Ind.
Woods Motor Vehicle Company, Chicago.
Pope Motor Car Company, Indianapolis, Ind.
National Motor Vehicle Company, Indianapolis, Ind.
Holson Motor Patents Company, Grand Rapids, Mich.

ACCESSORIES.

American Electrical Novelty Company, Chicago.
American Coil Company, West Somerville, Mass.
Badger Brass Manufacturing Company, Kenosha, Wis.
Dayton Electrical Manufacturing Company, Dayton, Ohio.
R. E. Dietz & Co., New York city.
Electric Contract Company, New York city.
Hine-Watt Manufacturing Company, Chicago.
Motsinger Device Manufacturing Company, Pendleton, Ind.
Motor Car Supply Company, Chicago.
Miller-Knoblock Electric Manufacturing Company, South Bend, Ind.
Northwestern Storage Battery Company, Chicago.
National Carbon Company, Cleveland, Ohio.
Reym Electric Company, Anderson, Ind.
Richmond Manufacturing Company, Richmond, Ind.
C. F. Splitdorf, New York city.
Standard Carriage Lamp Company, Chicago.
Twentieth Century Manufacturing Company, New York city.
Western Motor Company, Logansport, Ind.
E. J. Willis, New York city.
E. S. Huff Company, Detroit, Mich.

Protection for Parallel Feeders.

In systems of distribution, and especially in such systems as employ feeders connected in parallel both at the generating and distributing end, it is important that if one feeder becomes short-circuited a rush of current from the "healthy" feeders to the faulty feeder should be prevented in order that the fuses or other protective devices may not open the circuit of all the feeders, and thus produce a shutdown of the system. In a patent, issued to Leonard Andrews last year, the use of discriminating choke-coils is explained for the purpose of preventing excessive current. The arrangement described in this patent, though very simple in its application to two feeders and though applicable with modifications to any number of feeders, nevertheless in the latter case introduces certain complications because of the necessary difference in size in the various choke-coils used.

To provide means of equal simplicity for any number of feeders for preventing the rush of current in such a system, Leonard Wilson of Pittsfield, Mass., has recently taken out a patent, assigned to the Stanley Electric Manufacturing Company of Pittsfield, Mass., which appears to be a solution of the problem.

In the accompanying drawings, Fig. 1 shows an arrangement embodying the invention, and Fig. 2 a modification of the system. Referring to Fig. 1, (1) (2) represent the bus bars at the generating station, and (3) (4) the bus bars at the receiving station. Feeders (A) (B) (C) are connected through fuses in parallel to bus bar (1). The other ends of the feeders are connected through the discriminating or differential choke coils (D) to bus bar (3).

The main of opposite polarity is represented by (E), the parallel feeders and the protective devices for this main being omitted for the sake of simplicity. Each of the choke coils has two windings, one winding (d) being in series with its feeder. The other winding (d') is in series with all three feeders and has only one-third as many turns as the first winding. Thus the ampere turns of the two windings are equal and are so arranged that under normal circumstances they neutralize each other, and consequently the choke coils offer no impedance to the flow of current from the feeders to bus bar (3). If, however, one of the feeders, as (A), becomes short-circuited, the fuse will blow, disconnecting the feeder from generator bus bar (1). When current flows from the healthy feeders (B) (C) back through feeder (A) to the short-circuit, the current in winding (d) of the choke coil of feeder (A) will be reversed relatively to the currents in windings (d) of the other choke coils, and the current will be equal in magnitude to the sum of the other two currents. The electromotive force induced in coil (d') by coil (d) of feeder (A) will be opposed in direction to and twice as great in magnitude as the electromotive forces induced in the other coils (d'). The effect on windings (d') in series in the three choke coils will therefore be neutralized and for the present may be left out of consideration. The full impedance of winding (d) of the choke coil of the feeder (A) will be placed in series with the impedance of the windings (d) of feeders (B) (C) in parallel, thus offering a check to the rush of current and preventing the blowing of fuses (b) and (c). The drop in voltage across the choke coil of feeder (A) will be twice that across the choke coils of feeders (B) and (C) in parallel. If the choke coils are of sufficient capacity so that the current flowing back through feeder (A) to the short-circuit is limited to the full-load current of the feeder, then the drop on bus bars (3) and (4) will be equal to one-third of the original

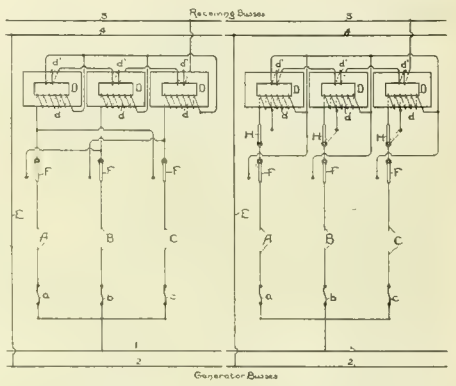


Fig. 1. Arrangement of Choke Coils. Fig. 2. Modified Arrangement with Auxiliary Contacts.

PROTECTION FOR PARALLEL FEEDERS.

voltage. The reason for this is that since the choke-coils prevent an abnormal flow of current only the drop in the choke coils themselves need be considered, and this drop is approximately equal to the full-line voltage. Since two-thirds of this voltage drop is across the choke coil (d) of feeder (A) and since the bus bars (3) and (4) are placed by the short-circuit of feeder (A), in shunt to the choke coil (d) of feeder (A), the voltage on the bus bars is approximately two-thirds of normal. Thus the drop at the bus bars due to the short-circuit is about one-third of the original voltage. It is evident that as the number of feeders is increased this drop will become smaller, in every case being equal to one divided by the number of parallel feeders. With a large number of feeders in parallel this drop will consequently be negligible and will in no way interfere with the operation of the system. With a comparatively small number of feeders, however, as shown in the drawings, this drop can be eliminated by restoring the balance of the choke coils, and thus destroying their impedance. In order to accomplish this result, switch (F) in the circuit of feeder (A) is thrown over, as shown in the dotted lines, to the auxiliary contact connected with feeder (B). This places two choke coils in parallel with feeder (B). Feeder (B) will then take two-thirds of the current and feeder (C) the remaining one-third. The choke coils will then be balanced, and the system will continue to operate as before. The switches (F) in the circuit of the feeders may be operated by hand or by any automatic device.

Where a considerable number of feeders are operated in parallel, any automatic device is entirely unnecessary, since the drop on the receiving bus bars is so small that it will not interfere with the operation of the system.

Another arrangement of switches for restoring the balance of the choke coils is shown in Fig. 2. In this arrangement the auxiliary contact of switch (F) is arranged to short-circuit the winding (d) of the choke coil, and at the same time by means of switches (H) one-third of the number of turns of windings (d) in the other two choke coils are cut out, as shown by the switches in dotted lines. By this means the balance of the choke coils will be restored and the voltage drop on the receiving bus bars eliminated. This latter arrangement of switches is preferable as regards CR drop in the feeders, but requires slightly greater complication of switches.

Interesting Damage Suit in Cedar Rapids.

Under this heading there appeared in the Western Electrician of December 28, 1901, an article concerning the lawsuit of Martinek against Swift & Co. at Cedar Rapids, Iowa. It will be remembered that one of the customers of Swift & Co. was killed on the premises of that firm by touching an incandescent-lamp socket. The current was supposed to be 110-volt and was furnished from a transformer owned by the electric-light company, of which Swift & Co. were customers. It was proved that the transformer was defective and that the high-potential current had leaked over to the secondary circuit. Under the circumstances, it was claimed that Swift & Co. were not responsible for the accident, as they had absolutely no control over the machinery furnishing the primary current nor over the transformers. The jury found for the plaintiff, giving $2,000 damages.

In commenting on the important principle involved in this case, Messrs. F. B. Badt and G. M. Willis, electrical experts of Chicago, who had followed the case closely, united in making this statement for the Western Electrician at the time of the trial:

"It is to be hoped, in the interest of life and limb of consumers of electric light, that an appeal will be taken, as otherwise a very bad precedent would be established. It goes without saying that the electric-light company should be made absolutely responsible to guard against the entering of the high potential into the secondaries and should provide safeguards, so that if such an entrance should occur, the dangerous potential should at once be relieved. The latest underwriters' rules recognize these facts and permit the grounding of the secondaries by permanently grounding the center of the secondary coil in the transformer, but, of course, it is easily understood that the grounding of any other point of the secondaries, intentionally or accidentally, would be an absolute safeguard to human life against the high-tension current. If the verdict as given should stand, it would simply mean that if a citizen invites a friend into his house and he should by accidental contact with a socket, get a fatal shock under circumstances similar to the ones explained, the host and not the electric-light company would be responsible for his death, if it could be shown that the wiring of the building in which the accident occurred should have been a little defective in some minor points. The absurdity of such a proposition is, of course, apparent to every electrical man and it is to be hoped, in the interest of the protection of human life, that the Supreme Court of the state of Iowa will reverse the verdict."

It is now to be observed that the Supreme Court of Iowa has reversed the verdict. In an opinion just handed down by that court in this case the law is laid down as follows:

"It was not negligence for the defendant to use a brass socket. They were then in universal use on secondary circuits, not only in Cedar Rapids but everywhere, and were then and are now considered absolutely safe so far as danger to life is concerned. The fact that they will not resist a current of 1,000 volts is not proof of negligence, for the defendant only contracted for a safe commercial current of electricity, and was bound only to supply proper appliances for its safe use. We are constrained to hold that the evidence on this branch of the case is wholly insufficient to support the verdict. * * *

"Unless the defendant in some way caused the defect in the converter it cannot be charged with liability for its defective condition. It was a consumer only, having no control or authority over any part of the light and power company's plant, wires or converters. The secondary circuit was brought by the company to the defendant's office, and it had no control over any part of the system except the wires within its office and car.

"The plaintiff seems to have thrown out a drag-net, hoping to prove some act of negligence on the part of the defendant, which would bring her a verdict. She succeeded in getting the verdict, but a very careful examination of the record convinces us that no negligence on the part of the defendant was proven and that the verdict is wrong.

"But little need be said regarding the other errors argued.

"The testimony of the witness Fawcett was incompetent, because he was admittedly not an expert. It was also error to admit testimony foreign to the issues presented by the pleadings, and much such testimony was received. The eighth instruction was the law of the case, whether right or wrong, and should have been followed by the jury and a verdict returned thereunder for the defendant.

"Instruction 10, asked by the defendant, should have been given. It told the jury that if a verdict was found against the defendant, it could not recover the amount from the light and power company.

"The jury should have been instructed to find for the defendant on the whole case. It is unnecessary to mention other errors. For these pointed out the judgment is reversed."

The Princeton Copper Company, which operates mines in the Huachuca Mountains in Arizona, is said to contemplate the building of an electric railway from its mines to the nearest railroad point, a distance of about 14 miles, in order to provide means for facilitating the shipment of ore.

Western Society of Engineers.

Many interesting subjects will be discussed in future meetings of the Western Society of Engineers, as shown by the program just issued for the months from January to June. Among the papers to be presented are several which bear indirectly on central-station and railway practice. Among them are the following: "Some Performances of Boilers and Chain-grate Stokers, with Suggestions for Improvements," by A. Bement, February 17th; "The Use of Pulverized Coal for Fuel Under Steam Boilers," by John M. Sweeney, March 3d; "Railroad Signaling," by G. E. Ellis, April 21st; "The Freight Transportation and Electric Locomotives of the Illinois Tunnel Company," by George W. Jackson, May 19th; "Exhaust Steam for Heating," by George Wellsby Scott, June 2d.

The officers of the society for 1904 are: President, H. W. Parkhurst; first vice-president, C. W. Hotchkiss; second vice-president, W. L. Abbott of the Chicago Edison Company; third vice-president, Professor W. D. Pence, Purdue University, Lafayette, Ind.; treasurer, Andrews Allen; secretary, J. H. Warder.

In reference to the proposed affiliation of the Western Society of Engineers and the Chicago Electrical Association, it may be said that the former society is in favor of the move, the same sentiment prevailing among the members of the latter. The matter will in all probability be decided at the next meeting of the Chicago Electrical Association, which is scheduled for February 19th.

Steam Turbines for Transatlantic Steamships.

The Cunard company expects soon to drive two of its mail steamers by means of steam turbines, and is now awaiting the results of tests which are in progress at the government tanks at Haslar with later models prepared to determine the resistance and power for given speeds, but with the addition of stern brackets for carrying the four shafts and propellers. It seems fairly certain that four shafts and four sets of turbines will be adopted instead of three, as at first proposed. Naturally four brackets have greatly increased the resistance, reducing the speed, and the problem is to devise an arrangement to give the highest propulsive efficiency. One question which the committee having the matter in charge must decide has reference to the economy tests which have been carried out, not only with the two English Channel steamers, but also on land stations where the advantage of superheaters has been compared against results with ordinary saturated steam. It is supposed that generally economy from the use of superheated steam is regarded as equal to nearly one per cent. per 10° F. of superheat, and as 200° is not at all excessive, the gain might be from 17 to 20 per cent.

Automobile Truck with Motors in the Wheels.

An especially interesting departure from the more or less fixed lines of automobile construction is displayed by a machine recently constructed under the Holson patents covering the "gyroscope" motor. The first motor car to be built embodying the principles of this new method of transmission was completed on February 5th, just in time to allow of its exhibition at the Chicago automobile show, where it attracted much attention last week.

In the Western Electrician of February 23, 1901, under the title of the "Holson Two-wheeled Electric Vehicle," was given an illustrated description of the method of driving the wheels of a vehicle independently by means of electric motors mounted within the wheels and propelling them through a specially designed system of transmission gearing. This arrangement was the invention of A. B. Holson of Chicago. Its basic principle is that used in the four-wheeled truck that now, three years later, excites interest. Mr. Holson appears to have laid aside his idea of a two-wheeled vehicle, with storage battery suspended below the axle, but, with the assistance of a stock company, the hub-motor idea has been developed.

Fig. 1 of the accompanying illustrations shows

FIG. 1. AUTOMOBILE TRUCK WITH MOTORS IN THE WHEELS.

the new Holson vehicle, which is designed for heavy freight haulage and weighs four tons, though it is expected that this weight will be materially reduced when the machine is built by approved factory methods which will economize in material. The capacity is four tons load upon the vehicle, with the ability to draw, if necessary, two trailers with a load of two tons each. When completed at the machine shop the car was taken out and driven without trouble nine miles to the Coliseum, where the automobile exhibit was held, carrying a load of 40 men, weighing nearly three tons, at a speed of six miles an hour on an average consumption of five horsepower. The battery consists of 42 cells of Exide battery, which are arranged in two groups, as will be explained later, giving a 50-ampere discharge for four hours.

Four "gyroscope" motors of two horsepower each are arranged, one within each wheel with its armature shaft nearly at right angles to the axle of the vehicle. Each motor is fastened immovably to the axle and carries an elongated armature shaft bearing on each end a pinion. These two pinions engage two annular gears within the wheel casing. Herein lies the most interesting feature of the transmission. The wheel proper is divided into two parts by a plane at right angles to the axle. Each section of the wheel carries an annular gear or rack for the engagement of one of the pinions of the armature shaft, the racks facing each other. The armature is set at a slight angle to the axle of vehicle, so that one of the spurs engages one of the gears and the other spur the gear facing the first, the two points

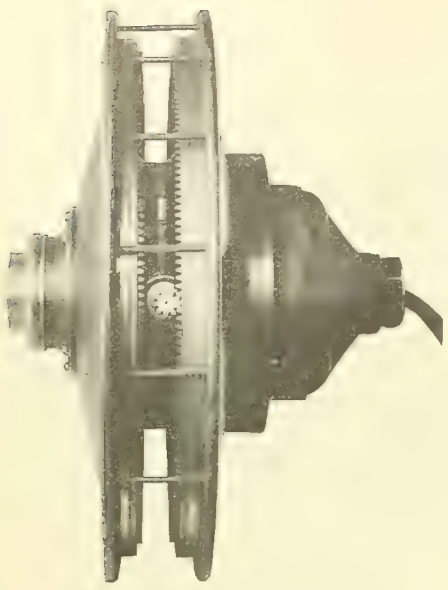


FIG. 2. HUB MOTOR FOR AUTOMOBILE.

of bearing coming at points diametrically opposite on the armature shaft. It will thus be readily seen that the forces applied by the armature shaft act as a couple which drive the two annular gears, and consequently the wheel and the vehicle, in the same direction. By this plan special advantages are attained. The motor drives from both ends of the armature shaft, grappling the wheel at both sides at the rim, relieving the thrust from the axle. This reduces the friction to a minimum. In winding a watch, for instance, it is obvious that better results can be obtained by using the thumb and finger as a couple on opposite sides of the stem, rather than by attempting to do the work by drawing from one side of the stem.

The two pinions need be but half the size that would be necessary if only one were used, to obtain the same reduction. In other words, double the reduction may be obtained within any given space. Consequently within the wheel itself there is sufficient space to reduce the velocity of a high-speed motor for adaption to the low speed required for a heavy truck. The fact that high-speed motors can be used without the intervention of complicated gearing mechanism, thereby using the form of motor which is the cheapest in construction and of the most efficient operation, is said to offset to a great extent the increased cost of construction over that where only one or two motors are used.

Another advantage is that the sides of the wheels which are solid metal plates, form the casings of the motors, keeping out dust and mud from the parts.

The motors themselves are of the bipolar type, direct current with series fields, and of a normal rating of two horsepower. The normal speed is 1,400 revolutions per minute, which, with the gear reduction of 25 40 1, gives the car a speed of six miles an hour. The motor frame carries a hub, one end of which is secured to the axle of the vehicle. A collar on this hub and also on a projection from the opposite side of the frame carry roller bearings which carry the journals of the solid-wheel plates, the motor frame supporting the weight of the car. Figs. 2 and 3 give a good idea of this construction and the position of the gears. The hub is hollow and the terminal wires are brought through the opening.

For operating the motors a special five-point controller has been designed which gives a series-parallel control, utilizing the battery in two sections, as shown diagrammatically in Fig. 4.

The motors in the front wheels and those in the back wheels are operated in pairs, the operation of each pair being identical. Taking one pair of motors, to illustrate, at the first position (I.) of the controller (Fig. 4), the two fields and the two armatures are in series with one-half the battery. At the second position the two armatures are still in series, but the fields are thrown in parallel, as shown in (II.), on one-half the battery. In the third position (III.) both fields and armatures are in parallel on half the battery. In the fourth position (IV.) the armatures are again thrown in series and the fields in parallel, but this time with the whole battery, while in the last position (V.) the armatures and fields are both in parallel with the full battery pressure. This arrangement gives a uniform movement at starting, and, taken together with high-gear ratio, the start is made with almost no jerk, which is a matter of great importance in vehicles carrying a storage battery.

Steering is accomplished by an attachment which moves both front and rear wheels at the same time, so that they follow along concentric curves, reducing the wear and tear on the rear tires. For braking, a band brake or strap clutch is provided on each wheel. The steering and brake mechanism may be seen in Fig. 1, though much of this will be enclosed in a perfected car.

Favorable results are looked for in the efficiency of operation of the gyroscope-motor car. The results of an efficiency test made at Lewis Institute, Chicago, on a motor vehicle using this type of transmission showed a friction loss in gear of only three-fourths of one per cent. up to a 16 per cent. overload, using a reduction of 14 to 1.

One feature which apparently adds to the merits of the new vehicle is the fact that a complete motor unit is embodied in a single wheel. Therefore an extra wheel, weighing 425 pounds, can always be carried on the truck, and in case of an accident all that is necessary to remedy the fault is to jack up the axle and replace the defective wheel with the good one, requiring only a few minutes time. The motor connections terminate in four plugs of different shapes, each of which fits into a correspondingly shaped hole in the connecting block on the vehicle, so that an inexperienced person may replace the wheel without getting the connections wrong, for there is only one way that they will fit.

Four-wheel drive should lengthen the life of tires, which at best are a heavy item of expense in a city where the pavements are rough.

The work of developing the ideas of Mr. Holson and the building of the experimental car in Chicago have been carried out by the Holson Motor Patents Company of Grand Rapids, Mich., of which M. B. Church is chairman, A. B. Holson, vice-chairman, and M. Clay Church, secretary. The work of designing the car itself was placed in the hands of Karston Knudson of Chicago.

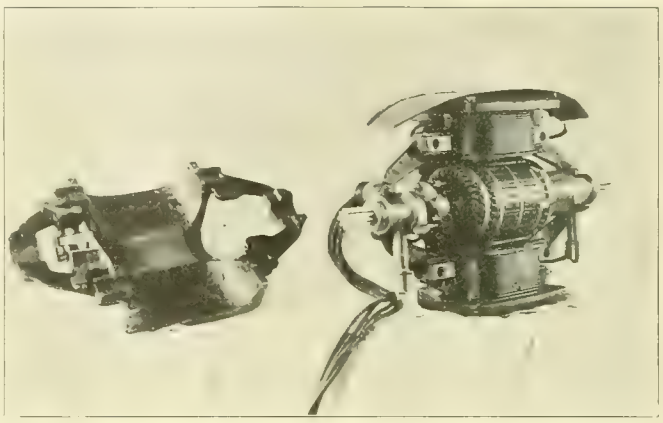


FIG. 3. HUB MOTOR FOR AUTOMOBILE SHOWING ELONGATED SHAFT AND PINIONS.

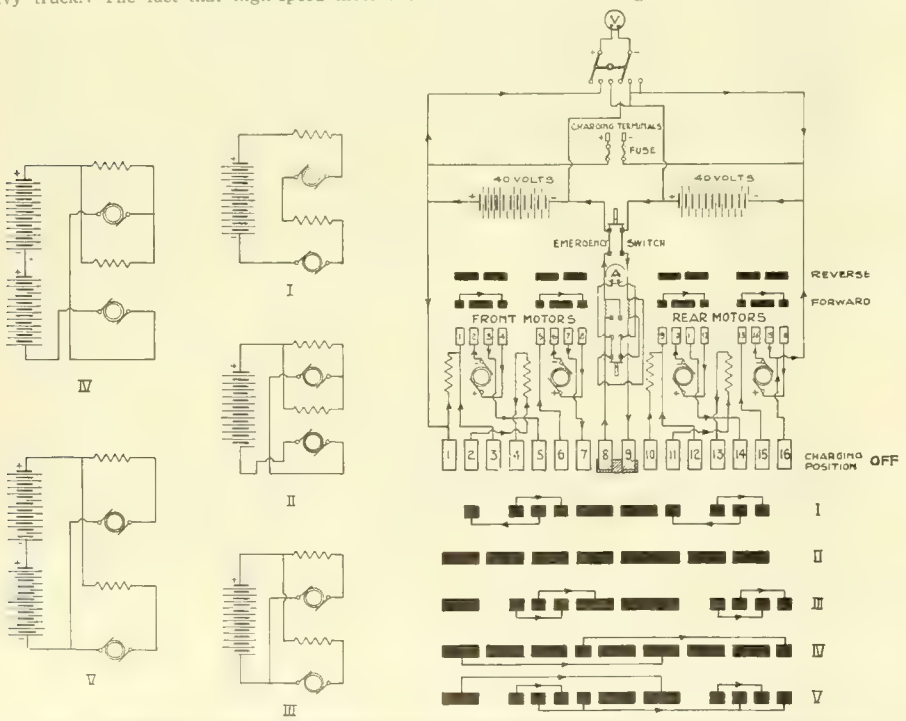


FIG. 4. AUTOMOBILE TRUCK WITH MOTORS IN THE WHEELS. DIAGRAM OF CONTROLLER CONNECTIONS.

Ruhmer's Photographone.

Among the more recent solutions of the problem of preserving the sound vibrations of the telephone, one of the best is that of Mr. Poulsen. This apparatus registers the sound waves upon a wire or band of steel enrolled on a cylinder. The telephonic electrical impulses produced by a microphone are led to an electromagnet, before which is drawn the wire or band mentioned. These feeble currents induce a certain amount of magnetism in the wire or band as this passes along the face of the core. Now this magnetism is permanent; so when it is desired to reproduce the registered words, the recipient wire or band is placed before an electromagnet, the windings of which are connected with a telephone. As the different portions of the magnetized metal pass before the magnet, currents corresponding to the vibrations there recorded are generated, and act in turn upon a telephone receiver.

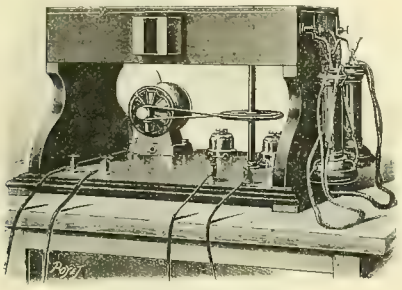
The inventor recently communicated to the Industrial and Hygienic Congress of Copenhagen some improvements in the apparatus since its first inception, which are interesting. The fact that a respiration of the feeblest character is readily registered, demonstrates its sensitive character.

In the later form the cylinder is replaced by a very thin, round disk, which may be readily placed in an envelope, and carried, no matter where, and used on a second machine, and kept indefinitely. Thus thousands of copies of an oral effusion may be reproduced without noticeable enfeeblement.

Another interesting apparatus utilizes the characteristic electrical properties of selenium. The photographone of Mr. Ruhmer of Berlin is essentially a cinematograph, in its simplest form. In a box, which is lightproof, are fixed two shafts upon which a photographic film is placed which moves at a given speed from the one to the other by means of an electric motor. This film passes through the focus of a cylindrical lens, specially constructed, which concentrates the rays of a peculiar form of light (lampe parlante), the vibrations of which are recorded on the moving film. This register is then developed and fixed in the usual manner. There is now visible a constant band of alternate light and shade, the length of the film, which corresponds exactly to the intensity variations in the light to which it has been submitted, and, of course to the sound waves transmitted.

Now, to reproduce the words thus obtained, a positive of the photographic record is made at the same speed exactly by placing a second film behind

the negative, and submitting it to the rays of a light source through the negative film. The differences of light and shade upon the negative produce corresponding light gradations, reversed, upon the second film. These variations of light and shade, when the film is placed between the light source and a selenium cell correspondingly vary the conductivity



RUHMER'S PHOTOGRAPHONE

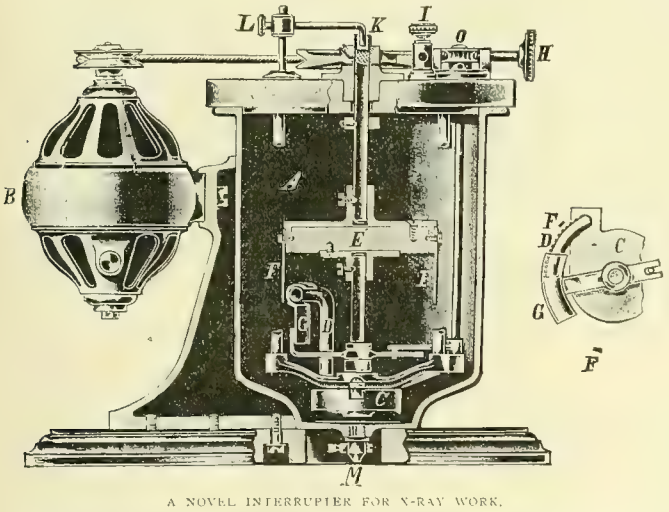
of this latter medium, and thus vary the vibrations in a telephone receiver in circuit with the selenium.

From the original negative any number of positive records may be made, and it would seem that a new field is thus opened for the investigators of the close relations existing between light, sound, electricity and magnetism.

A Novel Interrupter for X-ray Work.

Ever since induction coils have obtained their present importance in connection with Roentgen rays and space telegraphy, there has been a search for available interrupting devices, which is among the most important working elements of an induction coil. The principal requirement is an accuracy and safety as great as possible with regard to the regulation of the duration of the current impulses and the frequency of interruptions.

This want has been more keenly felt in connection with Roentgen apparatus, as Roentgen tubes have to be adapted during operation to the induction coil so as to give most favorable results, both with the visual examination or in photographing, and in X-ray treatment. On the other hand, such interrupters must work with a low consumption of energy and put the tubes to as low strains as possible. In



A NOVEL INTERRUPTER FOR X-RAY WORK.

fact in the case of the vacuum tube being run with high current intensities, the regulation of the vacuum is far from being sufficient, a rapid and safe regulation of the frequency of interruptions and duration of current impulses being a factor of the highest importance.

The Wodal interrupter, as brought out recently in Berlin, is said to fulfill in a satisfactory way these requirements. With this interrupter, there is required neither an alteration of the metal segments nor a modification in the self-induction of the primary coil. By means of a simple and safe mechanism, the breadth of the mercury jet issuing from the interrupter may be progressively modified so as to warrant a continual regulation of the duration of current impulses, by steps as small as possible. This will result in the Roentgen tube being in any case utilized to a much higher degree, a great safety being insured even with higher strains.

The design of the Wodal interrupter may be seen by the cut. The cast-iron case (A) bears laterally a small electric motor, the vertical axis of which transmits the movement to (K) by means of an endless cord. The axis (K), placed in the hollow of the box bears a prolongation supporting several metal segments which are separated from the lower part (C) by means of an insulating intermediate piece (E). On the bottom of (A) there is some mercury capable of traversing the compartment (C) perforated below, and being conveyed to (D) during rotation, by means of small pump. Above (D) there is a semi-circular projection device, provided with a number of holes, by which the rotating segments (F) will pass during operation, while the mercury will issue from these holes. The number of holes may be altered at will by means of a closing piece (G), operated from the regulating screw (H). All the holes being opened, a broad ribbon jet will pass on to (F), the maximum duration of current impulses being thus obtained. In the case of a single hole being opened, on the other hand, the duration of an impulse is smallest, and the current may be wholly switched off by covering the last hole. The holes are opened and closed by means of the screw (H), as may be observed on an index in (O).

The path followed by the current in the Wodal interrupter is as follows: The current is supplied to the motor from a special rheophore, an inserted regulating resistance allowing of the number of revolutions of the motor and, hence, the number of interruptions, being readily altered. No special regulating resistance is necessary for the primary of the induction coil, even the most delicate regulation of the current supply being secured by means of the interrupter itself. The Wodal interrupter, like other interrupters, is inserted between the source of current and the primary of the induction coil, the current being conveyed from the terminal (J) through (O) to (C) and the compartment (G). The jet issuing from the latter will next insure the passage of the current from (D) to the segment (F) through (K) to (L), being capable of issuing from the interrupter through a second terminal. The discharge cock (M) allows of the mercury being drawn off in the case of a purification of the latter being necessary.

About five kilograms of pure mercury are required for filling the interrupter compartment. In order to insure more rapid interruptions with a minimum sparking, the reservoir is filled with about three liters of first-class petroleum, one filling being sufficient for a long time, even with daily use. In the case of the tube showing any flickering after prolonged use, the mercury will require purification, when the charge may be drawn off through the cock (M), the petroleum separated from the mercury, and the remaining muddy mass well washed with benzine or a caustic liquid, so as to cause the finely divided mercury globules to combine again to form available mercury.

The Wodal interrupter is convenient on account of its easy regulation. As compared with electrolytic interrupters, it affords the advantage of a perfectly noiseless operation and very low consumption of current (about 1½ to three amperes), being adaptable for use with any high-tension direct currents.

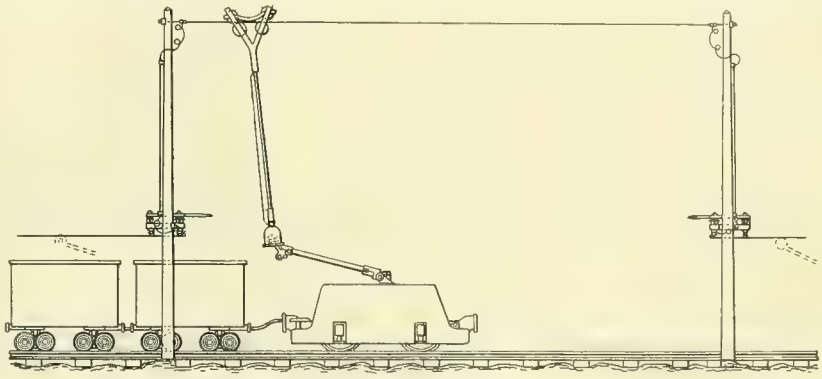
Allis-Chalmers Company May Enter Electrical Field.

Although the company has made no announcement of its plans, and its officials are reticent, it is reported that the Allis-Chalmers Company may enter the electrical field as a general manufacturing company. The fact that $2,500,000 was set aside last month to increase the capacity of the E. P. Allis plant at Milwaukee lends some color to the assertion that this large factory will be the first of the four plants of the company to open an electrical department. It is further asserted that John H. Kelman, superintendent of the Stanley Electric Manufacturing Company of Pittsfield, Mass., has resigned his position to take one with the Allis-Chalmers Company, and that other electrical men will go with him. More than that, it is hinted that William Stanley and John F. Kelly, engineers and inventors, are interested in the new move.

Unique Road Crossing for Trolley Wires.

In conducting mining operations and excavations and similar work in some localities where electric trolley lines employing cars and locomotives of low altitude are used, the trolley conductor wires must be of correspondingly low altitude. Provision must be made, therefore, by which the presence of the trolley lines will not interfere with the ordinary uses of roads crossed by the low-altitude lines, at the same time enabling the crossing trolley line to be operated continuously and without interruption from the "breaks" caused by the crossings.

To provide such a means of crossing is the object of an ingenious invention, by James M. Collins of Byesville, Ohio, which comprises the removal of sections of the low-altitude conductor wire at the crossings and substituting sections of wire sufficiently elevated to permit of the ordinary uses of the crossing road. By connecting the ends of the elevated section electrically with the adjacent portions of the low-altitude conductor wire and providing each of the elevated sections with a traveling trolley carriage having a depending end with which the trolley wheel of the electric locomotive engages when the car passes beneath the elevated section, the current may be continued to the locomotive while passing the crossing.



UNIQUE ROAD CROSSING FOR TROLLEY WIRES.

Referring to the drawing, the locomotive shown is of the conventional type employed in mines, but the invention may be employed in connection with any type of locomotive. The electric conductor is in this instance a low-altitude trolley line, ending at opposite sides of the crossing roadway and supported by vertical posts. The ends are shown supported in the usual manner by insulated hangers.

Mounted upon an elevated section of the line is an auxiliary conductor movable along the section. It is shown as a trolley carriage, consisting of a frame, having trolley wheels above the wire and guard pulleys beneath the wire, so that the carriage will travel with the minimum of friction along the wire. The four wheels constitute guiding devices to limit the swinging of the auxiliary conductor in the direction of the movement of the traveling conductor.

Depending from the carriage frame is a rod or pole, having a socket or housing attached to its lower end, the socket being electrically connected to the carriage.

When at the ends of the elevated section, the housing and its connections will be retained by forked bars on the insulated hangers, so that the open lower end of the housing will be in position to receive the traveling conductor, such as a trolley wheel on the trolley pole of a locomotive. As the trolley leaves the end of the low-altitude trolley wire, it will at once engage the housing and carry the carriage with it along the wire until the shank of the pole above the housing enters the opposite forked bar, when the housing and its connected carriage will be stopped; but the trolley wheel will be drawn out of the housing and again run upon the main conductor. On the return trip the housing and its attached carriage are again "picked up" by the trolley and carried back again across the roadway.

The sections many be placed at any distance above the ground, and as many may be inserted into the line as required, and they may be of any required length.

This device is patented, the patent having been assigned to Joseph A. Jeffrey of Columbus, Ohio.

In defining the word, "engineering," Professor Kent, dean of Smith College of Applied Science at Syracuse, says: "Engineering is not only the science and art of utilizing the forces of nature for the benefit of man, as Tredgold defined it, but also it is the art of overcoming the resistances of nature, including human nature."

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

Independent Telephone Association of Michigan (annual meeting), Grand Rapids, February 24th and 25th.

Iowa State Telephone Association (annual convention), Des Moines, March 8th and 9th.

National Electric Light Association (annual meeting), Boston, May 24th to 26th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

SOME interests in Washington appear to have entered upon a crusade against the modern heavy street-railway car. A bill has been introduced in the Senate by Senator Gallinger to provide that six months after the measure shall have been passed and approved it shall be unlawful for any street railway within the limits of the District of Columbia to operate any cars weighing more than 10 tons, unless upon special permits issued by the commissioners for the purpose. Why discriminate against the heavy cars? Twenty-five-ton cars are in service in Chicago and other cities, and, with proper safeguards, are operated safely enough. Passengers prefer them to the smaller cars. Why should the people of Washington be required to put up with inferior transportation facilities?

THOMAS A. EDISON well deserves all the honors that the American Institute of Electrical Engineers or any other organization can heap upon him. He is a great man. He has given to the world a long list of valuable inventions in telegraphy, telephony, electric-lighting and electric-railway work. He invented the phonograph—a stroke of pure inventive genius almost unparalleled. He has improved X-ray methods, produced a most ingenious electric pen, devised an accumulator cell that promises to be of the utmost value in automobile work and has done a great deal to improve electrochemical apparatus and magnetic separating devices. He has made the fortune of a hundred other men and has made a great deal of money for himself, but he seems to care little for money. He had taken out 742 patents in the United States up to January 1, 1901, and since then the number has been largely increased. His inventions cover a wide field, but are nearly all related to electricity. Those that have been alluded to in the foregoing lines show only a part of the work Edison has done. But even in the imperfect outline here presented enough has been indicated to give some idea of the wonderful record of a remarkable man.

Of all Edison's accomplishments, perhaps the most important was his work in the domain of electric lighting. By a remarkable series of downright inventions and almost equally remarkable applications and improvements, including the incandescent lamp, the Edison dynamo and the three-wire system, as well as many minor fittings and appliances, interior electric lighting was made practicable, and a great industry was established. Edison attacked the problem of subdividing the electric current for incandescent lighting, and he solved it. His work was very thorough; he was not daunted by great obstacles; he had what seemed to be a veritable insight into the future; and he virtually created a new art. His work has stood the test of time at least as well as, perhaps better than, that of any inventor that ever lived.

The Edison dinner in New York last week was worthy of the extraordinary man in whose honor it was given, and that is certainly saying a good deal. It brought out quite a remarkable gathering of noted electrical men, including another great but modest inventor, Elihu Thomson. Mr. Thomson received an ovation when his name was mentioned by the toastmaster only second to the greeting that had previously been extended to the guest of the evening. To those whose memories run back to the time when there was a great gulf fixed between the high-tension men and the low-tension men this cordiality is pleasing and significant. The attendance included telegraph men, telephone men, engineers, educators, business men, inventors, central-station men, and, of course, a liberal sprinkling of "old Edison men." It was truly a representative delegation from the great electrical community—representative not only of the branches of the electrical industry, but, so far as the speakers are concerned, geographically representative also, for the addresses were delivered by two men from Chicago, two from Boston, one from New York, one from Philadelphia and one from Princeton. Edison had a right to be proud of such an assemblage and of such enthusiasm as was shown. That he was appreciative and grateful is shown by the characteristic message that he ticked off on the key. It was truly a brilliant and long-to-be-remembered affair.

Established under such memorable circumstances, the Edison medal ought to be as useful and inspiring to electrical students as its founders desire. Undoubtedly it will become, in the language of the president of the Edison Medal Association, the "blue ribbon" of the profession—a coveted emblem to be striven for annually by the youthful American followers of Thales and Gilbert—and Edison.

DISINTERESTED persons who attended the telephone meeting of the Chicago branch of the American Institute of Electrical Engineers last Tuesday evening and listened to the discussion on the merits of manual and automatic telephone-exchange systems must have come away with the impression that the new automatic system has both advantages and defects; that there are some branches of telephone work that cannot be encompassed with an automatic exchange, but that, on the other hand, the new system offers some advantages which the familiar manually operated boards do not afford. The paper of the evening around which the controversy raged was written by Mr. Franz J. Dommerque, a telephone engineer of established reputation, whose conclusions were not favorable to the automatic system. The writer contended that the new system affords no greater speed—he put both types of exchange on a par in this respect—is more complicated and more apt to get out of order; is more expensive not only as to first cost but also as to operating expenses despite the saving in operators' salaries. Mr. Dommerque pointed out that the automatic affords only a single-line service, while the manual exchange can give also party-line service. Further, he said that the automatic people had not yet arranged to give pay-station service—a branch of the business of convenience to the public and of profit to the exchange.

Mr. A. H. Dyson, a young engineer connected with the automatic forces, answered Mr. Dommerque (who was unavoidably absent), and, in the face of a determined assault on the part of the manual forces, maintained himself manfully. He defended the talking circuit of the automatic, which had been criticised by Mr. Dommerque. This circuit has 14 contacts, he said. The talking qualities of his system, he insisted, were the equal of any manual system. The automatic, he said, could be adapted to common-battery systems, thereby meeting the objection previously made that it was used only with local-battery telephones. He asserted that the automatic system takes less than half the time of the manual in making a connection. Later this statement was disputed by other speakers, who demonstrated, apparently, that the automatic has no such advantage as this. Mr. Dyson attacked Mr. Dommerque's figures of cost and gave a statement of his own, showing a great saving in operating and maintenance expenses in favor of the automatic. He admitted greater first cost for his system, but figured the saving in operators' wages and other items. However, he allowed but 3½ per cent. for depreciation against Mr. Dommerque's 7½ per cent., and later came in for pointed criticism on this point, almost everybody else considering that 3½ per cent. was too low an estimate.

Several speakers followed Mr. Dyson, and nearly all were in favor of the manual system. The automatic was denounced as having too many contacts and magnets, as being too complicated and too apt to get out of order. Mr. L. W. Stanton, however, thought it likely that the automatic would prevail in the end. But the manual board can give very fair service if the traffic is handled intelligently. Mr. Stanton thought that a combination of automatic selection and manual operation might be useful. To this Mr. Dyson objected: "Why stop half way? If you're going in for automatic, why not have it completely automatic?" He said a good machine was more accurate than a human being. Others objected to the springs, said to be 11 in number, in the automatic telephone, and it was said that there were only two springs in the common-battery instrument. For the automatic it was pointed out that it permitted of continuous operation, day and night, even in the smallest exchanges, and that it insured secrecy of communication—thought to be an important point.

Of course, the foregoing is the merest outline of the discussion, which, toward the close, unfortunately drifted into something like a commercial wrangle. But the question brought up is one of much importance, and we present the above inadequate summary for the benefit of the readers of the Western Electrician.

THOMAS A. EDISON THE GUEST OF THE INSTITUTE.

At the annual dinner of the American Institute of Electrical Engineers, held in the main ballroom of the Waldorf-Astoria, New York city, on the evening of February 11th, Thomas A. Edison, the distinguished inventor, was the guest of honor. The dinner had many unique and interesting features and was altogether a brilliant success. Incandescent-lamp decorations, as might be expected at an Edison dinner, were used with tasteful profusion. There were festoons of lamps around the galleries and over the rostrum. At the speakers' table four-candlepower lamps were entwined in the smilax decorations. The date selected was Mr. Edison's birthday, and the guest of the evening sat under a grouping of 57 lamps arranged in honor of the event. All the lamps had frosted bulbs. American flags, the state shields of Ohio, New Jersey and New York and a painting of Mr. Edison's birthplace were other features of the decorations. There were 60 tables, each set for eight persons, and practically all the places were filled. In addition, many auditors sat in the boxes and galleries. When the ices were served, in the course of the dinner, it was found that some of the confections had taken the shape of Edison's inventions, as the historic Edison dynamo, the modern dynamo, the phonograph, etc. Telegraph wires were strung in the room from a "quad" set in front of Mr. Edison to another instrument at the place of Mr. A. B. Chandler, president of the Postal Telegraph Company. Marconi wireless apparatus was also installed. During the progress of the dinner and the post-prandial exercises the entire company—and it was a distinguished one—manifested its eagerness to do honor to Mr. Edison. There was much enthusiasm, and the whole affair was brilliant and pleasurable. The menus were elaborate and handsome productions, each bearing Mr. Edison's autograph and a fine picture of a portrait bust of the inventor. This picture is the one reproduced herewith.

A noteworthy feature of the evening was the presentation to the Institute of the deed of trust of the Edison Medal Association, which has raised a fund, the income from which shall be applied annually to the striking of a medal to be presented to the student in electrical engineering in the United States or Canada whose thesis or recorded research shall be deemed most worthy.

Messages from President Roosevelt and Others.

Following are some of the messages of congratulation read during the evening:

Thomas A. Edison, Waldorf-Astoria, New York: I congratulate you as one of the Americans to whom America owes much and as one of the men whose life work has tended to give America no small portion of its present position in the international world.

Theodore Roosevelt.

Hearty congratulations on birthday. Sorry not to be present to celebrate twenty-fifth anniversary of your great invention. Marconi.

It is most unfortunate that I cannot be present when the "king of the telegraphers" is to be crowned with the medal crown. Though absent, yet I here profess to the monarch loyal and unfaltering allegiance, swearing to render him at any and all times such service as the most potent head of the clan that ever ruled his people ever received from his humble and devoted subjects. To which I hereby pledge our life, our fortune and our sacred honor. Long live "King Edison the First!" "73" to one and all.

Andrew Carnegie.
(Liegeman to King Edison the First.)

Hearty good wishes to Mr. Edison. I look back with greatest interest to his brilliant inventions in electric lighting and telephony which I had the greatest pleasure of successfully maintaining in all courts in England.

Alverstone.
(Lord Chief Justice of England.)

I join heartily with the American Institute of Electrical Engineers in gratitude to Edison for his great electric work, and for the phonograph, a most exquisite and instructive scientific discovery, and for his many other useful and well-worked-out inventions for the public good. Kelvin.

I enthusiastically join in the honors paid to-day to my dear and illustrious friend Edison, whose system I am proud to have introduced first into Italy. Colombo.

Admiring your great inventions, Hungarian friends send sincerest congratulations. De Fodor.

The electricians of France send their heartiest congratulations to Mr. Edison on the occasion of the ovation in his honor. Mascart.

Hearty congratulations to our honorary member of the Elektrotechnischer Verein (Germany). Emil Naglo.

Greeting and kind wishes to American Engineers. Congratulations to Edison on the twenty-fifth anniversary of his invention of the glow lamp. Gisbert Kapp.

Fraternal greetings to the American Institute of Electrical Engineers. Ascoli.
(President of Italian Society of Electrical Engineers.)

The Institution of Electrical Engineers of England tenders fraternal greetings to American Institute on occasion of annual dinner. Gray.

Other messages were received from Governor Herrick of Ohio, Governor Murphy of New Jersey, Governor Odell of New York, President Francis of the St. Louis Exposition and Mayor McClellan of New York city.

Opening Speeches.

After the dinner had been served and a standing toast to the president of the United States had been drunk, Mr. Bion J. Arnold of Chicago, president of the American Institute of Electrical Engineers, made the opening address. In the course of it he said:

"Although the electric light came into commercial use in 1880, followed soon by the electric motor, our Institute was not founded until 1884; but since that time the growth of our membership may be taken as indicative of the rapid development of the art in which we are engaged, until we now have a membership of about 3,000 active minds, one-fifth of whom are full members, scattered not only throughout every state and territory of the United States of America, but throughout almost every country where civilized man exists.

"These men are now engaged in teaching, investigating or quietly designing, installing or directing the operation of properties which have, by the combined efforts of the engineer and capitalist, in addition to increasing the comforts and conveniences of mankind, been mainly instrumental in adding to the material wealth of the world something over $4,000,000,000.

BUST OF THOMAS A. EDISON REPRODUCED FROM MENU OF EDISON DINNER.

"Nearly 30 years ago, when as a boy in the public school of a western prairie town, I was designated by my teacher to write a biography, I chose as my hero the man whom we honor to-night. My boyish efforts were the best that I could command, and while I aspired with the great hopes and ambitions of youth for a career of achievement, my environments were so foreign to those necessary for a technical calling, that I little dreamed I would ever have the honor of representing such colleagues on such an occasion as this.

"Either around these tables or associated with us in similar societies across the waters are the men who, through their efforts, have converted our cities from darkness into day; increased the range of human speech; bridged our oceans for the transmission of intelligence, with and without wires; made it possible to preserve the human voice long after the speaker has passed away; emancipated the horse; made accessible the energy of the water-power of the world, and who are gradually eliminating the element of distance in the transmission of electrical energy, until the steam locomotive, formidable rival that it is, may ultimately be superseded.

"While the art of electric lighting is now fairly well developed, improvements are gradually taking place, the great field of electrochemistry is rapidly opening up, and the electric-railway question is assuming vast proportions. Already the governments of Sweden, Switzerland and some of the Australian states are, on account of the high cost of fuel, considering the adoption of electricity on governmental railways, and many railway companies in this country, and abroad, are now, for other reasons, equipping parts of their lines, or seriously considering it, as exemplified in the great work of the New York Central and Pennsylvania Railroad companies in the vicinity of New York, by means of which the steam locomotive will soon disappear from this city forever.

"The engineer has waited long, but it may be truthfully said that this is his age, for no longer is his work misunderstood by the intelligent. It is now recognized that the preparation necessary to enable him to discharge his duties in the higher branches of his profession is as arduous and as thorough as are those required for the other great professions.

"Furthermore, it is recognized that while great works have been accomplished in the past and are now being carried on by engineers who were not technically educated in their youth, but who succeeded in spite of the difficulties incident to such careers, the changes which have taken place during the last decade make it necessary, for those who aspire to excel in this calling, to take their technical courses early and thoroughly. While our guest this evening is a distinguished example of what can be accomplished without such a training, he, nevertheless, after having taught himself and many others, recognizes the tendency of the times, and by his participation in these exercises lends his name and his influence in the right direction for the guidance of the youth of the future.

"It is right that we should, from time to time, select from among our number those most deserving and honor them by establishing in their names such marks of distinction as may seem proper. It is especially fortunate that our profession is so young that we can select for our first distinction the one whom we all agree now the most deserving, and, instead of honoring him after he has passed beyond the appreciation of earthly honors, we are able to have him with us to-night, to see and to feel the esteem in which he is held by his proteges, who recognize in him not only a man of great natural genius, but also the exemplification of what has been defined as genius itself—the ability for hard work."

At the conclusion of his address President Arnold turned the assemblage over to the tender mercies of Mr. T. Commerford Martin of New York, who gracefully performed the duties of toastmaster. In eloquent phrase Mr. Martin introduced the honored guest of the evening. Among other things, he said:

"I am sure you will agree with me that the American Institute of Electrical Engineers could find no worthier hero and no greater boon to mankind to signalize than the man and the theme around whom to-night we twine the laurel wreaths of our admiration and our love. It is no meteoric career that flashes momentarily upon our dazzled gaze to-night, but one of steady glow and stately swing across the starry heaven of achievement. And yet, while it is no meteoric career in whose life story we pass a milestone, it has been adventurous and romantic to a degree—it has been broadly, typically, wholly American. In this country, in this republic, whose name is a synonym for freedom and liberty, one of whose fathers was also our father—Benjamin Franklin—this worthy and modest successor of his has been freer than he would have been anywhere else in the world to work his discoveries and his inventions, to enlist the capital and the labor equal to their exploitation, and to be welcomed by a public every ready for every new thing that adds to the resources of civilization. I have ventured to associate the name of our guest of the evening with that of Benjamin Franklin, as one whom we expect to see, in future years, alongside of him in the American Hall of Fame.

"The founding of this medal should be an incentive and an encouragement to every ambitious youth in America, and should lead him to recall the lad in the modest hamlet in Ohio, the cheery little newsboy in Detroit, the half-shod, half-frozen operator struggling bravely for a job along the icy pikes of the central states, the untutored experimenter in Boston, taking eagerly fees for lectures on electricity that he was too modest to deliver, the embryonic inventor in New York, grub-staked by a far-sighted Wall Street banker with his first stock ticker; the deaf investigator at Menlo Park, taking splendid retaliation on his affliction by preserving forever, with his phonograph, [illegible] the prolific patentee for 30 years keeping the pathway to the Patent Office hot with his footsteps, and the man who, taking in his Promethian hand this [illegible] glorious light such as never was before on land or sea—Thomas Alva Edison. Charge your glasses! Lift them high! Shout three cheers to him! (Great applause and cheering.)

"Mr. Edison has flatly declined to speak. He knows he can, but he won't. In substitution for a

speech, he has been good enough to prepare a telegraphic response, and Mr. A. B. Chandler, president of the Postal Telegraph-cable Company, who gave Mr. Edison his first job as an electrical engineer, has kindly undertaken to receive the message which Mr. Edison will send."

Mr. Edison's Response.

Mr. Edison then transmitted the following message over the telegraphic circuit:

"I want to thank you first of all, my fellow members of the American Institute of Electrical Engineers, for the great honor done me in thus celebrating my birthday, associated with the twenty-fifth anniversary of the completed development and successful introduction of the incandescent lamp. Your expressions of good will gratify me deeply. While I cannot but rejoice at the place which the incandescent-lighting art has made for itself among the inestimable comforts and conveniences of civilization, I feel that my share in the work is exaggerated by this prominence given me to-night.

"To my old friends and associates who have founded the Edison Medal in the Institute, I can but extend you thanks again. If I could do it in return, I would found a medal for everyone of you, for you are just as much entitled to recognition as I am. You gave me your friendship and loyalty, your watchful days of toil and sleepless nights of anxiety. Some of you helped to perfect the art by your engineering skill, your legal ability, your financial aid.

"The early days were enough to tire out anyone's courage and persistence, but you stood it all, and you put up with me into the bargain. (Laughter.) Now, in noble revenge for the burdens I put on you and in addition to all the evidences of friendship in the past, you add this unusual token of continued affection. I should not be human if I were not profoundly affected and deeply grateful.

"This medal is founded to encourage young men to devote their best thought and work to electrical development. I rejoice in this stimulus to harder study. Better trained and educated than were we pioneers of the times before every college and university had its electrical course, these coming men of the future should, and I believe will, carry forward to triumphs and arts heretofore undreamt of the principles and applications of electricity to which I have tried humbly to devote my life and energies from the hour my hand first touched the key. (Great applause.) God bless them, and you, my dear friends, and this American Institute of Electrical Engineers."

The Edison Medal.

Mr. Martin called upon Mr. Samuel Insull of Chicago, president of the Edison Medal Association, to transfer the medal and deed of gift to the keeping of the Institute. Mr. Insull said:

"I appreciate greatly the opportunity afforded me of representing on this occasion the Edison Medal Association, and of presenting, on its behalf, to our hosts of this evening, the American Institute of Electrical Engineers, as trustee, the fund raised to found and endow an Edison medal to go each year to that student in electrical engineering whose thesis or recorded research shall be deemed most worthy of honor." Mr. Insull read some extracts from the deed of gift and continued: "I take pleasure, Mr. President, in handing you this trust deed, with the full confidence that the medal will be bestowed for all time to come in the manner intended by the donors." Mr. Insull then handed the deed of trust to President Arnold, and proceeded thus:

"It is an especial personal pleasure to me, as one of Mr. Edison's old employes, to be associated with this movement for the purpose of doing honor to the illustrious guest of the evening and as marking the twenty-fifth anniversary of the introduction of the Edison incandescent lamp. The development of a vast industry of electric light and electric power with which so many present are associated dates (with the exception of series arc lighting) from the original work of Mr. Edison on the incandescent lamp. If you wish to trace the early history of the arc, you need scarcely go further than the records of the United States Patent Office, where you will find ample evidence to show that Mr. Edison is, beyond all question, the father, and I might almost say, the creator, of this great lighting industry.

"Those prominent and distinguished experimenters who, prior to and contemporaneously with Mr. Edison, sought to produce a commercial incandescent lamp, followed the path hewn out for them by the early series arc-light experimenters. They, as a result, made the mistake of producing a low-resistance lamp operating in series, and consequently requiring a varying potential, resulting in a system impossible to operate on a large scale. It remained for Mr. Edison, with a foresight almost supernatural, to see that what was needed was a constant-potential system, which would respond to the demand of every kind of service, and, as a result, he gave us the high-resistance lamp, the multiple-arc and feeder systems, embodying principles which all successful inventors have since been compelled to employ in their distribution systems—whether dealing with direct or alternating currents, with systems of lighting (except series arc lighting), and with systems of electrical power, whether moving or stationary. In short, Mr. Edison gave us as the result of his brilliant inventive work at Menlo Park the cardinal engineering principles of the great industry with which his name is so intimately associated, and in making these contributions to scientific and industrial progress he achieved such a position that I think posterity will not adjudge us of undue enthusiasm if we name him as the greatest electrochemical experimenter and the first electric-light engineer of his day.

"It is not alone as the experimenter and inventor, as the mathematician and engineer, of this industry that Mr. Edison is entitled to recognition. It should be borne in mind that at the time of his first exhibit of his light and power system on a considerable scale at Menlo Park in the winter of 1880 there were no factories for the production of the apparatus required for use in connection with the system, nor were there in existence, except in their crudest state, any of the numerous appliances used between the generator and the lamp, and which have since become everyday necessities. These appliances had to be developed and factories for their manufacture organized before it was possible to build the first plant and distributing system, which was successfully started in New York in the fall of 1882. Things which to-day we do as a matter of course, because they have been done by others before us, presented great difficulties in the first 10 years of the 25 years which this occasion marks.

"All these matters were dealt with under the guiding hand of Mr. Edison himself. The credit of carrying his great work as an inventor to a successful commercial issue is therefore due to him, and thus, besides being the inventor of his electric-light and power system, he was in every sense the captain of the great industry resulting from his successful laboratory work.

"I will not attempt on this occasion to mention the other branches of electrical work in which Mr. Edison has so greatly distinguished himself as an inventor and in connection with which he has contributed so much to the industrial development of our time. What he has done outside of the electric-light and power field would be a sufficient life's work for most men.

"The work that he has accomplished should prove a great inspiration to future generations of students of the electrical engineering profession. When, as a result of competing for the Edison medal, which we hope will prove, so to speak, the 'blue ribbon' of the profession, they study the life of the great master after whom this prize is named, they will find that without any of the advantages of collegiate education, without any early training except that gained as a train boy and telegraph operator, blessed with little beyond a quick mind and a strong constitution, but with a will to work and a great power of concentration, this country boy from the West rose from so lowly a beginning to be the foremost electrical inventor of his time."

Professor A. E. Kennelly of Harvard University, past-president of the Institute, accepted the gift in behalf of that body. He said that the very existence of the Institute was indirectly due, in his belief, to the stimulus which the electrical arts and sciences received about the year in which the Institute was born by the labors of Mr. Edison. "In applied electricity our guest of honor is a pioneer of pioneers," said Dr. Kennelly. "Whether it was Prometheus or Ben Franklin who first snatched fire from heaven, it was Edison who first succeeded in imprisoning the spirit of fire in the globe of the incandescent lamp, so that we can all command this spirit to dispel the gloom of night and gladden the departure of the setting sun.

"Broad and generous are the terms of the deed lying before us. Although our Institute is a corporation under the laws of the state of New York, this deed declares that any youth, of any country, educated at any college or institution, from Texas to Labrador or to the Behring Straits, may qualify for this medal. Applied science and pure science know no barriers, know no marks upon the marks, and only understand and recognize the barriers of the unachieved and the unknown. The action taken here this evening should stimulate every worker in electrical interests all over this globe. I hope that this medal from year to year will inculcate some of the spirit in which this inventor strove and accomplished. It is a favorite saying of his that inspiration, in the main, is only another way of spelling 'perspiration,' and that there is no secret so deep in nature, so recondite or remote, but persistent and ardent human labor will bring it to the surface. For that proposition this medal and this Institute stand."

Tributes from Colleges and Electrical Societies.

Professor Cyrus F. Brackett of Princeton University on behalf of the colleges and universities of the United States and Canada, accepted such responsibility as the founding and purpose of the Edison medal confer. He remarked of Edison that, "Wherever this man may go in the wide world, his pathway will be lighted by the results of his own genius." Speaking of electrical college courses, Professor Brackett said: "The colleges and universities should provide courses in which the mathematical theory of electricity shall be thoroughly taught and mastered. Practical courses in electrical measurements and in the testing of electrical appliances should illustrate the theory. As preparatory to such work the student should be well versed in the English language, so as to express himself easily and clearly, and he should have a working knowledge of French and German. That he should have a thorough grounding in mathematics goes without saying. A differential equation should not disconcert him. Physics and chemistry should, of course, be insisted upon, for electrical engineering is only a special exploiting of those sciences. If for any reason the student has not made this preparation complete, his deficiency must be made up during the course. The student should be familiar with accounts and affairs, and this should be secured in his course of preparation. With the preparation and course just sketched and a suitable training in the shop, the student may hope to become an electrical engineer in the course of some years of patient and diligent work."

Joseph B. McCall of Philadelphia responded for the Association of Edison Illuminating Companies. He welcomed the opportunity to pay tribute to the distinguished guest of honor. The Association of Edison Illuminating Companies has grown from five companies in 1885 to 72 companies in 1903. Since its organization meetings have been held annually at different places throughout the country, and much that is best in the present state of the business has been the result of the dissemination of ideas and experiences exchanged at the meeting, gained from actual practical operation. At the St. Louis Exposition there will be an Edisonian exhibit, suggested by Mr. Insull and made by the Edison Association, and now being prepared under Mr. Insull's direction with great care and thoroughness, showing the great development from the small dynamos in the beginning to the great installations in the modern central stations.

Charles L. Edgar of Boston spoke for the National Electric Light Association, which, he said, was very glad to take its part in paying tribute to Mr. Edison and to the twenty-fifth anniversary of the introduction of the incandescent lamp. Mr. Edgar concluded as follows: "I remember that when I went to Menlo Park in 1882 and was told to report at Garrick Street to Charles L. Clark and W. S. Andrews, I considered it an honor to be connected with anything that bore the name of Edison. Twenty-two years later I am still of the same opinion. I know of no business in the world which is so interesting and has so many opportunities as the business in which the most of us are engaged. I know of no phase of our work which is so pleasant or so thoroughly satisfactory as the associations which we are able to continue with Edison men and with Mr. Edison. Some of us in recent years have seen very little of Mr. Edison himself, but I for one can say that in looking back to my earlier associations with him, whatever may be my feelings of admiration, of honor, and of respect, more than half of the total is made up of my feeling of affection."

Mr. Edgar's was the last speech on the programme, and after a pohtograph had been taken, the gathering dispersed.

Names of Those Present.

The list of the names of those present who had places at the tables is as follows:

Adams, C. C.
Adams, E. D.
Aylsworth, J. W.
Aylsworth, Mrs. J. W.
Ashe, S. W.
Arnold, Mrs. Geraldine.
Arnold, Bion J.
Arnold, Miss Maude.
Arbogost, Ralph.
Arbuckle, John.
Anson, F. R.
Anson, Mrs. F. R.
Andrews, W. S.
Andrews, Mrs. W. S.
Andrews, W. C.
Andrew, J. D.
Barnes, H. H., Jr.
Barr, J. B.
Batchelor, Chas.
Batchelor, Miss.
Bates, Chas. A.
Bates, Mrs. Chas. A.
Baker, W. H.
Barry, David.
Barry, Mrs. David
Bates, F. C.
Beckwith, Miss.
Bertram, Jas.
Beves, A. S.
Berggren, E. J.
Beran, Theo.
Benton, C. A.
Bentley, W. H.
Berliner, Dr. A.
Beach, R. H.
Beach, Mrs. R. H.
Beal, W. R.
Bell, T. R.
Bell, A. C.
Bell, C. T.
Berg, G. H.
Billings, Miss H.
Bijur, Jos.
Blish, J. B.
Blake, H. W.
Blake, Mrs. H. W.
Blake, S. H.
Bryant, W. C.
Brevoort, Mrs. W. H.
Brady, N. F.
Bradley, C. S.
Bradley, Mrs. C. S.
Brackett, C. F.
Brown, Frank.
Bowker, R. R.
Bowker, Mrs. R. R.
Bottomley, J.
Bottomley, Mrs. J.
Bolles, F. G.
Boll, A.
Bruch, C. P.
Barclay, J. C.
Bradfield, W. W.
Burt, B. T.
Burke, Jas.
Burke, Mrs. Jas.
Buck, H. W.
Burch, Miss Martha.
Carlebach, W. M.
Carty, J. J.
Cassier, Louis.
Campbell, H. A.
Cecil, Thomas.
Chamberlain, J. C.
Chandler, A. B.
Chandler, Mrs. A. B.
Chandler, Dr. C. F.
Chandler, A. E.
Chandler, Mrs. A. E.
Chandler, Alex.
Childs, S. W.
Childs, Mrs. S. W.
Clinnock, F. R.
Clark, W. J.
Clark, W. S.
Clark, T. F.
Clark, Chas. L. W.
Clark, Mrs. Chas L.
Cliss, Miss Janice.
Coles, E. P.
Collins, A. F.
Coues-Page, L.
Coues-Page, Mrs. L.
Counselman, L.
Coffin, C. A.
Coffin, Mrs. C. A.
Cowling, J. F.
Clowry, R. C.
Curtis, C. G.
Crossman, T. E.
Clifford, H. E.
Davis, S.
Donaldson, W. W.
Dennison, E. W.
Doolittle, T. B.
Doolittle, Mrs. T. B.
Dooling, Thos.
Donshea, W. J.
Donshea, Mrs. W. J.
Dowling, R. E.
Dowling, Mrs. R. E.
Drake, F. E.
Drake, Mrs. F. E.
Dunn, G. S.
Durant, Mr.
Dyer, R. N.
Duncan, Louis.
Emmet, W. L. R.
Elliott, Alex.
Eglin, W. C. L.
Edwards, C. V.
Edwards, H. M.
Edwards, Mrs. H. M.
Edgar, C. L.
Edgar, Mrs. C. L.
Eastwood, A. C.
Edison, T. A.
Edison, Mrs. T. A.
Edmonds, S. O.
Edmonds, Mrs. S. O.
Erben, H. F. T.
Estabrook, H. D.
Ewing, G. C.

Faxon, Mrs.
Fletcher, W. H.
Fearons, G. H.
Fliess, R. A.
Forsyth, J. C.
Foster, H. A.
Freid, C. T.
Fritz, John.
Gartley, A.
Gawtrey, L. B.
Gherardi, B.
Gilbert, E. E.
Gilmore, W. E.
Gilmore, Mrs. W. E.
Gillette, J. W.
Gray, A. A.
Goldsborough, W. E.
Goldschmidt, E. W.
Gonzenback, E.
Gordon, H. D.
Guy, G. H.
Griffin, Eugene.
Hall, John.
Hammer, W. J.
Hammer, Mrs. W. J.
Hanger, J. M.
Hall, Washington.
Harris, G. A.
Haskins, C. D.
Haskins, Mrs. C. D.
Hastings, F. S.
Hatzel, J. C.
Hawks, H. D.
Herzog, F. B.
Henderson, A.
Henshaw, F. V.
Herreshoff, F.
Hewitt, Peter Cooper.
Hedley, Frank.
Hine, Henry.
Howell, J. W.
Howell, Mrs. J. W.
Howell, W. S.
Hunt, C. W.
Hunt, Mrs. C. W.
Hughes, C. T.
Hughes, Mrs. C. T.
Hutchinson, F. L.
Hartman, H. T.
Hartman, Mrs. H. T.
Holmes, F. S.
Insull, Samuel.
Insull, Mrs. Samuel.
Insull, M. J.
Irwin, P.
Jenks, W. J
Jenks, Mrs. W. J.
Jenkins, A. B.
Jackson, F. E.
Johnston, R. H.
Johnson, W. H.
Jones, Miss C. M.
Jones, F. W.
Jones, Mrs. F. W.
Jones, Paul E.
Jones, Mrs. Paul E.
Judson, H. C.
Kater, J. C.
Kelcy, I. D.
Kelsey, F. W.
Kennelly, A. E.
Keech, G. C.
Kintner, C. J.
Kimball, F. H.
Kitten, F.
Knowles, E. R.
Koiner, W. C.
Latey, H. G.
Lansley, W. J.
Latham, E. B.
Lieb, J. W., Jr.
Lieb, Mrs. J. W., Jr.
Leslie, E. A.
Leslie, Mrs. E. A.
Leslie, Miss Florence M.
Lillibridge, Miss.
Leithauser, Miss Marie.
Lewis, Eugene H.
Lippincott, Miss H. B.
Logan, W. S.
Lovejoy, D. R.
Lovejoy, J. R.
Lozier, R. T. E.
Lodyguine, A.
Lupke, Paul.
McClure, H. H.
McCall, J. B.
McCall, Mrs. J. B.
MacAndrew, A. G.
MacAndrew, Mrs. A. G.
McLean, Thos.
Mahar, F. W.
Mallory, W. S.
Mallory, Mrs. W. S.
Marsden, W. R.
Marsh, C. D.
Marsh, Mrs. C. D.
Martin, T. C.
Martin, K. G.
Mahony, J. J.
Mailloux, C. O.
Mailloux, Mrs. C. O.
Marshall, N.
Matcham, C. A.
Mitchell, R. P.
Miller, W. H.
Miller, G. E.
Morrison, G. F.
Morris, Elmer P.
Morris, Mrs. Elmer P.
Moneypenny, N. N.
Moneypenny, Mrs. N. N.
Moore, W. B.
Moore, W. E.
Moses, Dr. O. A.
Mullin, E. H.
Mullin, Mrs. E. H.
Mullaney, T. F.
Mullaney, Mrs. T. F.
Mullon, Mrs.
Munroe, G. H.
Munroe, Mrs. G. H.
Murray, T. E.
Murray, Mrs. T. E.
Nesbit, Wm.
Nicholson, S. L.
Ormrod, Geo.
Patterson, John.
Paine, F. B. H.
Packard, G. F.
Page, A. D.
Page, Mrs. A. D.
Parker, H. C.
Pattison, C. E.
Pattison, F. A
Peck, E. F.
Pikler, Henry.
Pearson, W. A.
Pippey, Mrs. B. Y.
Pope, R. W.
Pomeroy, L. R.
Price, C. W.
Price, Mrs. C. W.
Rafu, Robert.
Rayburn, C.
Randall, W. H.
Reed, F. H.
Reed, Mrs. F. H.
Reid, W. P.
Reid, Mrs. W. P.
Reiff, J. C.
Reist, H. G.
Rennard, J. C.
Rice, Calvin W.
Rice, E. W. Jr.
Rice, Mrs. E. W., Jr.
Richardson, H. C.
Ridgeway, A. C.
Ries, E. E.
Rogers, Nelson.
Rogers, O. A.
Rogers, Mrs. O. A.
Rushmore, D. B.
Russell, Mr.
Russell, Mrs.
Ryan, W. D'A.
Schafer, O. M.
Schwartz, Carl.
Scheffler, F. A.
Scheffler, Mrs. F. A.
Schnuck, E. F.
Scott, C. F.
See, A. B.
See, Mrs. A. B.
Serrell, L. W.
Sever, G. F.
Sheldon, S.
Sheldon, Mrs. S.
Sherman, R. M.
Sinclair, Angus.
Skinner, Miss L. A.
Skirrow, J. F.
Skirrow, Mrs. J. F.
Smith, A. H.
Smith, Oberlin.
Smith, Mrs. Oberlin.
Smith, Jesse M.
Smith, Mrs. Jesse M
Smith, D. S.
Smith, Eben.
Smith, H. W.
Summers, L. L.
Spencer, J. E.
Sperry, E. A.
Spier, C. L.
Spier, Mrs. C. L.
Sprague, F. J.
Sprague, Mrs. F. J.
Sprague, C. M.
Stanton, L. W.
Stephens, Miss.
Stephenson, Henry.
Stratton, F. A.
Stillwell, L. B.
Swasey, Ambrose.
Swasey, Mrs. Ambrose.
Taltavall, J. B.
Taylor, E. R.
Taylor, Mrs. E. R.
Taylor, J. W.
Taylor, Zachary.
Taylor, F. H.
Taylor, R. C.
Thurber, H. F.
Thomson, E.
Thompson, R. H.
Thomoson, Mrs. R. H.
Townley, Calvert.
Turner, H. W.
Turpin, M. Curry.
Upton, F. R.
Upton, Mrs. F. R.
Upton, Miss.
Usher, G. H.
Usher, Mrs. G. H.
Van Riper, J. C.
Van Riper, Mrs. J. C.
Van Every, J. B.
Vail, J. H.
Vansize, W. B.
Vom Baur, C. H.
Wallbridge, Mrs.
Ward, Geo. G.
Ward, Mrs. Geo. G.
Wagner, H. A.
Wagner, Mrs. H. A.
Wakeman, J. M.
Wakeman, Mrs. J. M.
Waldron, H. H.
Westinghouse, H. H.
Weber, Peter.
Wellman, S. T.
Wells, W. F.
Wells, Mrs. W. F.
Wetzler, Jefferson.
Wheeler, E. P.
Wheeler, Schuyler S.
White, J. G.
White, Mrs. J. G.
White, W. F.
White, Mrs. W. F.
Whitney, C. W.
Winter, E. W.
Wilder, S.
Willcox, F. W.
Wilgus, W. J.
Wightman, M. J.
Williams, Guy V.
Williams, Arthur.
Williams, Joseph.
Williams, Mrs. Joseph
Wills, A. T.
Wilson, Fremont.
Wilson, Mrs. Fremont.
Wilson, Miss Margaret.
Woodin, C. R.
Warren, W. A.
Winship, A. E.

The January earnings of the Chicago and Milwaukee Electric Railway Company, which operates between North Shore towns, show an increase of 49.61 per cent. over January, 1903. The amount for last month was $8,175 and for the preceding January, $5,461.

Echoes of the Baltimore Fire.

Business activity in Baltimore since the great fire has been resumed with commendable promptness, and the electrical interests are among the first to recover from the blow.

The Sprague Electric Company, whose Baltimore office was destroyed, is now located in the Maryland National Bank Building.

Another change made necessary is that of the Electric Storage Battery Company, which has found it necessary to remove its Baltimore district office to Philadelphia, where it is at present located at Allegheny Avenue and Nineteenth Street.

Luckily the Viaduct Manufacturing Company, whose home address is at Baltimore, was not affected by the fire, its offices and factory being located about 10 miles out in the country, at Relay, B. and O., on the Patapsco River, where everything is in operation as usual. This company manufactures telephones and electrical supplies.

The Underwriters' Salvage Company, in redeeming damaged goods, has decided upon a novel method of drying articles which would otherwise be unsalable, and for this purpose has placed an order with the B. F. Sturtevant Company of Boston for a complete drying kiln, to be used in connection with the Sturtevant fan system.

Rebuilding in the burned district has already been begun, and all the new buildings will be as near fireproof as modern methods can make them.

The restoration of almost the whole of the city's street-railway service within one week is one of the marked surprises in connection with the work of restoration. The success in this direction is due largely to the energy and skill of General Manager William A. House and President Hood, and they have been materially aided by the Baltimore and Ohio Railroad Company, which generously offered all the surplus power from the tunnel power house.

Subway Engineer Charles C. Phelps of the Baltimore Municipal Electric Commission says that the city will not permit the erection of a single pole or the stringing of a single wire for any purpose except for street railways within the burned district, and adds: "The electrical commission met and decided upon this course. Most poles in the territory swept by fire are already down. The rest are being taken down by squads of men under my direction. They are being cut up as fast as they are taken down and carted away for distribution among people who need wood. Under direction of the commission our men are isolating the burned district from all live wires. Absolutely none for even telegraph, telephone or lighting purposes will be permitted to be strung. In this district the city conduits are completed and are ready for the reception of wires of all companies. Most of the companies have their cables already on hand, while those that have not can easily get them. No permits for poles will be issued. They are down now and they will stay down. The commission has decided upon this course and will stick to it." For months the commission has been endeavoring to force the various companies using poles into the city to use the subways. It was never anticipated the poles would come down at such cost, but now they are down they will remain so, and the business section of Baltimore will be free from them.

Commonwealth Company Gets More Land.

The Commonwealth Electric Company of Chicago has just made another purchase of land in connection with its Fisk Street holdings. The land lies on both sides of the Chicago River, with Twenty-second Street on the north and Cologne Street on the south, and contains, together with a small plat south of Quarry Street, included in the sale, 182,000 square feet. The company's total purchases now include the following: Purchased in 1892, 616,066 square feet; from the estate of Caleb Allen, recently reported, 195,000 square feet; from the estate of Joseph Drexel, above stated, 182,000 square feet; leased from estate of B. S. Rotsch, 80,000 square feet. This is a total of 1,073,066 square feet, the purchase value being $565,200. The object of the recent purchases is to have a sufficient area in which from time to time to extend and develop the plant of the company.

The business of the Commonwealth and Edison companies in the various sections of Chicago in which they operate has grown beyond the expectations of the officers, and it is believed that the next few years will show equally well. The Commonwealth company has already expended over $2,000,000 in construction at its Fisk Street station, and it is estimated that within the next six or seven years $8,000,000 will be expended.

New Excess-rate Discount.

The Chicago Edison Company is making a proposition to such of its electric-light customers as are willing to make a contract for a period of one year or more, agreeing therein to use each month during the period covered a certain minimum amount. The offer is in the form of a contract in which it is provided that if the customer uses in any month a larger number of lamp-hours than will be obtained by multiplying the greatest number of lamps used simultaneously during the month by 30, he will receive a discount upon the portion of the bill representing the excess over the amount so obtained. For instance, if the maximum number of lamps burned simultaneously in any month is 50, and the total consumption is 2,000 lamp-hours, the customer will receive a discount on 500 lamp-hours, that being the excess over 1,500 hours, or $15 worth, figured at one cent per lamp-hour, which is obtained by multiplying 50, the maximum, by 30 hours per month.

Affairs of the Western Electric Company.

The Boston News Bureau says: "The annual report of the secretary of the Western Electric Company showed total sales for the fiscal year ended November 30, 1903, of $30,250,000, compared with the total sales of $28,626,800 in 1902, a gain of a little over five per cent. The net earnings were $2,760,000. The sum of $920,000 was distributed in dividends and the total surplus on November 30, 1903, was $8,870,000. No report was made to the stockholders by the president, but the officials say that the company is in excellent condition, and that there will be no issue of new stock this year.

"At present the interest of the company is centered in the construction of its enormous new plant at Hawthorne, about eight miles from Chicago on the Belt railroad, which connects all the railroads entering Chicago, thus giving superior advantages for handling freight. The new plant will ultimately cost several millions of dollars, and will be one of the most complete and modern industrial plants in the world. The outlay for the present, however, will not much exceed $1,000,000, and it is hoped that manufacturing will begin in the new plant by June 1st. The cost of this plant at Hawthorne is coming out of the earnings of the company. Thus far everything has been paid for as the work has progressed. No issue of stock nor any mortgage is contemplated to secure the remainder of the money required, but the floating debt of the company will be increased for a time. As soon as the new plant is in working order certain of the buildings owned by the company at the present location will be vacated and sold, and this shifting of investments will pay for the new plant. Under the circumstances it does not seem likely that the stockholders will get any extra dividend or distribution of surplus this year."

Electric Automobile Train.

An exhibition of a tractor road train was recently given at Glendale, L. I. On account of the condition of the roads, which were practically glare ice, it was impossible to drive the train a great distance, but the test demonstrated that under anything like reasonable conditions the train had ample power for operation. Each wagon of the train is practically self-propelled, the tractor being really a generating plant, from which electric current is supplied to motors under each of the two trail cars, as well as to its own driving motors. A three-cylinder, four-cycle, 40-horsepower gasoline engine and a direct-connected 30-kilowatt generator constitute the generating set and furnish a 220-volt direct current to a pair of six-horsepower motors under the tractor and to the two five-horsepower motors with which each trail car is equipped. The tractor motors are connected by gearing—giving a speed reduction of 26 to one—to the forward wheels, the steering being accomplished by means of the rear wheels. The trail cars are, of course, driven from the rear, and motors and rear-wheel sprockets are connected by roller chains of two inches pitch, the speed reduction here being about 45 to one.

Gas Lighting in Chicago.

The annual report of the People's Gas Light and Coke Company for 1903 shows gross receipts of $11,854,800, as compared with $11,058,413 in 1902. The percentage of expenses to receipts was 54.3. Statistics accompanying the report show: Miles of street mains, 1,871; number of meters, 347,750; number of gas stoves, 125,181; number of public lamps, 24,948; number of gas "arc" lamps, 28,477. President Knapp, in his report, states that something over a year ago the directors concluded to take up the matter of pushing the introduction and installation of what are known as gas "arc" lamps. A careful record of the operations of these lamps indicates that the consumption of gas by an "arc" lamp is substantially the same as the consumption of the average family gas stove. The increase for the year in the number of gas meters set is 5,600 and in the number of gas stoves installed, 19,337. While the increase in both these departments is not quite so large as during the year 1902, whatever deficiency exists is more than counterbalanced, it is said, by the installation of the 28,477 gas "arc" lamps.

Electric Lights on a Texas Farm.

Meerscheidt Brothers of San Antonio, Texas, contemplate installing an electric [illegible] on their large irrigation farm situated near the city. The power will be used to operate the irrigation machinery and the lights will be placed in the fields in order to expedite the picking of the products at night. Additional irrigation machinery is also to be installed.

The "GE" Trademark in Incandescent Lamps.

The interesting and important question of the protection of a trademark came up in the case of the General Electric Company against the Re-new Lamp Company and others. The defendant renews incandescent lamps, and in doing so it appears that, without intending to deceive, it renewed lamps containing the "GE" trademark, without removing the latter. The General Electric Company objected to this, contending that such a renewed lamp was not a "GE" lamp, and that such a use of its trademark was unauthorized. Judge Brown of the United States Circuit Court for the District of Massachusetts, has upheld this view in a decision handed down on February 2d. As the question of trademark protection is one of general interest, the opinion accompanying the decision is given in full.

Brown, J. This is a bill to enjoin the use by the defendants of the complainant's trademark "GE" on electric lamps. The general character of the case is set forth in the opinion of this court on the petition for a preliminary injunction, reported in 121 F. R., 164. At that hearing it was the defendants' contention that the complainant had placed within the stem of an electric lamp a non-removable label bearing the letters "GE" as a device to hinder the defendant in its business of repairing and renewing electric lamps; and that, under color of a claim for the protection of a trademark, the complainant was in reality seeking to destroy the defendants' business. Reserving any opinion on the merits of this contention, either in fact or in law, a preliminary injunction was denied because of doubts whether the complainant's case was, in substance, an ordinary trademark case, and because of the novelty of the legal questions which would arise if the defendants should establish their contentions of fact.

The defendants, by their answer, renew the contention that the letters "GE" in the stems of the lamps are non-removable, and were put in the stems, not as a trademark, but in pursuance of a scheme to prevent the remaking of the lamps.

Upon final hearing, I am of the opinion that the defendants have not established their contentions of fact. It is, therefore, unnecessary to consider the complainant's argument that the complainant's motive in locating its trademark within the inner stem of the lamp is immaterial; nor is it necessary to consider the scope of the legitimate uses of a trademark, nor the applications of the rule that a court of equity will not shut its eyes to the evident character of a transaction, or suffer itself to be used to effect an ulterior and avowed purpose.

Upon the evidence, it must be held that the complainant's trademark, affixed to the inner stem of the lamp, is practically removable in the remaking of lamps, since it can be obliterated at an expense of 55 cents per thousand lamps, by applying to the exterior of the stem, and over the complainant's trademark, a small quantity of chemical paste. Since the bulb is opened in remaking, to insert new filaments, and to fasten the ends of the leading-in wire with carbon paste, the application of a similar paste for the obliteration of the trademark would seem an obvious expedient. While the defendants say that this method was discovered by them since the filing of the bill, yet the method is so simple, and was so readily available to common judgment and ordinary skill before the filing of the bill, that it must be held that, while the complainant's trademark was non-removable in the ordinary use and sale of the lamps, it was not non-removable, in any practical sense, in the remaking of lamps according to the defendants' method. To remove it, it was not necessary to make a "discovery," but to use ordinary and obvious means.

It also becomes very doubtful if the complainant's officers were in any degree influenced to adopt the peculiar location of the trademark because they thought it non-removable in remaking. The complainant has shown good business reasons for applying its trademark "GE" to some portion of an electric lamp. In doing this, it naturally adopted a practice so common that it could give rise to no reasonable inference of a scheme to attack the defendants' business. Its application to the inside of the inner stem might tend to support an inference that the location was chosen with the object of preventing removals in remaking; but the complainant shows, also, good business reasons for affixing the label to the interior of the stem. Indelible trademarks had been blown or etched on the glass of lamps of other makers. It was suggested by an agent of the complainant that, "from an advertising point of view, we have nothing so good as the ten or twelve millions incandescent lamps that we distribute through the world annually, provided that it would be practicable to put some indelible trademark, and provided that our customers would not object." Etching was discussed, but considered more expensive. In the correspondence between employes of the complainant, there is no reference to the business of remaking lamps; on the contrary, this correspondence is strong evidence that it was the real purpose of the complainant to affix an indelible trademark for the ordinary purposes of a trademark and not, as the defendants allege, as a part of a scheme to attack its business of remaking lamps. It is also apparent that, with this indelible label in the stem, it will be impracticable for vendors of lamps to acquire a reputation for themselves based upon the merits of the complainant's manufacture; since, if they affix their own labels to complete lamps, the complainant's indelible labels will still remain to indicate their origin. In the former opinion it was said:

"It may be that, upon a full investigation of the facts, it will appear that the complainant's use of its trademark in its present position is a natural use growing out of ordinary business considerations. If that fact be established, the doubts as to the complainant's title to relief would probably disappear. The complainant could hardly be required to forego an appropriate and proper application of its trademark merely for the reason that incidental business complications might result to the defendants."

Upon full hearing, I am of the opinion that the complainant's use of its trademark in the stem of the lamp is a natural and proper use, growing out of ordinary business considerations; that it did not, in fact, tend to destroy the defendants' business, or appreciably reduce their profits, and that there is no sufficient or substantial reason to justify an allegation that the complainant, either alone or in combination with others, did devise a scheme to attack the business of the defendants.

The defendants' contention that agreements between the complainant and 84 allied corporations in various cities are in restraint of trade and illegal, in my opinion, has no bearing whatever upon the question of the right of the complainant to protection for its trademark, and requires no discussion. Nor is there any merit in the defense that the complainant has been guilty of such improper practice in the use of its trademark as to bar it from invoking equitable relief. Assuming that it did renew or reconstruct lamps, and sell them to the trade without notice of this fact, there is no evidence of any imposition on the public, or that a lamp remade by the complainant was not, in every substantial respect, the same as a new lamp made by it. A "GE" lamp remade by the defendants is not a "GE" lamp, but a new construction. This question is dealt with in the former opinion. A "GE" lamp remade by the complainant is a "GE" lamp, since, in remaking, it becomes substantially a new "GE" lamp. If, of equal merit with the former, there is no imposition on the public in selling it as a "GE" lamp. But neither this nor the other points to the same general effect are of sufficient importance to require discussion. The case, upon the facts, becomes a simple one. The complainant has a valid trademark. The defendants, without legal justification, put forth lamps bearing this trademark. Though they did so without any intent to deceive, and have been honorable in intention and in their business methods, and, so far as appears, have caused no actual deception, yet the use of this trademark in violation of its legal rights, entitled the complainant to an injunction.

A draft decree may be presented accordingly.

Circuit-breakers for Low Tension.

Since the introduction of circuit-breakers for the purpose of automatically interrupting currents at any predetermined point, manufacturers of electrical apparatus have been constantly engaged in an effort to produce appliances which will break abnormal currents with the greatest degree of regularity of action, and the least damage to the breaking device. In this development the Westinghouse Electric and Manufacturing Company of Pittsburg has produced, successively, Types A, B and C, and it now presents Type D, as a high-grade automatic device sold at a moderate price. In this last-named type the current is shunted to carbon arcing tips and there ruptured, as in the original type A, and the single break is used as in types B and C.

The Type D circuit-breaker is designed for use upon circuits not exceeding 250 volts. Its distinguishing feature is the simplicity of its construction. As will be noted from the illustrations, there is no complicated or hidden mechanism, the entire device being open to inspection. It is small and compact, there are but few parts, and the most of these are made from punchings, combining strength, lightness and smoothly finished surfaces at a cost which enables the maker to adopt popular prices. There are no springs to get out of order, the only thing of this kind being the flat strip which carries the carbon arcing tip and which also serves to throw back the movable arm when the breaker is opened. All screws are locked and the adjustments are few and permanent.

For the movable contact a laminated brush is used, made from the best leaf copper, and protected by a copper shunt and so arranged that when the breaker is opened, the current is shunted to the carbons above. The arc occurs when the final break is made on the carbons, the construction of the contacts aiding the natural tendency of the arc to rise, and preventing it from being communicated to the other live parts. Flexible braided leads carry the current from the movable-contact brush to the terminal, thus reducing the number of movable current-carrying contacts to a minimum. The temperature rise of the contacts is, it is asserted, never over 20° C. with a normal current.

The current passes through a coil through which is thrust one pole of a laminated iron horseshoe electromagnet. The armature is attached to the other pole of the magnet, and is so placed that a current sufficiently strong will draw up the free end of the armature, a movable counterpoise serving to vary the amount of current required. When the armature is drawn up, contact points attached to it strike the toggle joints which hold the breaker closed, and the circuit is opened. If desired, the circuit-breaker can be opened by hand at any time, in the same manner as an ordinary switch. The Type D circuit-breaker is made with one, two, three or four poles, thus covering all the requirements for alternating-current and direct-current circuits.

The single-pole breaker (Fig. 1) is recommended for use upon motor or lighting circuits when a switch is used in series to complete the circuit after the breaker has been closed. The two-pole breaker

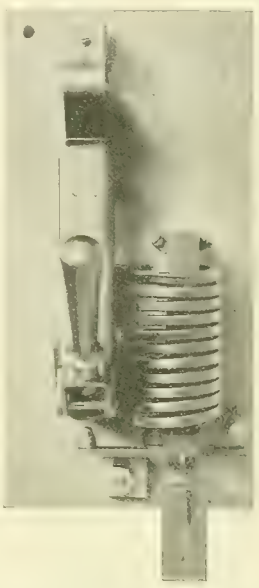


FIG. 1. CIRCUIT BREAKERS FOR LOW TENSION. SINGLE-POLE BREAKER.

(Fig. 2) is used to interrupt the current simultaneously in both wires of a two-wire circuit. The two poles are closed independently. A switch to complete the circuit is not necessary, as the tripping mechanism is so designed that a short-circuit or an overload will cause the first pole closed to open immediately upon closing the other. This feature combines the functions of two devices at practically the cost of one, with added convenience and saving of space.

Three-pole circuit-breakers for use upon three-wire direct-current or three-phase alternating-current circuits, and the four-pole breakers for two-phase alternating-current circuits, are so arranged that the

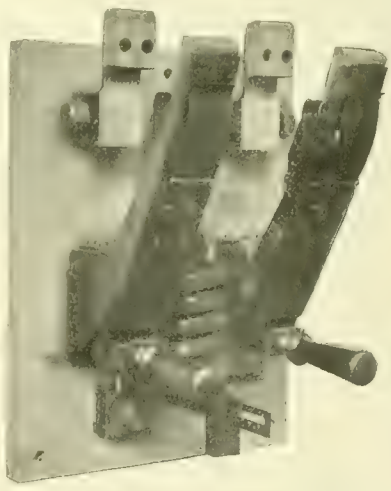


FIG. 2. IRCUIT BREAKERS FOR LOW TENSION.— DOUBLE-POLE BREAKER.

poles are closed at the same time by the same handle and tripped simultaneously, either by hand or by tripping coils.

As regularly made, the type-D circuit-breaker has front connections, as shown, but when desired for switchboard mounting, a threaded copper stud for rear connections is substituted. It is neatly finished in black oxide and presents an attractive appearance.

The Emporia Business Men's Association of Emporia, Kan., states that there is an excellent opening for street and interurban railways at Emporia and that it will be pleased to correspond with anyone interested. Emporia is the county seat of Lyon County and has a population of 13,000. There are numerous small towns tributary and the population of the country within a radius of 25 miles is 35,000, outside of towns. It is said that the grades are easy and there are no engineering difficulties. I. E. Lambert or J. E. Martin may be addressed.

Coil Windings for Electrical Purposes.[1]

By Richard Varley and Charles R. Underhill.

In studying the many phases of electromagnets, very interesting points are noticed. For instance, for long ranges, the pull will vary almost in direct ratio to the ampere-turns, while for short ranges, that is, where there is a short gap in the circuit, the proportionate pull will be much greater for low magnetizing forces than for high magnetizing forces. The reason for this is obvious. In the case of a long range, the iron will not become sufficiently saturated to increase the total reluctance of the magnetic circuit, as the reluctance of the air gap is at least 90 per cent. of the total reluctance. In the case of the short air gap, however, and particularly if the sectional area is great, the reluctance of the gap may not exceed, or in some cases may be less than the reluctance of the iron portion of the magnetic circuit; therefore, it is very difficult to make any set rule for determining the pull.

Again, there have been very few data published regarding the coil and plunger type of magnet, or solenoid. General magnetization curves have been shown, but no particular working data given. It has been found that by making different sized magnets of various types, a general curve may be drawn by reference to which the proper dimensions may be found for any pull through any range desired.

The data required are as follows: The pull, whether uniform or accelerating; the distance through which the pull must act; the time the current is to be on the magnet and the length of time between the contacts operating the magnet. It should also be specified whether the magnet is to be in a vertical or lateral position, unless the weight of the armature is to be counterbalanced by a weight or spring. When this is not specified, it is customary for the manufacturer to make the pull of the magnet great enough to include the weight of the armature. It is important to know the length of time the current will be on the winding, in order to make the radiating surface sufficiently great, and also to know the length of time between the contacts, as the magnet will cool during that time, and so that this may be deducted from the heating.

As an example: Let us assume that an electromagnet is required which will pull 25 pounds through a range of 10 inches. Now, since the field of the solenoid is nearly uniform throughout its entire length, the solenoid immediately suggests itself for this purpose. But here the designer lacks data on the relation between the ampere-turns in the winding and the necessary diameter of the plunger in order to fulfill the specifications. The practical way out of this difficulty is to make a test. By selecting several lengths of solenoids with different diameters, and by testing these solenoids with various sizes of plungers, excellent data are obtained which help the designer to determine the proper size of solenoid and plunger for any specific purpose.

It is obvious that an ironclad solenoid is stronger than the simple type of solenoid, as the iron completes the magnetic circuit. But here again the designer lacks data, and therefore tests must be made before the actual design can be completed.

Again, the plunger electromagnet is much stronger than the simple or ironclad solenoid, for short distances, as it has the combined functions of the ironclad solenoid and the electromagnet, and data have to be obtained for this. So it is for all the different types of electromagnets. True, we have excellent data for electromagnets with closed magnetic circuits, but it is a rather difficult undertaking to calculate accurately the action of an electromagnet when its range of action is comparatively great.

To the casual observer, the winding of an electromagnet is the least important of that indispensable detail of so many electrical devices. The magnet circuit is carefully considered, as it should be, of course, but the winding is briefly referred to in terms of ampere-turns. This is correct, so far as it goes, but how about the economy of that winding? How shall the winding itself be so constructed that the maximum of magnetic energy, in ampere-turns, may be obtained with the minimum amount of electrical energy?

The ampere-turns are, of course, dependent upon two things only, namely, the resistance of the average of all the turns in the winding, and the electromotive force applied to the winding. This rule is based upon the following reasoning: Assume a single layer of insulated wire wound upon a core of any given diameter. Now assume but one turn of wire with, say, one volt pressure on that turn. If the resistance per turn of wire is 0.01 ohm, the resultant current would be 100 amperes, therefore, for one turn of wire there will be 100 ampere-turns. Now assume two turns of wire with the same total pressure, i. e., one volt. The resistance will then be 0.02 ohm, and the current 50 amperes. Then 50 amperes and two turns equal 100 ampere-turns, as before. This rule holds the same for any number of turns, only in the practical condition the average diameter of all the turns is taken.

As the current strength for a constant resistance is dependent upon the voltage, in the case just considered the ampere-turns for 10 volts would be 10 times the ampere-turns per volt, or 1,000 ampere-turns. Therefore it will be seen that the ampere-turns, for any specific case in which the voltage and mean diameter of the winding are given, depend entirely upon the resistance of the average turn, regardless of any number of turns in the winding.

The economy of the winding for any specified number of ampere-turns depends entirely upon the number of turns in the winding, as the greater the number of turns for the same mean diameter, the greater will be the resistance, and, consequently, the less will be the current for the same ampere-turns and voltage. The meaning of this is, that less electrical energy is required to maintain a given magnetizing force in a coil with many turns of a given size of conductor, than with a few turns of the same conductor.

The ideal condition would require a wire whose cross-section should be square or rectangular, and the insulation should be vanishingly thin; that is, the convolutions should be insulated from one another, without any space being occupied by the insulation. The practical conditions, however, are far from being ideal, not only with respect to the exceedingly thin insulation, but also on account of the infeasibility of using wire of square or rectangular cross-section, owing to the perversity of the square wire in endeavoring to rest upon its corners in the winding, instead of upon its flat sides, as is assumed in the ideal case; and while the rectangular wire or ribbon answers very well for heavy work, it does not give satisfactory results with wires finer than No. 14, on account of the greater amount of insulation required to cover it for equal cross-sections as compared with round wire, and for this reason best results are at the present time obtained with round wire.

The ordinary method of insulating is to wrap cotton or silk about the wire. For all practical conditions, cotton is quite as good for insulating as silk, but, owing to the greater thickness of the cotton, the silk-covered-wire winding is more economical as to operation, although a trifle more expensive in first cost.

Let us compare the various weights of copper in the ideal case with the weights of copper in the windings with silk and cotton-covered wire. In the ideal case the winding volume would be entirely filled with copper, while in the practical cases, the volume occupied by the insulation, as well as the volume lost due to the interstices between the turns of round insulated wire, must be deducted from the total winding volume to give the volume of the copper. For this purpose, let us consider a winding volume of one cubic inch. For the ideal condition, the weight of the copper would be 0.03 pound, while for a No. 30 B. & S. wire insulated with silk to a two-mil increase, the weight of the copper would be but 0.175 pound, and for a cotton-insulated wire of the same diameter, the increase in diameter, due to the cotton, being four mils, the weight of the copper in the winding would be but 0.129 pound.

It is sometimes desirable to use an insulating material which will not burn when the winding becomes very hot, and asbestos-covered wire is used to some extent, especially in arc lamps, where the temperature of the controlling magnets is influenced by the heat from the arc, but while this insulation is not inflammable and does not char or crumble, it is so thick that only a small portion of the available winding volume is filled with copper, and for this reason the asbestos-insulated wire is not economical, as compared with cotton-covered wire.

In the calculation of the proper wire to be used in a given bobbin for any specific purpose, there are two factors which must always be determined. One is the resistance factor, and the other, the space factor. These two factors may be combined and called the combined space and resistance factor, and expressed in terms of "ohms per cubic inch." Therefore, if we know the cubical contents of our bobbin, and have previously calculated a table of "ohms per cubic inch" for the various sizes of insulated wire, we may quickly determine the proper size of wire for our purposes.

Let us consider a round winding: Since the winding on a bobbin of circular section is really a hollow cylinder:

The volume will be $\pi L\left(\frac{D^2 - d^2}{4}\right)$ cubic inches,

Where D = outside diameter of winding
d = inner diameter of winding
L = length diameter of winding.

Now let us consider the section and length of insulated wire, which is to comprise the winding. First, let us get our resistance coefficients.

It has been found by experiment that a commercial soft copper wire 0.001 inch in diameter has a resistance at 68 degrees Fahrenheit of 10.3541 ohms per foot. Now, since for the same length, the resistance of a conductor decreases in direct ratio to the sectional area of the conductor, the resistance will vary with the square of the diameter of the wire. Therefore, denoting the diameter of the wire by $\triangle$, the ohms per foot for any diameter of copper wire will be $\frac{.00010354}{\triangle^2}$, or the ohms per inch $= \frac{.00000086284}{\triangle^2}$.

Now it is obvious that if we know the length of a given wire that will just fill the bobbin in question, we may quickly find the resistance by multiplying the length of the wire by the resistance per unit length. But here we must consider the sectional area of the wire and insulation. For wires of a smaller diameter than No. 20 B. & S. the cotton insulation makes the total diameter .004 inch greater than the diameter of the wire. This is generally referred to as a four-mil increase.

When the wire is wound into the bobbin, the turns of one layer cross the turns of adjacent layers at an angle which is dependent upon the diameter of the wire and the diameter of the turn. Therefore, at a certain point on each turn, the corresponding turn of the adjacent layer will be centrally over this turn, but 180 degrees around where the wires cross one another, the wires will imbed slightly.

The gain due to imbedding is approximately 7.3 per cent., but since this gain in space is about equally offset by the spreading of the insulation laterally, due to the vertical tension on the wire during the process of winding, the longitudinal sectional area of the bobbin consumed by each turn of wire is approximately equal to the square of the diameter of the wire and insulation.

The turns, then, are equal to the longitudinal cross-sectional area of the winding, divided by the square of the diameter of the wire plus insulation, or

$$N = \frac{TL}{g^2}$$

Where N = total number of turns in the winding.
T = thickness of winding.
L = length of winding.
g = diameter of wire plus insulation.

Now the total length of the wire Lw in the winding will, of course, be equal to the number of turns multiplied by the average length of all the turns, or

$$Lw = \frac{\pi L (D^2 - d^2)}{4 g^2}$$

Therefore, the resistance ρ of the winding will be

$$\rho = \frac{.00000086284 \times \pi L (D^2 - d^2)}{4 g^2} = \frac{.00000027107 L (D^2 - d^2)}{4 g^2}$$

To simplify the operation in practice, it is customary to calculate separately the constants for the various sizes of wire, both the resistance and space factors. Since for any given size of insulated wire with given insulation, the space and resistance factors may be resolved into the combined space and resistance factor, and in this factor the constant π is incorporated, therefore, the resistance ρ may be found by the simple formula:

$$\rho = RL\left(\frac{D^2 - d^2}{4}\right)$$

where R equals the combined space and resistance factor.

Space and resistance factors are arranged in the form of tables for reference, therefore only the volume of the bobbin need be found in order to ascertain the resistance which may be contained therein with any size of wire, or the size of wire may be determined which will give the desired resistance for any winding volume. In this latter case, however, the true outer diameter of the winding must be recalculated, as the calculated constants seldom coincide with the tabulated constants; therefore, the next smaller size of wire is taken and the true outside diameter of the winding calculated by the formula,

$$D = \sqrt{\frac{4\rho}{RL} + d^2}$$

For windings of square or rectangular cross-section, special formulæ are required. However, these formulæ only have to be used in determining the average length of all the turns, as the thickness and length are the same as in a winding, or circular cross-section.

In order to obtain the theoretical results in practice certain precautions must be taken; for instance, the actual diameter of the insulating sleeve must be taken, and also the exact diameter of the wire and the thickness of the insulation. A change of .0001 of an inch in the diameter of a No. 35 wire will change its resistance about six per cent. for equal lengths of wire; therefore, caution must be taken to be sure that it is not stretched during winding, as the ampere-turns will be materially reduced. A slight increase in the insulation will also make a marked change in the amount of wire in a winding. Also, in calculating the weight of insulated wire, the specific gravities of the wire and insulation must be known.

1. Abstract of paper read by Mr. Underhill before the Northwestern Electrical Association in Milwaukee on January 21, 1904.

Chicago Street-railway Situation.

Consideration of the traction ordinance for the Chicago City Railway Company by the committee on local transportation has been delayed by the death of Alderman Mavor, a prominent member of the committee. In the case of the Chicago Union Traction Company it seems probable at the time of going to press that Judge Grosscup will make some radical changes in the receivership, intended as a means of settling the differences between it and its underlying companies. The change contemplates a complete divorce of the control of the North and West Side companies from their tenant. To the three receivers of the Union Traction it is planned to add a fourth to represent the interests of the citizens of Chicago.

Permission has been granted from the secretary of state to incorporate the Alton, Granite and St. Louis electric railway of Alton, Ill. The incorporators will be J. F. Porter, W. F. Porter, M. E. Meeks, W. S. Baker and Levi Davis. The capital stock will be $100,000.

Independent Telephone Association of Wisconsin.

The fifth annual convention of the Independent Telephone Association of Wisconsin, held in Milwaukee, February 10th and 11th, was well attended. The meeting was called to order by the president, Richard Valentine of Janesville, in the convention hall of Hotel Pfister, at 2 p. m. Wednesday. Secretary H. C. Winter was in his accustomed place and did much to make the convention a success. In his address the president pointed out that the Independent telephone companies throughout the state are still making wonderful progress; that all companies have greatly increased their list of subscribers and that new exchanges are being built in some of the important cities and still others are contemplated; that numerous toll lines have been constructed and some copper lines built, and the prospects for copper-line construction during the year are very good. The company now installing an Independent exchange in Chicago has given assurance that this year it will connect with the Independent companies of surrounding states, and no doubt most of the sections of Wisconsin will have long-distance service to that city by the end of the summer. Mr. Valentine spoke at length upon the telephone legislation that the association had tried to secure at the last session of the Legislature, and particularly upon the bill prohibiting discrimination in telephone rates, which had passed the House by a large majority, but was lost in the Senate by only one vote. Attention was called to the apathy of many of the companies in the state in matters of general concern, the belief being that if there had been a little more general activity the passage of this important measure would have been easily assured. All Independent companies were urged to join the state association, and to interest themselves in the nomination and election of their representatives. Most of the Wisconsin companies will soon have long-distance service to the wholesale cities of Duluth, Superior, Minneapolis, St. Paul and Dubuque on the north and west, and Sheboygan, Racine, Kenosha and Chicago on the east. If the business men of Milwaukee realized how extensive the Independent telephone business has become in this state and are alert to their own interests, they will demand that an Independent franchise be granted in the city of Milwaukee, as otherwise much business that would naturally come to the metropolis of the state will be diverted to other cities.

J. C. Harper, president of the Dane County Telephone Company, Madison, then delivered an address on the "Legislative Prohibition of Discrimination in Telephone Rates," referring particularly to bill 603 A, which was a measure drafted by the committee of legislation appointed at the last annual meeting and for the passage of which the officers of the association labored so hard, only to be defeated in the Senate at the last moment by one vote. He commented upon the significance of the bill and its effect in leveling rates throughout the state. In discussing this address A. B. Ferdinand of Milwaukee pointed out the many beneficial features of such legislation.

W. F. Goodrich of the LaCrosse Telephone Company spoke in regard to the postmaster-general's order, issued some time ago, ordering local postmasters to have the Independent telephones removed from the postoffices and substituted by the Bell instruments. He stated that the postmaster at LaCrosse had received such an order, and that the postmasters of Minneapolis and St. Paul had been notified to have removed the interior systems, which had been installed in the postoffices in these two cities by the local Independent companies. In further discussing this order J. C. Harper of Madison stated that, upon inquiry at the Madison postoffice, that there never had been a long-distance communication to or from Washington by telephone, showing that there is no necessity for such long-distance connection with the Washington postal department. A. B. Ferdinand advised the appointment of a committee to draft resolutions concerning the postmaster-general's order, which was done, and Messrs. W. F. Goodrich, A. B. Ferdinand and C. W. Twining were named. This committee later presented a resolution which was adopted, to the effect that such an order proceeding from the postmaster-general is unfair to the Independent companies and shows discrimination in favor of the Bell companies, since very little long-distance conversation is carried on with Washington and therefore the Independent companies are just as well fitted to give the service as the Bell. Moreover, as many, if not more, rural telephone users on rural mail routes have Independent apparatus installed and they should not be deprived of the privilege of telephoning direct to the postoffice. The association entered its protest against this "unjust discrimination," and copies of the resolution were ordered sent to the president, postmaster-general and the members of Congress.

A resolution was presented by W. F. Goodrich to the effect that a committee of five be appointed to whom shall be referred the proposition for long-distance service between Wisconsin and any other state contemplating a contract for more than one year between members of this association and members of [illegible] company. The resolution was adopted, the committee selected consisting of W. H. Little, Portage; A. L. Hutchinson, Wayauwega; H. Teasdale, Sparta; W. Van Middlesworth, Racine, and A. B. Ferdinand, Milwaukee.

James F. Keelyn presented a resolution recommending that a committee of three be appointed, to which disputes arising among members of the association or between members and non-members shall be referred. The following-named gentlemen were appointed on the committee: G. W. Wilder, Chicago; F. S. Veeder, Mauston; Charles Shernecker, Sun Prairie.

Another resolution which was adopted pointed out the necessity of securing as members of the association every Independent telephone company in the state, and asking that the traveling men who represent the supply companies who are members of the association be asked to do all that they can to secure members. This resolution was presented by C. W. Twining of Monroe.

General resolutions were also presented regarding the establishment of an Independent exchange in Milwaukee to give toll connections throughout the state, that the thanks of the association be extended to those who have aided in giving publicity to the association, and that only persons bringing credentials indorsed by the company represented and by the secretary of the association be hereafter admitted to the meetings. Later a committee consisting of Alfred Weller, A. B. Ferdinand and Wilmer Seig was appointed to interest the citizens of Milwaukee in regard to the exchange. At the close of the session on Wednesday a motion was made by A. B. Ferdinand that a committee of three be appointed to call upon the officers of the Badger State Telephone and Telegraph Company to ascertain its policy in regard to competing with other Independent lines. A. B. Ferdinand, J. C. Murdoch and J. E. Keelyn were the gentlemen named.

A motion being made that a committee on resolutions be appointed, the president appointed Messrs. A. L. Hutchinson, W. H. Little and H. Teasdale.

A committee of three was appointed to ascertain the plans of the Chicago Automatic Telephone Company in regard to connecting with the Independent companies of Wisconsin, the members being Messrs. Ferdinand, Keelyn and Valentine. This closed the proceedings of the day.

Thursday morning's session opened at 10 o'clock. W. J. Bell of Oxfordville urged that a committee be appointed for securing additional members to the association. Mr. Bell, Mr. Kepler and C. W. Twining were appointed.

F. J. Whittemore, representing the Green Telephone and Electric Company, spoke in regard to the suspension of that company by the association from its membership, stating that such action was unfair and that the company was not deserving of any such action. A motion was made to rescind the suspension, which was lost.

H. Durant of the Automatic Electric Company stated to the convention that the Chicago automatic company will connect for long-distance purposes with the Wisconsin Independent companies who have toll lines, and assured the members that all rumors to the contrary are without foundation.

Professor G. W. Wilder, professor of telephony in the Armour Institute, Chicago, made an address on "Improvement in the Telephone Service." He made many valuable suggestions in regard to the service in general, stating that prompt service is essential and operating expenses should not be cut down at the sacrifice of good service. The problem the telephone man has to meet is to give the subscriber the best service and get a fair return on the investment. Managers should keep themselves fully informed as to latest apparatus and improvements and be up to date. Persons conducting a telephone business should incorporate, as otherwise they are partners and personally liable for debts, damage suits, etc. Cross-talk is an ever-present evil and hard to contend with, but should be kept at a minimum. Party lines are usually more profitable than separate-line service, and, if properly grouped, will give satisfactory service. The various lockout systems are no longer experimental and are now being extensively installed. Pay telephones should be put in for the convenience of the public, and are always found very profitable. The cost of underground-construction work has been greatly reduced the last few years and is now being put in more generally than in the past and is sure to pay in the long run.

The final business of the convention was transacted on Thursday afternoon.

Upon motion that a committee on legislation be provided, J. C. Harper, Madison; A. L. Hutchinson, Weyauwega; A. B. Ferdinand, Milwaukee; Mr. Larson, Richard Valentine, Janesville, and Mr. Cavanaugh were appointed.

The following-named companies made application for membership and were accepted: F. Bissell Company, Toledo, Ohio; Cambridge Telephone Company, Cambridge; Columbia County Telephone Company, Morrisonville; Fulmer Lumber Company, Florence; Independent Consolidated Telephone Company, Weyauwega; Kingston Telephone Company, Kingston; Mazomanie Telephone Company, Mazomanie; Oxford and New Haven Telephone Company, Oxford; Signalphone Company, Milwaukee.

Secretary Winter then read his report for the year, showing the continued rapid growth of the Independent telephone business in the state, and of the association, which now comprises 64 active and 25 associate members, embracing, approximately, three-fourths of the Independent telephone interests of Wisconsin. During the last two years 90 new telephone companies were incorporated in the state, with $1,500,000 capital, and to-day there are in Wisconsin 250 Independent telephone companies, with an investment of $3,500,000, 1,200 toll stations, 350 exchanges and 35,000 subscribers, of which number about 8,000 are rural subscribers.

J. C. Harper of Madison urged the adoption of a design to advertise local and long-distance toll stations and that the association secure a supply of such designs and sell them to the members.

Officers were elected for the ensuing year as follows: President, Richard Valentine, Janesville; vice-president, H. G. Slater, Waupaca; secretary and treasurer, H. C. Winter, Madison; members of the executive committee, C. W. Twining, Monroe; G. Huette, Sheboygan; J. C. Harper, Madison; W. F. Goodrich, LaCrosse; Julius Thielman, Merrill; John M. Baer, Appleton; E. A. Miller, Hixton; J. C. Crowley, West Superior.

The next annual convention will be held in Milwaukee, February 9 and 10, 1905.

Members and Visitors.

The following is an alphabetical list of the exchange companies (with their delegates) represented at the convention:

Badger State Telephone and Telegraph Company, W. L. Smith, Neillsville; Badger Telephone and Telegraph Company, H. Sipperly, Milwaukee; Belleville Telephone Company, H. J. Ulrich, S. E. Miller, Belleville; Beloit Telephone Company, J. E. Carr, Beloit; Brodhead Telephone Company, J. C. Murdoch, O. C. Schulz, Walter Bliss, Brodhead; Calumet Telephone Company, J. J. Schoofs, Johnsburg; Cambridge Telephone Company, G. W. Wilder, Cambridge; Cedar Lake Telephone Company, John Rosenheimer, Schleisingerville; Central Wisconsin Telephone Company, E. A. Miller, W. A. Marr, Hixton; Central Wisconsin Telephone Company, W. J. Bell, Portage; Citizens' Telephone Company, William Van Middlesworth, A. T. Gille, Racine; Citizens' Telephone and Telegraph Company, James E. Keelyn, Kenosha; Citizens' Telephone Company, G. Huette, Sheboygan; Columbia County Telephone Company, W. R. Chipmen, Morrisonville; Dane County Telephone Company, J. C. Harper, H. C. Winter, Madison; Dane County Rural Telephone Company, Hiram Nelson, Madison; East Valley Telephone Company, E. D. Smith, New Prospect; Eastern Wisconsin Telephone Company, L. H. Schram, A. A. Paulson, Kiel; Edgerton Telephone Company, F. W. McKinney, P. C. Brown, T. B. Earle, W. A. Shelley, William McIntosh, Edgerton; Fox River Valley Telephone Company, F. T. Green, Appleton; Friendship Telephone Company, William J. Bell, Friendship; Independent Consolidated Telephone Company, A. L. Hutchinson, John Kidd, O. Morrison, William Reuther, Weyauwega; Interstate Telephone Company, George Morrison, Winona, Minn.; Interurban Telephone Company, Charles Shernecker, B. J. Anderson, G. H. Beazam, Sun Prairie; Juneau Electric Company, F. S. Veeder, O. G. Loomis, I. C. Baldwin, Mauston; Kingston Telephone Company, W. R. Simms, E. J. Joslen, O. W. Joslen, Kingston; La Crosse Telephone Company, W. F. Goodrich, La Crosse; Menomonie Ridge Telephone Company, E. A. Croll, Iron Mountain, Mich.; Monroe Telephone Company, W. P. Bragg, C. W. Twining, Monroe; Monroe County Telephone Company, H. Teasdale, C. M. Beebe, W. G. Loomis, Sparta; Orfordville Telephone Company, F. A. Cole, Orfordville; Oxford and New Haven Telephone Company, W. J. Bell, Oxford; People's Telephone Company, J. L. Farrington, Rio; Pewaukee and Sussex Telephone Company, Alex. Caldwell, Pewaukee; Plymouth Telephone Company, L. H. Schram, Plymouth; Portage Telephone Company, E. H. Warner, W. H. Little, F. H. Runkel, Portage; Rock County Telephone Company, Richard Valentine, H. C. Willitz, Janesville; Rock County Farmers' Telephone Company, Richard Valentine, Janesville; Stoughton Independent Telephone Company, E. Sipperly, Stoughton; Two Rivers Telephone Company, C. F. Kirst, Two Rivers; United Telephone Company, C. W. Twining, P. J. Weirich, Monroe; United Telephone Company, C. W. Forbes, Hyde Park, Ill.; Waupaca Citizens' Telephone Company, H. G. Slater, R. J. Havenor, Waupaca; Winnebago County Telephone Company, A. B. Ferdinand, Milwaukee.

The supply companies having exhibits at the convention, with their representatives, were:

American Electric Telephone Company, C. P. Garst; J. Andræ & Sons Company, Herman Andræ, J. C. Schmidtbauer, A. E. Stadelbauer; Automatic Electric Company, H. S. Durant, A. G. Rousseau; F. Bissell Company, N. S. Walker; Central Electric Company, W. W. Geisse, J. W. Mason; Electric Appliance Company, S. A. Dinsmore, J. B. McMullen; Electric Supply Company, L. W. Burch; Elliott Addressing Machine Company, R. St. John; Eureka Electric Company, Herbert Rosenow; Fulmer Lumber Company, D. M. Fulmer; Green Telephone and Electric Company, F. J. Whittemore; Holtzer-Cabot Company, E. R. Harding; Illinois Electric Company, C. W. Bacon; International Telephone Supply Company, H. H. Davenport; Kellogg Switchboard and Supply Company, F. E. Rotchka, W. B. Hind; Miller Anchor Company, G. H. Miller; Monarch Telephone Manufacturing Company, E. E. Yaxley, W. H. Trim; Nordstrom Lockout Telephone Manufacturing Company, William Herron; J. A. Roebling's Sons' Company, W. H. Slingluff, Bond Wisler; Signalphone Company, A. D. Weller; Standard Telephone and Electric Company, J. H. Parish, W. A. Taylor; Sterling Electric Company, W. E. Doolittle; Stromberg-Carlson Telephone Manufacturing Company, Don C. Gould, H. A. Jones; Vought-Berger Company, M. I. Berger, D. W. Campbell, A. Meinama.

Telephone Improvements in Columbus.

President F. S. Dickson, of the Federal Telephone Company, has announced the sale of the remainder of the stock of the Citizens' Telephone Company of Columbus to a syndicate composed of Columbus men. After the financial embarrassment of the Everett-Moore syndicate over 4,000 shares of the stock of that company were sold to the Columbus syndicate with the provision that it might be repurchased within a certain time. The option expired in November, and, as the plant needs improvements and extensions, the Columbus people have since been urging the Federal to take some action either in buying or selling. Columbus people formerly held $150,000 of the stock, and this sale gives them the remainder, amounting to $750,000. The price paid for the stock has not been made public, but it is understood that it is satisfactory to the Federal people. It is stated that arrangements will be made at once to put in a new switchboard with an immediate capacity of 8,000 telephones and an ultimate capacity of 19,000. Many important extensions will also be made. The plant at Dayton, which is largely con-

trolled by the syndicate which purchased the Columbus property, has been equipped with automatic apparatus that has been giving satisfaction, and it is not unlikely that the same kind of equipment will be purchased for the Columbus plant. In all about $500,000 will be spent in enlarging the plant and extending the service. The building occupied will also probably be enlarged. The syndicate is composed of John Joyce, H. A. Lanman, J. B. Hanna, Frank A. Davis, E. R. Sharp, W. A. Hardesty estate, Cyrus Huling, F. L. Beam, L. D. Hagerty and others. Frank L. Beam is the manager.

Automatic Telephony Discussed at the Institute.

Automatic versus manual telephone-exchange operating formed the subject of discussion at the meeting of the Chicago branch of the American Institute of Electrical Engineers on February 16th. There was an excellent attendance, and much interest was manifested in this live subject. P. Junkersfeld presided, and two papers were read—both, however, by men connected with manual-switchboard companies. One was on "The Commercial Aspect of an Automatic Telephone Exchange." This was written by Franz J. Dommerque and read by R. L. Ames, in Mr. Dommerque's absence. The general trend of this paper was against automatic operation. The second paper described "Two Methods of Giving Toll service in Connection with Automatic Exchanges," and was read by the author, Charles S. Winston. This paper gave an account of the connections between manual toll boards and automatic exchanges in Grand Rapids, Mich., and Dayton, Ohio. It was not controversial.

An animated discussion followed the reading of the papers, referring to points brought up in Mr. Dommerque's paper. A. H. Dyson appeared as champion for the automatic system and held his own well. L. W. Stanton of Cleveland, while not a partisan of either side, thought a sort of combination of the automatic and manual systems might be of advantage. H. P. Clausen, A. D. T. Libby and C. O. Harris ardently advocated the well-tried manual system. Professor Morgan Brooks of the University of Illinois pointed out some of the good points of a small automatic exchange. Professor J. C. Kelsey of Purdue University also briefly participated in the discussion.

The discussion did not bring out much that was new, but it showed the well-known advantages and defects of the automatic system. Further reference to it may be made in a future issue of the Western Electrician.

The next meeting of the Chicago branch will be held on March 8th, when the Steinmetz and Slichter papers on single-phase and repulsion railway motors will be discussed.

TELEPHONE MEN.

C. E. Wisard has resigned as manager of the Howard (S. D.) Telephone Company, effective March 1st, and will be succeeded by C. N. Drake.

Henry Berberich has resigned as manager of the Home Telephone Exchange at New Haven, Ind., and H. E. Brudi has been appointed to succeed him.

George DuBay, manager of the Northwestern Telephone Exchange Company at Little Falls, Minn., has been transferred to Minneapolis. J. P. Jenson of Hudson, Wis., succeeds him as manager.

J. F. R. Hall, who has been in charge of the Taunton exchange of the Southern Massachusetts Telephone and Telegraph Company, has been transferred to the New Bedford exchange in the same capacity.

W. H. Winship has resigned as secretary and manager of the Northern Indiana and Southern Michigan Telephone and Cable Company at La-Grange, Ind., and will move to Indianapolis and enter the insurance business. His successor has not been selected.

S. G. McMeen of the telephone engineering staff of the Western Electric Company, Chicago, is in the City of Mexico making preliminary arrangements for the extensions and improvements of the telephone system of the Mexican Telephone Company. This company recently obtained a renewal of its concession from the Mexican government for a period of 30 years, under the terms of which certain stipulated improvements are required to be made. The company has six months in which to prepare its plans for submission to the government for approval.

The Kinloch Telephone Company of St. Louis expects to build a toll line from St. Louis to Kansas City via Nevada and Joplin, where it will connect with the Home Telephone Company, which has nearly 4,000 telephones.

Telephone News from the Northwest.

The voters of Duluth, Minn., approved the new ordinance which permits the Zenith Telephone Company to charge more for telephone service, on a sliding scale based upon the number of telephones in use. The People's Telephone Company of Superior, an allied company, seeks permission to make a similar change of rates in that city.

The Interstate Telephone Company may string wires across the Mississippi River from Dubuque, Iowa, to Dickeyville, Wis.

The Atwater (Minn.) Telephone Company has been incorporated with $10,000 capital stock.

A sleet and windstorm last week in St. Paul resulted in burning out the Dale branch exchange of the Northwestern Telephone Exchange Company. The telephone wires, weighted down by the heavy snow, were blown down and crossed with the street-railway trolley wires. The switchboard at the Dale branch caught the worst of the tension, and burned out almost immediately, with a loss of $20,000. A temporary service was soon arranged for at that branch, but it will take several weeks to get the board replaced by a new one.

The Minnesota Central Telephone Company declared a dividend of 10 per cent. at the annual meeting held in Willmar, Minn., recently. The gross earnings for the year were $103,382.82. The company operates 1,700 miles of toll lines, 26 exchanges and has 3,500 subscribers.

A rural telephone company is projected at Duelm, Minn., to build to St. Cloud, and there connect with the Northwestern Telephone Exchange Company.

The Citizens' Telephone Company of Mankato Minn., has contracted with the Minnesota Valley Farmers' Mutual Telephone Company for connection. This gives the former company service through the entire county.

The Albert Lea (Minn.) Telephone Company is considering the advisability of replacing its automatic system, now used, with a central manual system.

A company has been formed at Rollag, Minn. It will incorporate with a capital of $25,000.

The telephone office at Lake Preston, S. D., has been moved to larger quarters.

The Wisconsin Telephone Company is replacing its old-style Bell telephones with new common-battery telephones. The company will spend $150,000 in improvements before the end of the year.

The Interstate Telephone Company has asked for a franchise to enter Spokane, Wash., with a terminal line.

B. Teale has sold his interest in the Lamoni (Iowa) Telephone Exchange Company to F. M. Smith and others.

The Standard Telephone Company will extend its line from East Elkport to Guttenburg, Iowa.

The Stratford (Iowa) Independent Telephone Company and the Webster City company have been merged as the Hamilton County Independent Telephone Company, with a capital of $24,000. D. C. Chase of Webster City is president and J. W. Lee secretary.

The Iowa State Telephone Association will hold its convention at Des Moines on March 8th and 9th.

A telephone war seems imminent at Mt. Ayr, Iowa, between the Southern Iowa Telephone Company and the Mutual company, all attempts at a settlement having thus far proved futile. R.

Ohio Telephone Notes.

The Tontogany Telephone Company of Tontogany, Wood County, has been incorporated, with a capital stock of $10,000 for the purpose of building a line between that place and Bowling Green. Jacob Huffman, Charles O. Cummings, H. W. Hueber, Benjamin F. James and Robert C. Collins are the incorporators.

In order to make all preferred stock at five per cent. the Home Telephone Company of Dayton reduced its capital stock from $750,000 to $600,000, and then immediately filed papers increasing it to $1,000,000. The proposition is now on a more satisfactory basis.

The stockholders of the Mt. Pleasant Telephone Company of Mt. Pleasant have organized by the election of the following-named officers: President, Michael Gallagher; vice-president, Dr. J. A. McGleen; secretary and treasurer, E. B. Jones; general manager, J. M. Bennett. The plant of the co-operative company has been taken over and will be rebuilt in a first-class manner. Lines will be built to Dillonvale, Emerson, Harrisville, Adena, Martins Ferry and Bridgeport. In all a first-class plant will be constructed by the new company.

James A. Drake, secretary of the Elyria Telephone Company, has given notice that the first-mortgage six per cent. gold coupon bonds of March 1, 1899, will be redeemed on March 1, 1904, at 105, with accrued interest.

G. W. Mooney and W. B. Cook, promoters of the Austinburg Telephone Company of Austinburg, will in a short time ask the village of Geneva for a franchise. The work of securing the right-of-way between the two places is now in progress.

Officers of the Zanesville Telephone Company of Zanesville have been re-elected. J. B. Rhodes is secretary and general manager. Plans were outlined at the meeting for the coming year and reports of officers showing a healthy condition of business were submitted.

General Manager French of the Cuyahoga Telephone Company at Cleveland is having some trouble in adjusting numbers for the new switchboard which will be installed within a few days. Heretofore the four-button system has been in use, there being four numbers alike with the exception of the initial letter. Now, it seems, in some cases all four owners of certain numbers insist upon having them, whereas but one can be accommodated on the new board. C.

Indiana Telephone Items.

Senator Fairbanks has notified the Indiana telephone men that his amendment to the postoffice bill submitted on January 18th, proposing to appropriate $20,000 for experimental telephone delivery of special mail matter, has been taken from the table in the Senate and referred to the committee on postoffices and post roads. Mr. Fairbanks fears opposition from the House committee, members of which say such a system put into general use would mean the maintenance of a telephone in every fourth-class office at the government's expense.

"The man who will find some method of preventing telephone girls from marrying will have his fortune made," says Manager Springer of the Central Union Company at Muncie. "I don't know exactly why it is that telephone girls are able to secure husbands faster than other girls, but it is a fact. They don't even need to be pretty. After all, it is partly the fault of the company, which insists that the operators under all circumstances must be polite and have a pleasant voice. Men fall in love with them because of their voice. Ten of our young women married during the last year." Manager Bromley of the Delaware and Madison Counties Telephone Company says the marrying epidemic has permeated the local exchanges at Muncie and Elwood, and even spread to the business office. "Our exchanges are crippled much of the time by unexpected marriages," said he.

Arcadia is without a telephone plant at present. L. D. Cox of Sheridan has been trying for some time to sell the local plant to a company composed of Arcadia people, who finally declined to pay a big sum for what they regarded as a worn-out plant. Thereupon Mr. Cox took out the exchange. A company of home people is now being organized to put in a new and up-to-date service.

At a recent meeting of the directors of the Zionsville Telephone Company it was decided to raise the rates in the business houses. The secretary notified the business men of the increase of rates, stating that it was necessary, owing to the large outlay of money which the company has recently expended in improving its system. An agreement, pledging each signer to order his telephone taken out of his place of business at once unless the telephone company will agree not to raise its rates, was promptly signed by every business and professional man in Zionsville. The company is in a quandary. F.

Telephone Progress in Texas and Mexico.

The City Council of Luling, Texas, has granted a franchise to the Independent Telephone Company to establish and operate a telephone exchange at that place. It is announced by the officers of this company that it will immediately begin the construction of a long-distance telephone line to connect San Antonio and Houston, a distance of 225 miles. In addition to building this long-distance line the company will establish telephone exchanges at Marion, Seguin, Kingsbury, Harwood, Flatonia, Schulenburg, Weimer, Columbus, Eagle Lake, and probably other places on the route. Among the men interested in the company are H. W. Flato of San Antonio, Texas; T. H. Spear of New York, and George Cornelius of Minneapolis, Minn.

The Menard Telephone Company of Menardville, Texas, has just completed a telephone line to Hext, a distance of 15 miles, and will soon commence the construction of a line to McKavitt, Texas.

A long-distance telephone line is to be built between Hermosillo, Mexico, and Guaymas. A. Mascarenas, cashier of the Banco Senora, Chihuahua, Mexico, can give information.

A long-distance telephone line has just been completed between Guadalajara, Mexico, and La Barca. Governor Miguel Ahumada participated in the inaugural ceremony of the new line.

The Mexican government has granted a concession to M. A. Sepulveda of the Torreon Telephone Company to extend its lines to the towns of Gomez Palacio, Lerdo, and adjacent haciendas. The concession also authorizes the company to extend its lines to the cities of Durango, Monterey, Saltillo, Mapimi and other places. All of the principal towns and cities of Northern Mexico are to be included in the proposed system.

Southeastern Telephone Developments.

Councilman John Barron of Louisville, Ky., is preparing an ordinance to be introduced in the general council requiring all wires in the downtown district to be placed underground. Similar ordinances have been introduced before but failed to carry.

The Morgan County Telephone Company has succeeded in getting its lines into Decatur, Ala., after a long fight with the Bell company. Both companies have been operating in New Decatur, Ala., the Bell under the franchise of the American Telephone and Telegraph Company, it is said, and now the council

of New Decatur has ordered the American or Bell company to take its telephones out. An interesting time is expected.

A new telephone system has been completed in Gadsden, Ala.

Several persons were arrested in Atlanta, Ga., recently on a charge of violating the law which forbids the keeping of a place for the making of bets over the telephone on horse racing, etc.

The city of Green Bay, Va., is negotiating with the Lunenburg Telephone Company to run a line from Bruceville through the town to a point on the opposite side of the village.

It has been decided by the electric-light committee to accept the bids of both the Southern Bell and the Atlanta (Ga.) Telephone companies for furnishing the city with telephone service during the next five years, a certain number being taken from each company on conditions agreed upon.

A bill has been introduced in the South Carolina Legislature placing telephone companies under the control of the railroad commission.

A Montgomery (Ala.) special says that E. M. Cranford has been at work organizing a telephone company at Jasper, Fla., where it is proposed to maintain a rate 30 per cent. under that of the Southern Bell Telephone Company.

The Marion (N. C.) Telephone Company recently raised its rates, and it is reported that many of the patrons have had their telephones taken out. The company had made improvements on the system.

The Interstate Telephone Company, which recently gained sole control in Durham, N. C., has raised rates to $2 a month for residences and $3.50 a month for stores. L.

New England Telephone News.

Hearings are to take place next month on the several bills that contemplate further control of telephone matters in Massachusetts, recently introduced in the Legislature. Revision of rates is one of the principal objects sought, and there is much public interest in the matter. An attempt to create a special committee to consider the subject has been defeated, but petitioners will be given an opportunity to present their views before the regular committee on mercantile affairs.

Systematic robbery of the money receptacles of the slot machines of the New England Telephone and Telegraph Company has been in progress for some time, and the perpetrators have succeeded in eluding the police. About a score of cases have been reported within a short time, one of the most recent being a daring break at one of the large apartment hotels.

The long-pending cases of the city of Lowell against the seven directors of the Erie Telephone Company, involving originally a tax claim for $18,000, but amounting with interest to $38,500 at the present time, after 14 years of attempts to reach a settlement, have been compromised for $28,000, in accordance with a recent offer of the Erie Telephone Company. The proposition was accepted in joint convention of the two branches of the Lowell city government on February 9th. Verdicts favorable to the city have been rendered by the courts, and last August the Supreme Court passed upon one of the suits out of the seven, with a verdict favorable to the city's contention. B.

Michigan Telephone Matters.

C. F. Brown, secretary of the Independent Telephone Association of Michigan, has issued from Alma an announcement to the effect that the annual meeting will be held at Grand Rapids on February 24th and 25th.

The Michigan (Bell) telephone exchange at Port Huron has announced a new schedule of rentals which, in the case of a majority of subscribers, amounts to a raise of from $18 to $24 a year for residence telephones and from $24 to $36 on business telephones. Under the new system full metallic-circuit service is given and present users of the metallic telephones obtain a reduction of 25 per cent. in rates.

The Grand Rapids and Indiana railway has decided to try on its cars the new car telephone that was invented a short time ago. It can be placed at any part of the train and can be used while the train is in motion. Muskegon and Grand Rapids capital is interested in putting the device upon the market.

The Eaton County Telephone Company of Charlotte has added a new 400-capacity visual-signal switchboard to the exchange. This company was organized less than five years ago and now has about 500 telephones in commission. W.

Cable Interruptions in War Time.

The various cable companies of the United States have received word of the interruption of the Hongkong-Foochow and the Foochow-Formosa cables. No explanation accompanies the information. In cases of emergency, however, Hongkong and Foochow can be reached by the overland route and Formosa by way of Japan. The further announcement was made that no code messages would be accepted for Korea, and that all messages for that country would be taken at the sender's risk. Messages in any form are being taken for all other parts of the world except Port Arthur, where the Russian government has seized the cables and refuses to admit any messages.

Evansville Municipal Telephone Case.

The arguments in the Evansville (Ind.) municipal telephone case were heard in the Superior Court on February 9th before Judge W. D. Robinson of the Indiana Appellate Court as special judge. The suit was brought by ex-Judge R. D. Richardson to restrain the city of Evansville from entering into the proposed scheme for the organization of the Evansville Telephone Company.

Daniel H. Ortmeyer for the plaintiff argued that the municipal telephone scheme was unauthorized because the mayor is given the right to vote the stock owned by the city; because the city guarantees a dividend to the preferred stockholders, and in effect grants a monopoly to the telephone company; that the city ought to have the right to take an active part in the management of the company's affairs; that the ordinance provides that the directors must be members of the two political parties; that at the time the city made the agreement with the Evansville Telephone Company the councilmen, members of the board of public works and mayor of the city were interested in the company, and hence their acts are illegal; that the city must necessarily become involved in debts and litigation and that the whole plan is an ingenious scheme to circumvent the constitution of the state, and, finally, that the city has no right to become a promoter or subscriber to the Evansville Telephone Company. One of the chief arguments was that the charter granted the city gave a right to purchase or hold stock, but that the permission did not include the right to subscribe for stock in the prospective enterprise. It was also maintained that the franchise granted to the telephone company by the city contained a clause which would serve as a "wrecker" in providing that a receiver could be appointed in the event that the dividends were not paid on the preferred stock. It was also claimed that much of the stock had been subscribed through forcible means brought to bear on the part of the people pushing the municipal telephone scheme.

Attorney A. W. Wheeler made the argument for the city. His chief points were that any indebtedness incurred by the Evansville Telephone Company could not become an indebtedness of the city; that the city was fully protected by the provisions of the agreement with the telephone company so that no loss could fall upon the city. As to the other points, he contended that the plaintiff had no right to raise them because they effect only the inside management of the Evansville Telephone Company and do not effect the taxpayers of the city.

Judge Robinson took the matter under advisement and announced that he would rule on the case in about three weeks.

MANUFACTURERS AND DEALERS.

The capital stock of the Automatic Electric Company of Chicago has been increased from $3,000,000 to $5,000,000.

The Western Telephone Construction Company will soon vacate its factory at Winthrop Harbor, Ill., and remove to Chicago to secure advantages in shipping and to save freight on fuel.

The Trumbull Electric Manufacutring Company of Plainville, Conn., is sending out its catalogue No. 4 descriptive of switches, cord adjusters, plug cut-outs, etc. The flush receptacle recently illustrated in the Western Electrician is also described in this publication. The Type A switches illustrated are enclosed in 500-volt spacings up to and including 100 amperes.

An odd-shaped folder, made to represent, when closed, a box of condensers ready for shipment, is being distributed by the Stromberg-Carlson Telephone Manufacturing Company. "In opening the case" the first thing considered is a five-line switching telephone vs. a five-knife switch arrangement. One of these telephones is illustrated and its advantages over the knife-switching method sometimes used on rural lines are explained in the folder.

A beautiful catalogue on "Modern Methods" in telephone practice comes from the North Electric Company of Cleveland. Besides matter relative to the company's various styles of switchboards, apparatus, terminal racks, power boards, batteries, etc., there are suggestions as to the maintenance and operation of exchanges and examples of the advantages to be derived from operating upon modern methods. Particularly well arranged is a combination of two switchboard sections with one toll section. Rural telephone apparatus is also another important branch with this company, and some fine boards are illustrated for this particular field, ranging from 10 to 25 lines. The last-mentioned are of the drop-signal type. A simple but rigid construction has been adopted for the relay and terminal racks, made up of angle irons and supplied with rings for convenience in making cross-connections.

The stockholders of the Central District and Printing Telegraph Company at their annual meeting in Pittsburg, Pa., decided to increase the capital stock from $10,000,000 to $15,000,000. The increased capital will be issued as required in the business at a price to be fixed by the board of directors. Net earnings for last year were $742,083.97, an increase of $164,003.45 over the preceding year.

GENERAL TELEPHONE NEWS.

The Farmers' West Crescent Telephone Company has been incorporated at Reardon, Wash. G. Garber is president, and A. J. Cone, secretary.

The Goldendale Telegraph and Telephone Company of Goldendale, Wash., is making preparations for the extension of its lines 100 miles to the northwest of Goldendale.

The Lothrop-Davis Company, operating in Butler, Nevada, is preparing to extend its telephone and telegraph system to Goldfield, and the work of constructing the line will be commenced immediately.

The Tehama Lumber Company, with headquarters in Corning, Cal., is making arrangements for the construction of a telephone line connecting the company's holdings with Paskenta, Newville and Corning.

The Central Union Telephone Company, which has been operating in Wabash, Ind., without a franchise since last May, has been ordered by the City Council to accept the city's franchise or remove all poles and wires from the streets.

The Elkhart (Texas) Telephone Company, which was recently organized, has constructed and placed in operation a telephone line to the towns of Slocum and Denson Springs, a distance of 15 miles. The line will be extended.

The long-distance telephone system, which is owned by John Woessner and associates of Saltillo, Mexico, has been extended from Torreon to the city of Durango. A line is also to be built from Torreon to Monterey, and thence to Tampico, a distance of several hundred miles.

The Southwestern Telegraph and Telephone Company will let the contract in a few days for the construction of a new exchange and office building at El Paso, Texas. The work of putting the wires of the system underground in the business part of the city is now in progress. B. H. Johnson is superintendent of construction.

The Utah Independent Telephone Company of Ogden, Utah, has been granted a franchise to do business in Salt Lake County. The commissioners of Weber County now have an application under consideration from the company for permission to operate in that place. Action on the matter will be taken at the next meeting of the commissioners.

The Sunset Telephone and Telegraph Company of San Jose has been granted permission by the supervisors to erect poles on Harter Avenue, from Newhall Street to the town of Santa Clara, for the purpose of transferring its wires from the Southern Pacific's right-of-way, where they parallel the 40,000-volt circuit of the Standard Electric Company.

As a matter of convenience to those in Chicago having both an automatic and a Bell telephone the United States Telephone Directory Company has published a "Complete Telephone Directory of Chicago and Vicinity" containing a complete directory of the Bell telephones and automatic telephones in use, the numbers being both inserted after the subscriber's name where the person has the two systems connected.

During the year the Southern New England Telephone Company will carry on the work of extensive improvements to its plant and service throughout the state of Connecticut. General Superintendent Henry H. Sykes says that the company will open one new building in Meriden probably about the first of April. In New Britain the company has purchased land for a new building, the plans for which are now being drawn.

In a recent issue of the Indianapolis News appeared the following advertisement of J. O. Copeland: "For the betterment of the service I have changed my phone to New Phone 2259. I have discontinued the old phone." This advertisement was published without the knowledge of the officers of the New Telephone Company, which operates the Independent system in Indianapolis, and naturally they are pleased at this recognition of the excellence of their service.

J. E. Farnsworth, general manager of the Southwestern Telegraph and Telephone Company, with headquarters at Dallas, Texas, announces that the Western Telephone Company of Boston, of which the Southwestern is a part, will expend several million dollars in improvements and extensions of its system in Arkansas and Texas during the present year. The long-distance lines are to be built into new territory and a number of new local exchanges will be established.

The Phelps County Telephone Company of Holdrege, Neb., has awarded to J. F. Butterfield of Chicago the contract for the complete construction of an exchange for present installation of 300 telephones, with an ultimate capacity of 600. The lines will reach all the farmers in the county, contracts with several of the leading farmers having been secured already. It is expected that inside of six months 200 farmers' telephones will have been installed, in addition to the Holdrege exchange. A central-energy system will be used, and work is now under way.

Wind Pressure on Telegraph Structures.[1]

By Francis W. Jones.

It is a foregone conclusion among far-sighted telegraph and telephone managers, that economy of construction and maintenance, and a maximum traffic value, with a minimum interruption of wires, can only be secured by the observation of advanced engineering rules, and the transfer of the erection and care of telegraph and telephone systems from the hands of empirics, to the hands of competent engineers, both mechanical and electrical.

In view of the great obstacles that exist to the economical and proper maintenance of lines in this country, it may be that engineers cannot at present do all that would be possible under favorable conditions; yet, the greater the difficulties, the more necessary is the trained directing mind. It is at once a serious and grotesque situation when private corporations, investing capital and employing a very high grade of skill to perform a public service so indispensable to the whole country, should be legislated against and heavily taxed in every state in the Union, held to strict account by every court, frequently mulcted in enormous damages for errors that cannot be avoided, and denied by cities, towns and villages a reasonably free and unobstructed use of the highways for wires, which are daily necessarily multiplying in number to meet the public wants, so that it really seems that the telegraph and telephone, the two greatest friends of our commercial and social life, not only do not receive a solitary bit of encouragement, neither municipal, state nor federal, but are taxed, hampered and thwarted to the point of desperation, while, at the same time, the government and the public are becoming daily more and more imperious in their demands for the lowest rates and the best service.

Highways are filled with trolley and electric-light poles and ornamental trees. Railways are crowding out such lines of poles as they have been able to accommodate in the past, to make room for more tracks, and the long-distance underground problem is so vast, both from financial, electrical and engineering considerations, that it staggers the telegraph and telephone managers.

One of the first things to be considered is the effect upon poles and wires of the wind, which next to decay, is the cause of a large per cent. of interruption, delay of messages, and expense, the latter including the wages of idle operators and clerks, besides cost of repair.

There has been no uniform agreement among those in charge of line construction as to the force exerted against cylindrical poles and wires by the wind.

Professor S. P. Langley, who stands very high as an authority, states that the resistance experienced by a plane surface exposed normally to wind blowing at various velocities, may be calculated from the following formula:

R, resistance in pounds = $K A V^2$.
K, constant found by experiment = 0.00166.
A = area in square feet of one side of the plane.
V = velocity in feet per second.

Professor Langley states that the resistance encountered by a cylinder in wind normal to its side, is one-half the resistance which would be encountered by a plane exposing an area equal to its longitudinal section, but that account should be taken of the fact that small wires, cords, ropes, etc., have been found, by experiment, to cause a resistance of from five to 10 times what would be calculated, as per above formula, from their normal sections.

In England, Mr. John Gavey, the engineer-in-chief of the British Telegraphs, calculates the strength of the average structures and wires to withstand, at right angles to the wind's direction, a pressure of 17 pounds per square foot, and takes two-thirds of the diameter into the length of the round poles and conductors as the approximate area affected. The British table of wind pressure requires a velocity of 60 miles per hour to equal 17 pounds per square foot. Whereas, the following table, furnished by Professor C. F. Marvin of the United States Weather Bureau, shows that the wind requires a velocity of 85 miles to equal 17 pounds:

Table of Wind Pressures.

Wind Velocity Miles Per Hour.	U. S. Weather Bureau Lbs. Per Square Foot.	British Table Lbs. Per Square Foot.	Prof. Langley's Lbs. Per Square Foot.
20	1.27	1.97	1.42
30	2.64	4.42	3.21
40	4.44	7.87	5.71
50	6.66	12.3	8.92
60	9.22	17.7	12.85
70	12.2	24.1	17.50
80	15.5	31.4	22.85
90	19.2	40.	28.92

Mr. Oldbury Burne of the Indian Government Telegraphs, Calcutta, describes experiments he made by swinging a plate of 12 by six inches and a cylinder of four-inch diameter, both of exactly equal weight, and lengthening the extensible cylinder until both plate and cylinder attained the same amplitude of swing, giving the length of cylinder equivalent to the plate between 33 and 35 inches. Area of one side of plate 72 inches, and area of section of cylinder 33 by four inches = 132 square inches, and 35 by four inches = 140 square inches, former giving $\frac{2}{3.67}$ and latter $\frac{2}{3.89}$, or .545 and .515.

In India two-thirds of the diameter multiplied by length is used to calculate the wind-pressure area of poles and wires.

Wind Surface of 1 Mile of Wire.

B. W. Gauge No.	Diameter Inch.	Area of ⅔ of Diameter in Feet.	B. & S. Gauge No.	Diameter Inch.	Area of ⅔ of Diameter in Feet.
4	.238	69.5	[illegible]	.128	40.5
6	.203	59.5	9	.114	33.4
8	.165	48.4	10	.102	29.9
9	.148	43.4	12	.08	23.8

Kernot of Melbourne demonstrated, by experiment with heavy air blasts, that the pressure at right angles on a cylinder was about one-half on a flat surface of equal diameter, and that the pressure on one side of a cube was only 0.9 of that of a thin plate of equal area.

Telegraph structures and wires must be designed not only to withstand the maximum ordinary wind pressures to which they may be subject, but also to resist the sudden gusts, which are far more destructive than a steady high wind velocity. The extra weight and wind surface of clinging sleets and snows to poles, arms and wires, and the areas offered by pins and cross-arms to the wind must not be overlooked.

Wind Surface of Poles.

Length Above Ground, Feet.	Mean Circumference, Inches.	Area of ⅔ of Diameter, Feet.	Mean Circumference, Inches.	Area of ⅔ of Diameter, Feet.
20	27	9.54	30	10.59
30	30	15.91	34	18.01
40	35	24.73	38	26.86
48	38	32.24	41	34.79
58	42	43.06	45	46.15

A cubic foot of ice at 32° weighs 57.5 pounds, so by taking the average circumference or diameter of an ice-coated wire between two poles, and calculating its cubical contents in feet, then deducting therefrom the cubical contents of the wire, the weight of ice is readily ascertained.

1. From the Telegraph Age

BOOK TABLE.

National Electric Light Association (Proceedings of the Twenty-sixth Convention). Published by the association. 1903. Pp. (six by eight inches), 821, with 261 illustrations.

The members of the National Electric Light Association are to be congratulated upon the completeness and pleasing appearance of the volume which they will receive, containing the report of the twenty-sixth convention held in Chicago last May. The book contains introductory matter of a historical nature, including the date and place of all the conventions of the association since the beginning and a list of the past-presidents of the association. The list of active members shows 447 names, while there are 84 associate members. A complete report of all the proceedings of the twenty-sixth convention is given. The papers are printed in full, with discussions, numerous diagrams and illustrations accompanying them.

Four convention features are given in the form of appendixes and form a valuable portion of the book. Appendix A, "Decorative and Sign Lighting," by Arthur Williams of the New York Edison Company, gives an adequate idea of the vast extent to which electric lighting has become applicable to decorative work and for advertising purposes. This is made more comprehensive by the addition of over 80 fine halftone illustrations, some in tints, of many of the triumphs of this art, among the most interesting being the decorative lighting of expositions, much of which was directed by the late Luther Stieringer. "The Development of Electric Station Power Plant," by Elihu Thomson, is the subject of Appendix B and contains a historical sketch of the development of electric power plants and also some observations on the steam turbine and gas engine and their probable future effect on the central-station practice. Ralph R. Lawrence contributes in Appendix C a short description of "A New Form of Photometer," giving drawings and a picture of the new apparatus which belongs to the Massachusetts Institute of Technology. Appendix D contains the "Question Box," which contains enough material to form a book in itself. Among answers to the 257 questions asked, every central-station manager will be able to find many valuable hints which will apply directly to the particular conditions of his plant.

Yttrium for Nernst Lamps.

The Western Electrician correspondent at Austin, Texas, writes as follows: "The Nernst Lamp Company of Pittsburg, Pa., has had a force of men at work for several months mining a rare mineral called gadolinite in a locality situated 12 miles from Kingsland, Texas. This mineral is in the form of crystals and is found in pockets in the quartz formation. It is shipped by the company in considerable quantities to Pittsburg, Pa., where it is subjected to treatment in the laboratory for the extraction of yttrium. The latter product is used in the manufacture of electric lamps by the company. The company has acquired 35 acres of land upon which these pockets of the mineral are found. It is asserted by geologists and mining experts who are familiar with the Kingsland region that the mineral exists in other localities."

CORRESPONDENCE.

Great Britain.

London, February 3.—Mention was made a few weeks ago of the proposal to convert a portion of the Great Western Railway Company's suburban lines to electric traction. A contract has now been let to the Electric Construction Company for eight 6,600-volt three-phase generators direct-coupled to Belliss triple-expansion three-crank vertical engines of the high-speed enclosed type. They will develop 1,250 horsepower at full load. There will also be two auxiliary sets for lighting, etc., one engine being coupled to a three-phase generator and the other to a direct-current machine. These latter engines will be of the two-crank compound type. The same firm will also supply four surface-condensing plants. The boilers will be supplied by the Babcock & Wilcox Company. Of course these are merely preliminary details, as no work of construction has yet been commenced. The first section of line to be converted will be one running directly on to the District Company's lines, now being changed over by Mr. Yerkes, and therefore it would appear probable that a high degree of standardization will be reached—at any rate on the lines in and around London.

Technical education is still keenly discussed in scientific quarters. Sir William White made a suggestion a few days ago which I do not remember having been made before. He deprecated the great tendency to underestimate and depreciate ourselves, which was so prevalent, and thought that if the best results were to be obtained there must be conference between teachers and the representatives of business and the professions. Then if a permanent advisory committee were formed he would be extremely hopeful of the results. Perhaps some further interesting suggestions will be forthcoming next week, when the methods of technical education adopted in America will be discussed at the Institution of Electrical Engineers.

When the South African war started Colonel Crompton, the head of the corps of electrical engineer volunteers created by Dr. John Hopkinson in 1896, offered to take a detachment to the front. This offer was accepted, and so useful was the work it performed that further detachments were asked for. Altogether eight members died in South Africa, and at the headquarters of the corps in London this week a tablet to their memory was unveiled. The ceremony was performed by a member of the regular army, Major Pitt, of the Royal Engineers. The function was a simple one, but the playing of the "Last Post" at the moment of unveiling by the buglers added a touch of pathos to the proceedings. The tablet is a sheet of bronze inscribed with the names of those who died.

The discussion upon the Edison accumulator took place last week at the Institution of Electrical Engineers, but was not altogether a satisfactory one. No maker of British accumulators could be induced to speak, and in the end it was a triumph for Mr. Edison. Mr. Hibbert, the writer of the paper, and one who has carried out some hard work with the cells under automobile conditions, made some outspoken remarks with regard to the skepticism concerning the cell which he had had to encounter. He said he considered it unjust to the inventor.

There is a fear that trade unionism is likely to overreach itself in Great Britain. In days gone by the working man here has had to put up with a good deal, but his position now is far better than in many instances of less organized labor. However, it must be confessed that it is going too far to look upon the advances of science as an encroachment upon the working man's rights by the capitalist. The Amalgamated Society of Railway Servants, in an address by its organizing secretary, has been told that electrification is ousting manual labor, but that if the organization were kept up to a high standard it would be in a position to demand the reason and circumstances for such a change and tell the railway companies that the workmen's consent would have to be obtained.

The owners of the "G. B." surface-contact system of electric traction are to be allowed to construct an experimental line upon that system in Musselburgh (Scotland). It is to be hoped that the matter will be carried through a little more smoothly than was the case at Wolverhampton. G.

New York.

New York, February 13.—An order for 200 all-steel passenger cars for the subway of the Interborough Rapid Transit Company has been placed with a St. Louis company. With the exception of the end doors, window frames and sash, no wood will be used in the construction of these cars. An experimental car was built in the car shops of the Pennsylvania at Altoona last year, which was put in service on the Second Avenue elevated line for a thorough test on February 8th. The seating arrangement will be similar to that used in the present elevated cars, there being the usual longitudinal seats at each end with eight cross seats arranged back to back in the center. The seat frames will be made of pressed steel and the coverings of rattan. The interior finishings will be of aluminum. Pressed steel ceiling linings are to be used and a heavy steel floor laid. The cars are to be run in five-car local trains and eight-car express trains. In the local trains there will be three motor cars and two trailers, and in the express trains five motor cars and three

trailers. Each motor car will be equipped with two 200-horsepower motors, one on each axle of one truck only. This gives the express trains 2,000 horsepower available for accelerating an eight-car train. The length over all is 41 feet one-half inch.

A handsome pair of electroliers to be placed outside the home of Mayor McClellan in accordance with the tradition of placing lights in front of the homes of mayors has received the approval of the municipal art commission. The outlay required, it is understood, is about $1,600, but Mayor McClellan is inclined to think the design too ornate and the amount of money involved to be rather a waste, so there may be a more modest design accepted in its stead.

A notice has been sent out by H. H. Vreeland, president of the Interurban Street Railway Company, stating that the name of the company has been changed to the New York City Railway Company. This change was made by the authority of the Supreme Court and the Board of Railroad Commissioners.

Visible proofs of the existence of the great subway system are now manifested in the many little entrance stations which have sprung up at frequent intervals along the downtown streets. Each is built almost entirely of iron. Covering each stairway—and at some stations there are as many as eight sets of steps—is a structure that reminds one of pictures of pagodas. The sides and roof are of iron in each case and are set off by glass windows, the frames around the glass being of burnished copper. The rounded roof, surmounted by a little pinnacle, is trimmed with copper. Inside, the stations give ample waiting room, some of the larger ones being provided with spacious rotundas. White tile is used for interior finish, and everything has a substantial appearance.

A severe electric shock resulted in a peculiar manner to George Sperry of 299 Tenth Street, causing violent insanity. Mr. Sperry is a lineman and while repairing a broken wire in some way fell and became tangled in a network of wires, some of which were "alive." He was rescued with great difficulty and appeared to be crazed by the shock, becoming so violent that a straightjacket was necessary to control him. Soon after reaching the hospital his body suddenly became rigid and remained in that condition for an hour, when he became unconscious.

Dr. Coleman Kemp, consulting physician of the Manhattan State Hospital, tells for the first time the result of a series of experiments with fluorescin, which may do away with X-ray treatment of internal diseases. By the use of this remarkable fluid, it is said that the internal organs of the body become at once exposed to the naked eye as clearly as if through a transparent film of glass. It is asserted that the membranes of the stomach are so distinct in their outlines that they can be traced on the outside of the body in a dark or light room. The fluid will apparently prove of great value in the treatment of abdominal diseases. It is said to be entirely harmless and can be taken in quantities with impunity.

O.

New England.

Boston, February 13.—The Newton and Boston Street Railway Company, owned by the Boston Suburban Companies, so called, has petitioned the Massachusetts railroad commissioners for their approval of a discontinuance of all free transfers upon the lines which it operates, stating that "the financial condition of the company is such that it cannot afford to receive or issue transfers in the future." It is understood that the severity of the present winter in New England, unprecedented since trolley lines came into existence in this part of the country, has seriously affected the resources of all roads, and predictions of receiverships for some of them are made with considerable freedom. The freight-transportation privilege, if utilized by a combination of a score or more of parcels-express companies, as is contemplated, would undoubtedly swell the income of the roads interested very materially.

The Cape Heat, Light and Power Company has been organized for the purpose of furnishing electric lights to the town of Provincetown, on the tip of Cape Cod. A plant will be installed, provided contracts for 1,000 lights are obtained by the promoters.

Following close upon the declination of the courts to sanction the appointment of a receiver for the Middleboro Wareham and Buzzard's Bay Street Railway Company came the announcement that the New Bedford and Onset Street Railway Company, which had been furnishing power to the other line, had cut off the supply of electricity, pending an adjustment of accounts between the two companies. The tie-up lasted about 48 hours, and meanwhile an attachment was placed on the delinquent company's property in the sum of $25,000. It is stated that arrangements are pending for a settlement of the matter, and the road has resumed operations.

The Worcester and Southbridge muddle is clearing up. Creditors of the road are to be paid in cash on February 15th, on the basis of 50 cents on the dollar, in accordance with the negotiations which have been so long in progress. W. E. Rice, who is at the head of the reorganization syndicate, has raised $650,000 for the payment, and all the creditors except one bank and some merchandise creditors have accepted the terms proposed. A new board of directors is slated under the new ownership.

Surveys have been undertaken for an electric railway in Vermont, 60 miles in length, connecting St. Albans and Vergennes. It will carry passengers and freight, it is contemplated, and will parallel the Rutland and the Central Vermont steam railroads for a considerable part of the way.

A merger of New Hampshire roads is in prospect, the railroad commissioners of that state having been asked to sanction a union of the Lowell and Pelham, the Lawrence and Methuen, and the Haverhill and Southern New Hampshire lines with the Hudson, Pelham and Salem Street Railway Company, under leases to the latter corporation. Part of the system is in Massachusetts, and the consent of the Massachusetts railroad commissioners will have to be obtained also. It is stated that the Exeter, Hampton and Amesbury Company, which now controls the Hudson, Pelham and Salem, is to eventually become the owner of all the merged lines.

B.

Southeastern States.

Charlotte, N. C., February 13.—The Norfolk (Va.) Railway and Light Company and the Norfolk and Atlantic Terminal Company have discontinued their service to Old Point on account of lack of patronage. The schedule to Old Point may be resumed later.

It is reported that the Ashland line of the Virginia Passenger and Power Company of Richmond will be built, notwithstanding the cessation of some other work of the company.

The Louisville (Ky.) Railway Company will build an electric line to the Country Club of Louisville, the work to consume three to four months. Part of the line to Prospect may be on the right-of-way of the Louisville and Nashville railway, another rail being put in to accommodate the gauge of the electrical line.

The Delta Light and Power Company of Greenville, Miss., has begun the operation of a new two-mile electric line, up to date in every respect, and it is likely that two miles additional track will be built soon.

John W. Wiggins of Savannah has secured an electric-light franchise in Vidalia, Ga., and is now purchasing the necessary machinery in the North.

The Chattanooga (Tenn.) Electric Railway Company is projecting a one-mile extension to Rossville, Ga.

The trustees of Canton, Mo., have let the contract at $8,496 to Oder & Brownson of Palmyra, Mo., for a city electric-light plant.

The Standberry Electric Light Company of Standberry, Mo., has been incorporated with a capital of $25,000. James T. Norman, A. C. Frosble and T. D. Hussey are the stockholders.

The Municipal Electric and Construction Company is a new concern in St. Louis, Mo., with a capital stock of $50,000.

The town of Concord, N. C., is figuring on a new electric-light plant to cost about $18,000. The old plant may possibly be bought by the town, however.

The Coosa Water Power Development Company, with a quarter of a million dollars capital, has been formed to develop a waterpower in Calhoun County, Alabama. The Industrial Finance and Trust Company of Birmingham is fiscal agent for the new concern. It is said that northern capital is interested in the movement.

The light committee has decided to recommend that the city of Charlotte, N. C., make a contract with the new Catawba Electric Power Company of Fort Mill, S. C., to supply lights at $54 a year for the first 150 lights and $48 for all over that number. The present price paid the Charlotte Consolidated Construction Company is $90 per light a year. The new company expects to have power available in four months.

The Knoxville (Tenn.) Street Railway and Electric Light Comppany has been sold to Ford, Bacon & Davis of New York. It is stated that extensive improvements will be made in the near future.

L.

Texas and Mexico.

Austin, Texas, February 11.—R. W. Rogers of Texarkana, Texas, and J. A. Morgan of New York city are interested in the project of establishing an electric street-railway system at Palestine, Texas. They have been making a personal investigation of the situation and will soon apply to the City Council for a franchise for the use of streets.

The San Marcos Light and Power Company of San Marcos, Texas, has increased its capital stock from $20,000 to $30,000. It will make enlargements and improvements.

The Western Union Telegraph Company will extend its line to Saratoga, Texas.

C. J. Kleeman and associates of the City of Mexico will install an electric-light and power plant at their mine, situated near there. Waterpower will be utilized to generate the electrical energy.

The City Council of the City of Mexico has approved the plans of the Mexican Traction Company for the improvement and extension of its lines. A number of streets are to be traversed by these extensions.

The electric-light firm of J. & F. Borde of Tampico, Mexico, is installing a new electric-light and power plant at Tampico, Mexico. In addition to this plant, an opposition company has been organized and is also putting in a plant. The first-mentioned firm has the contract for lighting the city.

Steps have been taken looking to the installation of an electric-light plant at Tancitaro, Mexico. The names of the parties interested are not given.

The installation of the electric-light plant at Paracuaro, Mexico, has been completed.

The large dam of the A. K. Seago Box Company, across Big Sandy Creek, near Big Sandy, Texas, was recently partly destroyed. It is to be immediately repaired and the waterpower thus obtained is to be used for generating electricity for lights and power for Big Sandy. This company also contemplates establishing a waterworks plant for Big Sandy.

The Sour Lake Light and Power Company of Sour Lake is preparing to extend its transmission line to Batson, Texas, for the purpose of furnishing light and power.

Patrick Fitzgerald, general manager of the Lupita mine, situated near Mascota, Mexico, has applied to the government of the state of Jalisco for a concession to use the waters of La Maravilla River for the operation of an electric power plant, which he proposes to establish. The application will be granted.

An electric-light plant is to be established at Campeche, Mexico. The plans for the proposed improvement are now being studied by the government authorities. The machinery will be ordered from the United States.

A new electric-light plant has just been installed at Santiago Ixcuintla, Mexico. R. M. Burke of Chicago, formerly United States consul at Chihuahua, Mexico, has applied to the Mexican government for a concession to establish a large electric power plant, to be situated on the Conchos River, in the state of Chihuahua. Mr. Burke and associates already held a concession from the federal government for establishing a large electric power plant on the Conchos River at another point in that state. Their plans contemplate the construction of transmission lines to convey the electric current to the cities of Chihuahua and Parral and to different mining camps of the state.

Harry K. Johnson of Natchez, Miss., president of the Beaumont Traction Company, Beaumont, Texas, states that the lines of that company are to be extended from time to time, and that the extension to the oil fields will eventually be constructed. Work on the line to Spindle Top, a distance of about three miles, will probably be commenced this spring.

Engineer Weiser and his corps of surveyors are making good progress in their work of locating the route of the interurban electric railway that is to be built between Guadalajara, Mexico, and Lake Chapala. President E. H. Talbot of Chicago will soon make a personal inspection of the progress of the work.

Jose de J. Garcia has been granted a concession by the Mexican government to establish an electric power plant on the Laja River near San Miguel Allende, Mexico.

The Farmersville Mill and Light Company has been organized at Farmersville, Texas, with a capital stock of $50,000 for the purpose of installing an electric-light and power plant.

The street-railway system of Merida, Mexico, which is operated by animal traction, is about to pass into the hands of the United Railways of Yucatan, the proposed consideration being $1,500,000. It is the purpose of the United Railways of Yucatan to equip the system with electric traction as soon as the necessary machinery can be purchased and the construction work completed. The company has a capital stock of $23,000,000 and owns and operates 563 kilometers of steam railroads in Yucatan. The system of street railways is to be extended to suburban towns and to new parts of the city.

H.

Ohio.

Cleveland, February 13.—Rumors have been going the rounds of late that negotiaions are under way looking toward the consolidation of all the electric roads running out of Cleveland. Officials of most of the roads made an inspection trip over the Cleveland and Southwestern a few days ago, and this strengthened the belief that something of the kind is to be done.

Through the incorporation of the Ohio Union Traction Company some time ago, it is said the Appleyard interests expect to connect their lines in such a way as to make a through line from Cincinnati to Toledo. The new company has a nominal capital stock of $10,000, but the articles of incorporation will allow them to take the course suggested.

Twelve cars have been completed for the Scioto Valley Traction Company of Columbus and will be shipped shortly. This road will extend from Columbus to Chillicothe.

Senator Heihlein has introduced a bill in the Legislature giving electric railways the right to appropriate private property any place in a city or incorporated village in order to avoid dangerous curves or grades or unsafe foundations. It is claimed this bill, if enacted into a law, will give electric-railway companies the right of eminent domain, the same as steam railroads now enjoy. They now have this privilege outside of municipalities.

High water has incapacitated the power house of the Lake Shore Electric Railway Company at Fremont, and the division of the road between Sandusky and Toledo has been out of business for several days. The water has been higher there than for years.

Superintendent F. J. J. Sloat of the Cincinnati, Dayton and Toledo Traction Company has recommended that improvements costing something like $1,000,000 be made as soon as possible. Among other

things, he advises that a large power house be built at Hamilton and that the line be straightened in several places.

The "open-shop" plan will be inaugurated by the Westinghouse Electric and Manufacturing Company at Cleveland, it is said, as the different departments are again opened after being closed down for some time for repairs.

The stockholders of the Akron-Alliance Connecting Railway Company will hold a meeting at Alliance on March 2d, President R. D. Gibbey having sent out notices to that effect a few days ago. This company was incorporated several years ago, but not much has been done. It is now stated that the road will probably be built the coming summer.

Arrangements are being made to equip the Ohio penitentiary with electric lights. For some years gas for the penitentiary and other state institutions in Columbus has been manufactured there, but the officials have asked to be released from this arrangement. It may be that some of the other institutions will now be equipped for electric lights as well.

The Cincinnati Traction Company has made a demand that the government pay a straight five-cent fare for carrying letter carriers to and from their routes and also for carrying messengers. The government officials paid a lump sum of about $6,500 for this service last year, and the company says this is not enough. C. Thorp, chief of the free-delivery system, was in Cincinnati a few days ago and gathered data on the subject, which will be furnished the Postoffice Department in the form of a report.

The Eclipse Car Fender Company of Cleveland will equip a line at St. Louis during the World's Fair in order to exhibit the device.

The officials of the Cleveland Electric Railway Company have agreed to have all the cars equipped with power brakes within a year.

The Cincinnati, Toledo and Detroit Short Line Railway Company of Toledo has been incorporated with a capital stock of $6,000,000 by J. M. Morgan, L. J. Weadock, A. Burger, George Boodhart, W. P. Engel and Thomas M. Franey. It is said that this is a reincorporation of the People's Rapid Transit Company of Toledo. The charter provides that a line may be built through Hamilton, Butler, Preble, Darke, Mercer, Van Wert, Paulding, Defiance, Williams, Henry, Fulton and Lucas Counties. The incorporation's fees were $6,000. O. M. C.

Indiana.

Indianapolis, February 15.—J. B. Reed, of Townsend Reed & Co., is proposing to build an electric-railway line to connect Lafayette, Ind., and Kankakee, Ill. From Kankakee a line may be built to connect with Joliet, Ill., and thus a line from Indianapolis to Chicago will be secured—perhaps.

E. C. Folsom has been appointed superintendent of the Logansport and Wabash interurban and the Logansport local lines. Mr. Folsom is to have charge of the reconstruction of the local lines.

A bitter fight is being waged against the Indiana Union Traction Company by the officials of the gas-belt cities and the farmers generally because of the increase in rates and the enforcement of an order to take up a number of passes issued to citizens and employes. At Anderson, Marion and Muncie the police have been instructed to arrest conductors and motormen for the slightest violation of ordinances or franchises. Six influential farmers boarded a car and tendered the old rate of fare, which the conductors refused to accept. No attempt was made to put them off, but their names were reported to headquarters. It is now known that the next General Assembly will be asked to regulate interurban fares outside of cities.

W. H. Wylie of Wooster, Ohio, has arrived at Wabash to begin work on the new Wabash and Rochester traction line. The grade stakes will be set at once, and as soon as the ground is in condition a large force of men and teams will be put to work.

The Indianapolis, Columbus and Southern Traction Company and the Indianapolis Coal Traction Company, Plainfield line, have been granted one month's time by the Board of Public Works in which to begin hauling freight out of Indianapolis. The lack of terminal facilities is the cause named for not having carried freight long ago.

The flood washed away a part of the Evansville and Princeton Traction Company's bridge at Fort Branch, and the company's cars will be put out of through service for nearly a month.

The Lake County Light and Power Company has filed articles of incorporation with the secretary of state. The capital stock is $100,000. The company will build and operate light and power plants, the principal place of operation being at Whiting. The incorporators are Robert J. Cary and Arthur Young of Chicago, and Samuel T. Chase of Lake Forest, Ill.

The Richmond Light, Heat and Power Company has filed a mortgage on its local property in favor of the Continental Trust Company of New York for $300,000, covering an issue of bonds in that sum, which will be sold to meet cost of improvements soon to be made in the local plant. The plant is owned and the company officered by New York capitalists, who are making a damaging fight on the municipal plant.

Bids now being received for the public electric-lighting contract for this city for 10 years will be opened February 24th and the contract awarded March 1st. The successful bidder will have until April 1, 1905, to build a plant if necessary to do so.

The New Novelty Company has incorporated, with chief offices in Vincennes. The company will manufacture electrical burglar and fire alarms, fire escapes, double-cylinder gas engines and electrical apparatus. J. M. Stafford and F. J. Meyers are among the directors. F.

Michigan.

Detroit, February 13.—The Detroit Trust Company, as trustee, has filed a trust indenture and first mortgage securing an issue of $1,000,000 of first-mortgage bonds to be issued to provide for the construction of the Detroit, Flint and Saginaw electric railway. The total length of the line to be constructed under the terms of the mortgage is 46.8 miles. It covers all property acquired and to be acquired by the company; provides that $100,000 of the bonds shall be reserved to take care of the building of a double track between Saginaw and the Cass River bridge. It is understood that the promoters and operators of the road take enough of the bonds to provide for the present construction under way from Saginaw to Frankenmuth. It is the intention ultimately to extend this line from Frankenmuth to Flint and thence to Detroit.

The Scenic Railway of Detroit (capital, $60,000) has filed articles with the secretary of state. The company is evidently organized to take over the several amusement devices which have been constructed in Detroit.

The Bay City council has given the Bay City Consolidated Street Railway Company 60 days in which to equip its double-truck cars with air or other power brakes. Revocation of its franchise is threatened as a penalty. The company will probably not comply.

W. J. Emerick and W. S. Linton of Saginaw, who are interested, with Owosso men, in the building of an electric line from Saginaw to Owosso, to be known as the Saginaw Southern Railway, say it is still their intention to secure a franchise for the road connecting the two cities.

Five new single-truck cars from the Kuhlman car shops of Collinwood, Ohio, have been received by the Saginaw Valley Traction Company of Saginaw. They are all ready for service except putting in the motors and the wiring. The winter has been severe on the street-railway service.

The Detroit, Monroe and Toledo Short Line is making extensive preparations to have its line into Detroit completed by April 1st, and in order to supply the proper current and be prepared for all emergencies, is installing a new engine, boiler and dynamo in the power house at Monroe. Owing to disagreeable weather, the extension to Sibley's from Detroit has been held up.

Recently the Common Council of Lansing referred to the people the question of granting a heating and power franchise. So much public interest has been aroused over the question that the city is deluged with circulars and pamphlets on the subject. A vote will be taken, but as a result of the agitation it is probable that the city will itself engage in the business of furnishing heat, using the exhaust steam at the water and electric-lighting plants, which are under municipal control.

Onaway is to have a new electric-light system, most of the apparatus having been installed. It is expected that the system will be in working order in about two weeks.

The Lansing council has discontinued litigation with the Lansing Electric Railway Company to force the road to give up its charter on account of poor service. The suit was begun when the line was owned by Hawes & Angus, but Nelson Mills of Marysville and his associates, the new owners, are making every effort to give satisfaction, and have made a large expenditure for new equipment.

The Monroe council has passed a resolution to borrow $1,000 for six months for the municipal electric-lighting fund.

The Fidelity Construction Company has filed articles of association providing for a capital stock of $25,000, of which $8,740 has been paid in cash and $12,510 in other property. The company will construct electric and steam railways, light and power properties. George E. Fisher and G. G. Loring of Detroit, Benjamin M. Hopkins of Boston, Mass., and Edward N. Chase and Carl H. Burkhalter of Winchester, Ind., are the stockholders. The headquarters of the company are in Detroit. C. G. W.

Northwestern States.

Minneapolis, February 13.—An electric-light franchise was granted to James E. Geary at Pine River, Minn.

A company at Hamilton, Ohio, is negotiating for the purchase of the electric-light plant at Dyersville, Iowa.

Walnut, Iowa, will expend $14,000 in installing a new electric-light plant.

Herman Miles was given a franchise at Groton, S. D., for an electric-light plant.

A new electric-light plant is being put in at Ely, Minn., which will be the finest in the state outside of Duluth and the Twin Cities. It will cost $65,000.

There is some talk of building a trolley line from Willmar, Minn., south through Redwood Falls to Slayton.

A large electric power elevator will be installed in St. Mary's Hospital at Rochester, Minn.

The Construction Company of America, of New York, has absorbed the Sheboygan (Wis.) Light, Heat and Railway Company.

The City of Marshfield, Wis., is considering the advisability of buying the electric-light plant.

The Minnesota Power and Trolley Company is preparing plans for a new interurban line from St. Paul to Stillwater, via White Bear. This makes three suburban lines planned by the company from Minneapolis, the other two being to Lake Minnetonka and Anoka. The Stillwater line will be connected to Minneapolis by a new interurban from St Paul.

The gross earnings of the Duluth-Superior Traction Company during the last year were $450,403.

A new dynamo has been installed in the electric-light plant at Mora, Minn.

The electric-light plant at Cambridge, Neb., has been completed.

H. C. Higgins of Dixon, Ill., may build a trolley line from Marinette, Wis., to Peshtigo.

Harvey & Johnson have sold the electric-light plant at Omro, Wis., to S. Leighton. R.

Pacific Slope.

San Francisco, February 11.—The International Electric Company has been incorporated with a capital stock of $500,000. San Francisco is to be the principal place of business.

A proposition to issue $50,000 worth of bonds for building a municipal light plant will soon be submitted to the voters of Santa Rosa, Cal.

The Eureka Lighting Company has completed preliminary surveys for its waterpower electric-transmission system which is to supply Eureka, Cal., and the surrounding country some time next year. The survey for the 30-mile pole line from the power-house site on Trinity River to Eureka will be commenced at once. C. G. Miller says that the new generating plant will have a capacity of 6,000 or 7,000 horsepower. The company is controlled by the Pacific Lighting Company, of which Mr. Miller is president.

The Los Angeles Traction Company has been absorbed by the Los Angeles Interurban Railway Company, as has also the California-Pacific Railway Company and the Los Angeles and Glendale Electric Railway Company. The cars of the Los Angeles Traction Company are being taken to the shops as rapidly as possible, and the old name replaced by the new. Some new routings are also said to be scheduled.

The Oakland Transit Company is planning some extensive improvements to the electric system of Oakland. Among the most important is the construction of a subway which will pierce the hill across Fortieth Street. The plans provide for the erection of a large depot on the block between Fortieth and Forty-first Streets, through which the electric cars will pass. The company also intends to extend the University Avenue system in Berkeley.

Sealed proposals are being received by the Board of Supervisors of San Diego County for furnishing the county hospital with electric lights.

The supervisors of Yolo County have passed an ordinance granting a franchise to N. A. Hawkins for the construction of an electric line along the public streets and roads of Yolo County.

E. H. Test and A. N. Soliss of Ontario, Ore., have been granted a franchise by the City Council for the construction and operation of an electric-light and power plant in that city. Work on the plant will commence at once. A.

PERSONAL.

W. R. Haney of New Ulm, Minn., has been appointed superintendent of the electric-light plant at Warren, Minn.

R. W. Meyers, an electrician of San Francisco, has been appointed chief electrician of the army post at the Presidio, near San Francisco.

J. S. Leary has resigned his position as superintendent of the Fosston (Minn.) electric-light plant to accept a similar position at Valley City, N. D.

F. A. Nims has been elected president and T. S. Barber secretary of the Muskegon (Mich.) Light and Traction Company. About $30,000 will be spent in improvements this year.

Orrin F. Files, heretofore superintendent of the Haverhill and Amesbury Street Railway Company's system, has been appointed superintendent of the Citizens' Street Railway Company of Newburyport, Mass.

Carl Hering, past-president of the American Institute of Electrical Engineers, is president of the Engineers' Club of Philadelphia for 1904. Horatio A. Foster, another electrical engineer, is first vice-president.

William A. Walcott, for some time past the superintendent of the Salem division of the Boston and Northern Street Railway Company, has been superseded by Robert B. Chambers, superintendent heretofore of the Gloucester division.

George A. Stanley, purchasing agent of the Cleveland Electric Railway Company, has been chosen president of the New York and Long Island Traction Company, to succeed John E. Ensign, whose resignation was accepted a few days ago.

Cameron Forbes of Boston, who has been tendered the position of Philippine commissioner, is said to have [illegible] abilities and his technical knowledge of engineering

matters. Mr. Forbes is the grandson of Ralph Waldo Emerson and has been connected with the administration of more than 40 electric-railway systems.

Alderman William Mavor of Chicago, who was suddenly stricken with apoplexy last week while in attendance at a meeting of the committee on local transportation of the City Council, died at his home on February 11th. His death is keenly felt in the council chamber, as he was a man of excellent judgment, by which the city has profited in the years during which he has been the leader of the aldermanic body.

United States Senator Marcus A. Hanna, who died in Washington, D. C., on February 15th, built up the Cleveland City Railway Company's lines and was president and principal stockholder of that corporation for many years. Its capital stock was $7,600,000. Upon its consolidation with the Cleveland Electric Railway Company, of which Mr. Hanna was also a heavy stockholder, he was made chairman of the board of directors.

John A. Roche, former mayor of Chicago and identified with the mechanical and manufacturing interests of the city, was taken suddenly ill on February 10th and died about an hour after. Besides his many other connections he was at one time president of the Lake Street Elevated Railroad Company, and in 1894 became a member of the board of directors of Lewis Institute, of which board he was elected president. Mr. Roche was nearly 60 years of age. He is survived by a widow and three children.

Putnam A. Bates, assistant secretary and sales manager of the Crocker-Wheeler Company, announces that he has resigned his position and will retire from that company on March 1st. Mr. Bates has formed a partnership with John Neilson, who was until recently assistant secretary and assistant treasurer of the New York and Stamford Electric Railway Company. Under the firm name of Bates & Neilson the two will conduct a general practice of consulting electrical engineering, with offices in New York city.

Mrs. John B. O'Hara died in New York city on February 14th. The bereaved husband was formerly managing editor of the Western Electrician and is now a member of the editorial staff of the Street Railway Journal. He has many friends in electrical circles who will extend their earnest sympathy. Mrs. O'Hara was a young woman of great vivacity and charm of manner and a true and loyal helpmate to the companion of a life-journey that proved to be all too short. She was formerly Miss Margaret Hickey of Rochester, N. Y., and leaves, beside her husband and one son, a widowed mother, two brothers and two sisters.

At the annual meeting of the North Augusta Companies of Augusta, Ga., James U. Jackson was reelected president of the Augusta Railway and Electric Company, the Augusta and Aiken Railway (electric), the North Augusta Electric and Improvement Company, and other development companies. Charles G. Goodrich, cashier of the Georgia Railroad Bank, was elected vice-president of the Augusta Railway and Electric Company. A number of local capitalists were added to the directorate of the companies. James U. Jackson, Charles G. Goodrich, Thomas Barrett, Jr., and Henry H. Cumming compose the executive committee which will control the companies.

F. E. Fisher, for the last six years general manager of the Chicago and Joliet Electric Railway Company, has resigned his position with that company and will devote his time to the completion and the business interests of the new Joliet, Plainfield and Aurora Railway. The change will not be made till the first of April, when Mr. Fisher's term of office expires with the older company. J. R. Blackhall, who came to Joliet from Philadelphia to take the superintendency of overhead construction for the Chicago and Joliet company, will assume full charge on April 1st. F. E. Fisher is president of the Joliet, Plainfield and Aurora line, and is also president of the Fisher Construction Company. He states that as soon as the weather permits, the extension from Plainfield to Aurora will be made. Other extensions are also contemplated. While with the Chicago and Joliet company Mr. Fisher built up the system from 22 miles of trackage to a system of over 100 miles.

ELECTRIC LIGHTING.

The City Council of Kansas City, Mo., contemplates discontinuing the use to some extent of gasoline lamps for public lighting and substituting therefor electric lights and gas lamps.

The municipality of Paris, France, has accepted the plan of its engineer for the lighting of its great boulevards. The system is to consist of three sections, and all the lighting will be by electricity.

ELECTRIC RAILWAYS.

The Chattanooga (Tenn.) Electric Railway Company is having new seven-inch steel rails put down on all the paved streets in the city. The light rails which have been in use for so many years will be stored away and probably sold by the company.

Quite an unusual street-car accident was that reported at Homestead, Pa., recently in which a blind man was struck by a trolley car, and when he recovered consciousness it was found that the jar he received had restored his eyesight. At least so the story runs.

The Buffalo and Southeastern Railroad Company has been organized with $300,000 capital, to build an electric line from East Aurora, N. Y., to Buffalo. The directors are Densmore Pratt, Fay H. Ball, T. S. Miller, James Cadzow, E. E. Henshaw, Borden J. Cole, all of East Aurora, and Odell R. Blair, Buffalo.

A syndicate from Chicago has bought the Muscogee (Ind. T.) light and power plant, the ice plant and the gas franchise. The consideration was $125,000, and it is said that the new owners will also put in an electric railway system. The power plant was the first built in the territory. C. W. Turner was the former owner.

An electric railway which will connect Chesaw, Wash., with the Washington and Great Northern railroad at Cerlew, Wash., is to be built by the Ben Harrison Mining Company, owned by Ohio capitalists. Funds have been raised for the equipment of the road and construction will begin in a few days. The road will be about 35 miles in length, and the route will be along the course of the Kettle River.

It is reported that the Michigan Central Railroad Company has completed arrangements for the installation of an electric line along its right-of-way between Ann Arbor, Mich., and Detroit, to meet the competition of trolley lines between those points. It is stated that prominent stockholders of the Michigan Central hold the majority of stock in an electric power company which has just been organized in Detroit.

The company which is behind the proposition to build an electric railway from Topeka, Kan., to Council Grove expects to start the work early in the coming summer. The contract for the survey of the line has been made. P. L. Wise, the engineer in charge of the work, has estimated that the cost of building and equipping the line will be $1,122,400, of which $662,467 will be expended for the construction of the line and the remainder for the equipment.

The financial difficulties of the Chicago and South Shore Railway Company, operating an interurban line between Laporte and Michigan City, Ind., precipitated by a receivership suit and proceedings to foreclose a $300,000 mortgage commenced by the Royal Trust Company of Chicago in the federal court, have been adjusted, and the road will be operated by a committee of the bondholders, which will settle outstanding claims, improve the line, and continue its management. The present management will retire.

Announcement from Liberty, Mo., to the effect that the Clay County Court had granted a franchise to the St. Joseph, Parkville and Kansas City Railway Company to build an operate an electric line through the county, is confirmed by Charles F. Enright, secretary of the company. The plan is to build and operate an electric line from St. Joseph to Kansas City, following the Missouri River bottoms the greater part of the distance, connecting four Missouri River cities, and to build branch lines to Atchison, Leavenworth and Platte City. A franchise has already been secured through Buchanan County. The Clay County franchise calls for the construction of a modern bridge across the Missouri River at Kansas City. The road is to be double-track, and, under the franchise, work must be begun in three months and be completed in two years. The franchise is for 50 years.

SPACE TELEGRAPHY.

There is much experimental work in space telegraphy going on between naval vessels in the vicinity of New York harbor. Excellent records have recently been made in the exchange of messages between the Kearsarge and Minneapolis. Rear Admiral Converse, chief of the Bureau of Equipment, has made arrangements for a competitive test of four systems of space telegraphy to be held in the vicinity of New York harbor. These tests are to be made as comprehensive as possible.

The charge of transmitting space-telegraph messages from ship to ship at sea by the Marconi system is said to be sixpence a word, with the address and signature free. From ship to shore the rate on the American side is $2 for 10 words and 12 cents for each additional word, with no charge for address and signature. On the English side the charge for a message from a liner is six shillings for 12 words and sixpence for each additional word, the signature and address being charged for.

PUBLICATIONS.

A well-printed and illustrated catalogue of heating and ventilating apparatus is distributed to the trade by George D. Wilson of Chicago.

The Pope Manufacturing Company of Hartford, Conn., and Chicago distributes a tasteful valentine in colors, showing a pretty 1904 bicycle girl—"her bloom of rosy health happily blending with the sunshine of an opening spring." This seasonable greeting is sent free on request.

A carefully prepared catalogue describing "Dinkey Ventilated Controllers" has been issued by the Electric Controller and Supply Company of Cleveland, Ohio. These controllers are designed for use with motors which work under the most severe and exacting conditions—such as crane operation and the running of steel-mill machinery. The apparatus is described in detail, and spare parts are listed for all of the different sizes of controllers. A full set of diagrams appears as a part of the catalogue, showing the manner of connecting different types of motor through the controller to the line.

The Crocker-Wheeler Company of Ampere, N. J., is sending out a number of small bulletins which are called "flyers." These are in the form of two-leaf folders and each describes some particular machine-tool equipment for motor drive. There are 16 of the folders in the group on "Machine-tool Equipments," Nos. 153 to 168, inclusive. "Flyer" No. 145 is a larger size and contains quite a long discussion of electric drive for machine tools, with special reference to methods of variable-speed control, giving, among other things, a description of the multiple-voltage system of control in which three constant voltages of different values are maintained between the branches of a four-wire circuit, and showing a diagram for the connection of the motors of machines of different classes to this circuit. The company is also sending out an attractive calendar for February. Those receiving one will find it a useful addition to a well-appointed office.

MISCELLANEOUS.

A special committee of the Ogden (Utah) City Council recently reported unfavorably on the proposition to purchase the waterworks system of the city and running it as a municipal plant. The council, however, rejected the report and will further consider the matter.

The Edison Electric Company of Los Angeles, Cal., has purchased a site in San Pedro, where it will install a complete gas plant, with a daily capacity of 100,000 feet. While the apparatus has not yet been ordered, the company has decided upon the type that will be used.

The statement that the Eiffel Tower of Paris is to be torn down is denied by Mr. Mascart, president of the Academy of Sciences, who states that the tower is in a perfect state of preservation and that no change of position has been noted in either the tower or its foundation.

On February 10th a unique banquet was given by the Illinois Tunnel Company of Chicago to the Chicago Press Club. The banquet was in the company's tunnels, 40 feet underground, at the Jackson Boulevard and Fifth Avenue intersections. Several hundred guests were served at the banquet tables.

Silver is by far the best metal for use in reflectors on account of its great brightness when polished, giving an almost faultless white color, with only the faintest trace of yellow. But the metal cannot be used for this purpose in the vicinity of arc lights, as it quickly becomes dull in color, probably due to the ozone given off by the arc. Under similar conditions the metal palladium remains unaffected, and, furthermore, it is of nearly the same whiteness as silver. The manufacture of reflecting mirrors out of this expensive palladium is described, as follows: The outward curved, paraboloidal surface of the glass model of a mirror is first thinly covered with silver, and then a thicker copper covering is put on. By means of heat the metal cover is removed from the glass, and the silver which is on the hollow inner side of the curved metal sheet is first polished, and then by means of an electrolytical process covered with a thin layer of palladium.

TRADE NEWS.

Lawrence M. Bartlett of Casselton, N. D., would like to receive catalogues from electrical manufacturers and dealers.

According to a report in circulation in Germany the Siemens-Schuckert Company is endeavoring to enter into certain important arrangements with the Westinghouse Electric and Manufacturing Company, the nature of which have not been made known.

Ground has been broken for the plant of the Southern Street Car Manufacturing Company at Ensley, Ala. The main structure of the plant will be two stories, 300 by 300 feet, and will be used as the shops proper. The product will be street-railway cars.

The Sardis Electric Company has recently opened an office in Memphis, Tenn., at 224 Randolph Building, with D. L. Rush as electrical engineer and T. B. Trotter as mechanical engineer. The new company is prepared to do all kinds of electrical work, including repairing.

Judge Kohlsaat has appointed the Chicago Title and Trust Company receiver in bankruptcy of the American X-ray Company, one of the first concerns to begin the manufacture of X-ray apparatus in Chicago. The appointment followed the filing of a petition on behalf of creditors holding claims against the concern.

The A. and J. M. Anderson Manufacturing Company of Boston, well known to the trade as manufacturers of switches, switchboards, etc., has re-

cently opened a Chicago office at 175 Dearborn Street, with William Ward Hincher, formerly of the chief engineer's office of the Chicago Union Traction Company, in charge.

Maine slate for electrical purposes is highly recommended by the Monson Burmah Slate Company of Portland, Maine. Among the advantages which are claimed for it are that it is so closely grained as to be wholly free from moisture; that its insulating properties are very high and that for various uses in electrochemical works it forms a good acid-proof material for construction.

The Nernst Lamp Company of Pittsburg, in accordance with its new policy of establishing district offices in the large cities, has recently opened an office at 47 State Street, Detroit, Mich., and appointed Charles F. Case as district sales manager. The territory embraced by this office is the lower peninsular of the state of Michigan, the northwestern part of Ohio and the northeastern part of Indiana.

The annual conference of the branch-office managers of the Standard Underground Cable Company with the general sales, manufacturing, construction and executive departments of the company, was recently held in the general offices of the company in Pittsburg, the session covering three days. The report of each manager for the year 1903 and the business prospects for the year 1904 was presented and discussed, together with ways and means for rendering more efficient service in every department to the customers of the company, who now number considerably over 1,000. A pleasant social feature of the occasion was a theater party given by J. W. Marsh, vice-president and general manager of the company, to the visiting managers. The branch-office managers attending the meeting were Charles J. Marsh and George L. Wiley, from the New York office, Frank Clark Cosby from the Boston office, T. E. Hughes from the Philadelphia office, and J. R. Wiley and E. J. Pietzcker from the Chicago office.

BUSINESS.

The Carney Bros. Company of Chicago notices a constantly improving tone in the pole trade and anticipates a good, healthy spring business. The company has recently sent out its men to cover the western states, to which it has excellent shipping facilities.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) February 9, 1904.

751,440. Commutator Lead and Mode of Making Same. Charles F. Adams, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed August 8, 1903.

Sheet-metal strips are stamped and slitted part way along the median line and grooved the rest of the way along this line. The strips are then folded on the groove.

751,441. Means for Protection Against Reverse Currents. Leonard Andrews, Manchester, England, assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed June 25, 1903.

A main circuit, a local circuit, an electroresponsive device in the local circuit, and means for producing in the local circuit two electromotive forces are specified. One of the electromotive forces is dependent in phase on the current in the main circuit and the other dependent in phase on the voltage in the main circuit.

751,442. Reverse-current Cut-out. Leonard Andrews, Manchester, England, assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed June 25, 1903.

A series coil and a shunt coil are combined with a closed magnetic circuit adapted to be magnetized by the coils conjointly when the currents in the coils are in the same relative direction. An open magnetic circuit includes a movable member and is adapted to be magnetized by the coils conjointly when the currents in the coils are in relatively opposite directions. A switch is operated by the movement of the movable member.

751,456. Surface-cleaning Device for Third Rails of Electric Railways. Milton C. Canfield, Cleveland, Ohio, assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed January 14, 1903.

A roller carried by the car truck presses down upon the rail, breaking up the ice. Compressed air increases the pressure of the roller.

751,458. Station Indicator and Advertising Device. Louis Casper, Chicago, Ill. Application filed May 2, 1898.

Two endless chains carry curtains pivoted between the chains. Each of the curtains is provided with a transverse metallic edging at bottom, and contact pieces engage the curtains and form electric terminals of an electric circuit and a signaling device.

751,460. Lightning Arrester. Cummings C. Chesney, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed August 8, 1903.

The operating parts are a line wire, a circuit from the line wire to earth, including an air gap and an electromagnetic device in the circuit adapted to increase the length of the air gap. A closed conducting circuit is connected in inductive relation to the winding of the device.

751,474. Pole-changer for Dynamos. Isidor Deutsch, Montreal, Canada. Application filed May 14, 1903.

Combined with the armature shaft and a pivoted switch lever provided with suitable contact arms designed to coact with suitable contacts are means attached to the lever and designed to be held normally in a definite intermediate position. An arm is secured to the spindle of the switch lever, and means are interposed between the armature shaft and the switch lever for changing the position of the switch lever and consequently the arm.

751,484. Fan. Charles A. Eck, Belleville, N. J. Application filed April 2, 1903.

The mechanical features of a fan are described, the motive power being an electric motor.

751,485. Fan. Charles A. Eck, Newark, N. J. Application filed June 20, 1903.

A fan, driven by an electric motor, has means for adjusting it easily at any angle.

751,501. Electric Telephone. Ernst Gundlach, Western Springs, Ill. Application filed November 10, 1902.

Combined with the vibratory diaphragm is a device for tensioning the diaphragm by mechanical force. A permanent magnet has a pole piece of small diameter or cross section, being of smaller power than required for tensioning the diaphragm without the aid of the mechanical force.

751,508. Motor Vehicle. Bohn C. Hicks, Chicago, Ill., assignor to the Center Drive Automobile Company, Chicago, Ill., and Pierre, S. D. Application filed June 15, 1903.

The electric motor is geared to the drive wheel and pivotally suspended at its front end from the running-gear frame, and connected at its rear with the axle by rigid connecting rods or bars, which are flexibly connected with the rear axle.

751,517. Apparatus for Ascertaining the Acceleration Due to Gravity. Paul G. W. Keller, Manitowoc, Wis. Application filed March 5, 1903.

A traveling carriage is provided with suitable wheels and axles to engage a trackway. A stop block, operated by an electromagnet, engages the trackway to stop the travel of the carriage upon which it is located. The magnet is controlled by suitable electrical connections.

751,539. Ringing Key for Telephone Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed May 9, 1902.

Combined with a manually operated ringing key is an escapement controlling the return of the key to its normal position, and an electromagnet actuating the escapement. A source of intermittent current independent of the ringing current is in a circuit including the magnet.

751,547. Motor-controller. Francis V. Nicholls, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed June 13, 1903.

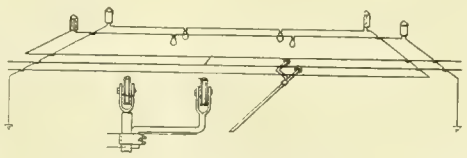
Controlling and reverse cylinders of a controller for electric motors contain an interlocking mechanism to prevent the movement of either cylinder except when the other cylinder is at a predetermined position. The mechanism comprises two overlapping disks, or such segments of the disks as are suitable for the purpose, one mounted on the controlling cylinder and the other on the reverse cylinder, each disk having a peripheral guard ring.

751,549. System of Electrical Distribution. John S. Peck, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed May 1, 1903.

Several compound-wound rotary converters are adapted for operation in parallel. A bank of transformers each has several secondary windings so disposed that the number of rotary converters connected thereto may be varied without materially varying the compounding effect upon the direct-current circuit supplied.

751,563. Dynamo-electric Machine. David B. Rushmore, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed June 26, 1903.

The field poles supporting the coils are cut away on two sides so as to leave segmental spaces between the poles and the coils.



NO. 751,760.—CROSSING SIGNAL.

751,566. Ringing Key for Telephone Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed May 9, 1902.

An adjustable retarding mechanism controls the release of the switch which carries the ringing current. A continuously acting commutator independent of the switch periodically interrupts the ringing current, whereby current is intermittently applied a given number of times, dependent upon the retarding mechanism.

751,571. Time-limit Relay for Electric Circuits. Harve R. Stuart and Arthur B. Reynders, Wilkinsburg, Pa., assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed April 11, 1903.

The principal features of the device are contact-terminal members, an electromagnet, an armature therefor, the weight of which normally holds the members out of engagement, mechanical means for moving one of the members into engagement with the other when the magnet withdraws its armature and a retarding device for the movable member of the circuit closer.

751,574. Electric Spark-producing Apparatus. Chester H. Thordarson, Chicago, Ill. Application filed March 10, 1903.

Separable contacts, one of the contacts being movable toward and from the other, are held together yieldingly by a spring. A magnet and a spring-supported armature are arranged to strike the movable contact to separate it from its co-operating contact, the armature being weighted, so that it delivers a hammer blow.

751,581. Controlling Mechanism for Electric Vehicles. Frank S. Wahl, Buffalo, N. Y. Application filed December 21, 1901.

A controller shaft is revoluble in one direction from the neutral or open-circuit position, to supply energy, and in the other direction to operate a reverse switch.

751,595. Parallel Feeder Protection. Leonard Wilson, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed July 16, 1903.

Combined with parallel feeders is a choke coil for each feeding having two opposing windings of equal ampere turns, one of the windings being energized by the current in one feeder and the other by the current in all the feeders. Means for restoring the balance of the remaining choke coils when one feeder is cut out are further specified.

751,597. Electric Switch. Gilbert Wright and Harold C. White, Pittsfield, Mass., assignors to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed June 13, 1903.

A switch rod is operated by a spring. Another member is adapted to compress the spring, driven by a motor. A clutch between the member and the motor is disengaged when the spring is compressed. Means for releasing the rod and means actuated by the movement of the rod for re-engaging the clutch are other essential parts.

751,598. Means for Controlling Governor Motors. Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed September 24, 1903.

The starting and reversing switch for the motor comprises a number of flat springs tending to assume a given position. Two sets of contacts are arranged on each side of the springs and adapted to engage the springs when moved from the normal position.

751,616. Magneto-electric Generator. Hugh J. Creighton, Anderson, Ind. Application filed May 13, 1903.

The base of the generator is supplied with an elongated slot near one end. A spring arm is secured to the other end of the base. A stud is integral with and depends from the pole pieces through the slot in the base.

751,634. Rheostat. George Graybill and John P. Oden, York, Pa. Application filed June 8, 1903.

Two concentrically arranged telescopically connected tubes are in electrical connection in every adjusted position. A plug connected to one end of the outer tube is provided with two contacts, insulated from each other, and one of which is electrically connected with the body of the tube. A conducting rod or pin, electrically connected with the other contact in the plug, extends into and longitudinally of the inner tube. A body of finely divided resistance material is arranged within the inner tube about the rod therein, the resistance material being insulated from the inner tube. Two contacts in a socket are insulated from each other, one being arranged in the path of the rod or pin and the other electrically connected with the inner tube. (See cut on next page.)

751,654. Apparatus for the Regulation of Electrical Circuits in Heating Devices. Willie D. Kilroy, Uxbridge, England. Application filed October 6, 1902.

A square prismatic plug carries contact strips connected to a subdivided conductor and provided with a shield to house the end of the socket. The socket has elastic contact pieces connected to supply terminals and has labels on its four faces to indicate its angular position, with reference to the plug, to give the effect indicated by the labels.

751,655. Telephony. Isidor Kitsee, Philadelphia, Pa. Application filed January 9, 1901.

Several electromagnets, connected each to an outlying or subscriber circuit, are each shunted by an auxiliary circuit. A movable arm is adapted to open the shunt of each of the magnets in order, means operatively connected to the armature of each of the electromagnets retarding the movement of the arm. Other means operatively connected with the movable arm electrically insert in the circuit calling the receiver of the operator's telephone.

751,664. Electric Insulator. Thomas T. Lyman, Montclair, N. J., assignor to the H. W. Johns-Manville Company, New York, N. Y. Application filed April 4, 1902.

The insulator is for the prevention of the formation of electric arcs and is composed of asbestos, plaster-of-paris and silicate of soda, vitrified and coated with a waterproofing solution.

751,728. Rotary Snap Electric Switch. Monroe Guett, Hartford, Conn., assignor to the Hart & Hegeman Manufacturing Company, Hartford, Conn. Application filed September 23, 1903.

Spring terminals are fixed to the base of the switch and a rotary commutator carries [illegible] ends only exposed. A block of insulating material extends upwards from the base in front of each spring terminal and has its inner wall conforming to and closely fitting the periphery of the commutator.

751,739. Insulator. Peter S. Lindal, Edinburg, Pa. Application filed March 31, 1903.

An insulating block is clamped on the wires by means of a [illegible]

751,743. Insulator. Joseph M. Mahoney, Boston, Mass. Application filed December 1, 1903.

Two semi-tubular insulating members may be taken apart for the insertion of the wire in the groove of one of the members thus formed. Then the other half is [illegible]

751,749. Trolley Wheel. John E. Palmer, Somerville, Mass. Application filed November 14, 1903.

The trolley wheel is carried on a shaft and mounted thereon on the same shaft are two conical members, whose bases normally come nearly together immediately over the trolley wheel. The conical members are hollow where they surround the wheel and semi-circular portions are cut out of the edges, which permit the trolley wire to pass through the opening thus formed and rest on the wheel. The cones are mounted slidably on the shaft and are held together normally by springs at each end. In attaching the trolley the cones slide apart upon pressure of the wire, which then falls into place. Once in place, the cones snap back and hold it in position. (See cut.)

751,760. Electric Signaling Apparatus. John E. Stannard, Springfield, Mass. Application filed February 2, 1903.

An auxiliary trolley carried by the main trolley pole of a car engages a second trolley wire parallel to the main line and extending some distance each side of a crossing. Any car approaching the crossing thus closes a local circuit, which operates a signal at the crossing. (See cut on preceding page.)

751,772. Storage-battery Plate. Charles B. Askew, Chicago, Ill. Application filed May 20, 1903.

In a storage-battery grid is a central web having perforations made therethrough, and parallel ribs projecting from the web, each of the ribs having its upper and lower surfaces disposed at right angles to the medium plane of the web.

751,777. Flexible Conduit. Archibald T. Blackler, Malden, Mass., assignor to James S. Wilson, Chelsea, Mass. Application filed March 14, 1903.

An insulating conduit for electric wires consists of circumferential elements, and longitudinal, substantially flat warpstrips interwoven therewith and composed of smooth, flexible, compact, insulating material.

751,780. Electric Signal. Harold E. Bradley, Warwick, R. I. Application filed October 3, 1903.

In the electric signaling device are combined an electric switch, a finger mounted on a shaft to control the switch and two ratchet wheels mounted on the shaft and facing in opposite directions. A spring-actuated sliding pawl engages each ratchet wheel. A magnet operates each of the pawls, the magnets having but one coil, a core extending through the coil, pole pieces at each end of the core and an armature pivoted near its end to swing on an axis parallel to that of the core and controlled by both of the poles.

751,781. Electric Alarm Clock. Harry A. Chase, East Orange, N. J. Application filed March 6, 1900.

Details are described.

751,788. Electrical Signal Apparatus. John M. Golding, Washington, D. C. Application filed July 15, 1903.

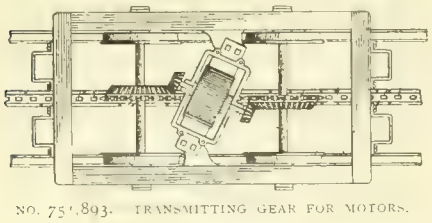
An electric circuit includes a battery, a resistance, a circuit-breaker and an electromagnet. A shunt circuit includes a bell in parallel with the electric circuit, a circuit closer adjacent to the magnet, and an indicator movable to operate the circuit closer and engage the core of the magnet, which latter will attract and hold the indicator to maintain the circuit closed and ring the bell until the circuit-breaker is operated.

751,797. Central-energy Telephone System. John H. Lendi, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed December 19, 1900.

Combined with the connecting plug and a plug-seat switch is a combined relay and repeating coil, one winding of the repeating coil being opaque to the passage of continuous currents, the other winding constituting the relay winding. A signaling device is controlled by the relay and plug-seat switch.

751,799. Means for Controlling the Operation of Locks of Elevator Hatchway Doors. Axel Magnuson, New York, and Theodor Eskilsson, Long Island City, N. Y. Application filed November 12, 1903.

Hatchway doors are provided each with a locking dog and an armature carried thereby. An electromagnet having a core adapted to retain sufficient residual magnetism to hold any dog in its open or unlocked position is carried by the car. Circuit connections are supplied whereby the locking dogs remain undisturbed as the car passes them unless the electromagnet be energized.



NO. 751,893. TRANSMITTING GEAR FOR MOTORS.

751,803. Wireless Electric Apparatus Acting on Typewriters. Giuseppe Musso S. Angelo dei Lombardi, Italy. Application filed September 23, 1902.

Several stations, each of which is provided with mechanism for imprinting signs one by one contains moving means for governing the signs located at each station. Means for synchronously moving mechanism at the various stations governing the imprinting of the signs, means for governing the synchronous movement and means for simultaneously starting or stopping the same are embodied in the invention.

751,818. Electrically Produced Sound Intensifier. Gustaf T. Swenson, San Pedro, Cal. Application filed December 17, 1902.

Means to intensify the sound comprise a number of separated microphone contacts insulated from each other on one side and all being adapted to be actuated by the vibration of a single telephone diaphragm.

751,829. Telephone. Ernest T. Billig, New York, N. Y. Application filed December 2, 1902.

A battery-carrying handle supports the receiver and transmitter, with means for making a call or signal consisting essentially in an electromagnet, a spring arm fastened to the core of the magnet at one end and carrying a plate that it attracted toward and away from the core, and a screw that is normally in contact with the spring-supported plate. The signaling means are arranged in proximity to the receiver diaphragm.

751,830. Arc Preventer. Charles E. Blood, Fitchburg, Mass. Application filed October 14, 1903.

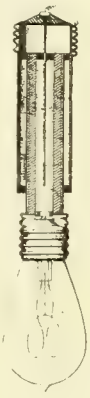
Combined with a rotary cylinder and fixed and movable contacts are pipes in line with and disposed between the fixed and movable contacts. An air-supply pipe leads to the first-mentioned pipes to bring the air for blowing out the arc.

751,839. Electric Hair-brush. Henry C. Doersch, Nyack, N. Y., assignor of one-half to William S. Pickard, Brooklyn, N. Y. Application filed June 1, 1903.

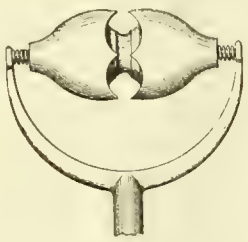
One terminal of the secondary of an induction coil is attached to the body and the other through wires to the hair brush.

751,845. Telephonic Repeater. Merritt Gally, Brooklyn, N. Y. Application filed April 23, 1903.

A telephonic repeating device, for connection with two telephone lines comprises connections for a primary circuit. A primary induction coil consists of a number of secondary wires wound together, a part of them for connection with one telephone line and a part of them for connection with another telephone line. (See cut.)



NO. 751,634.—RHEOSTAT.



NO. 751,749.—TROLLEY WHEEL.

751,857. System of Electrical Propulsion. Erich Krause, Hoboken, N. J., assignor of one-fifth to Hans Kürten and Rosa Kürten, Hoboken, N. J. Application filed October 22, 1903.

Several cores with wires wound on forming coils contain rods arranged in the interior of the coils and cores, the end of the coils being connected with the rods. Main conductors and auxiliary conductors are in proximity to the rods connected with the main conductors. A movable armature is adapted to electrically connect one set of rods with the movable conductors adjacent thereto, for energizing successively one coil after another for attracting the armature and causing it to pass through the coils.

751,893. Locomotive System. Thomas G. Aultman and James C. Gaskill, Fairmont, W. Va.; said Aultman assignor to Joseph A. Jeffrey, Columbus, Ohio. Application filed May 20, 1903.

In an electric haulage system the locomotive has a front and rear axle with two track wheels and a sprocket wheel rigidly connected directly to the axle of each. A motor on the car is connected to the gearing of the front sprocket wheel by means of two spur gears on opposite ends of its shaft, one spur driving from one side and the other from the opposite side, so that the two gears are revolved in the same direction. (See cut.)

751,900. Trolley-road Crossing. James M. Collins, Byesville, Ohio, assignor to Joseph A. Jeffrey, Columbus, Ohio. Application filed February 2, 1901. Renewed September 9, 1903.

A main trolley line has a break or open space with a bridging connection for such space in electric connection with the main line on each side of the space. A conductor movable along the bridging connection and having a contact member with which the trolley that moves along the main line is adapted to engage, and a stop for limiting the movement of the contact portion of the conductor furnishes the locomotive current to pass the space.

751,903. System for the Operation of Electric Motors. Arthur C. Eastwood, Cleveland, Ohio. Application filed September 25, 1903.

A body of resistance is divided into a number of sections, a switch for each section, each having two contacts, of which one is connected to its particular section and the other is connected to one of the supply mains. A solenoid for each switch is successively energized by a solenoid, the solenoids, after the first, each having one terminal connected to the controller and the other connected to the resistance side of a switch whose solenoid in operation is actuated before it.

751,949. Road-crossing Device. Frank L. Sessions, Columbus, Ohio, assignor to Joseph A. Jeffrey, Columbus, Ohio. Application filed August 8, 1902.

An engaging device carried by an auxiliary conductor is normally held in place to cause the engagement of the conductors in either direction of movement of the traveling conductor, and movable relative to the auxiliary conductor under excess of pressure in either direction to permit the separation of the conductors.

751,969. Globe Holder for Arc Lamps. James J. Wood, Fort Wayne, Ind. Application filed March 9, 1903.

The globe holder of an electric arc lamp is described.

751,974. Rail Contact Shoe and Support Therefor. George W. Brady and Lawrence R. Jones, Wheaton, Ill. Application filed April 13, 1903.

A horizontally arranged body portion carries depending sides pivoted to its lateral edges. A contact block has divergent side faces arranged below the body portion with its side faces disposed to limit the inward movement of the pivoted sides of the shoe.

751,982. Sound Magnifier for Relays. Matt A. Hacker, Irvine, Ky., assignor to himself, Joe S. Gardner and Leonard A. West, Irvine, Ky., and Courtland P. Chenault, Frankfort, Ky. Application filed April 28, 1902.

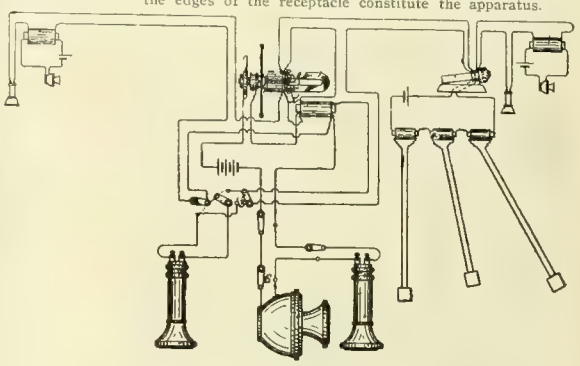
Combined with a relay and its armature is a sounding surface, and a loose and freely sliding pin interposed between the armature and the sounding surface and transmitting the blow of the armature of the surface.

751,985. Underground-conduit Insulation. John M. Humiston, Berwyn, Ill. Application filed April 27, 1903.

In an insulation for underground conduits are two adjacent ends of ordinary metallic pipe sections, an interposed tubular insulating section of considerable length and couplings connecting the ends of the respective sections together.

751,986. Apparatus for Purifying Liquids. Otto Kartzmark, Brooklyn, N. Y., assignor of one-half to William Davis, Jersey City, N. J. Application filed December 26, 1900.

A receptacle open at its upper portion to the air, a series of detachable electrodes located therein and energized from a suitable source of power, and means for passing the whole of a liquid in a continuous stream simultaneously upwardly between the electrodes and over the edges of the receptacle constitute the apparatus.



NO. 751,845.—TELEPHONE REPEATER

751,991. Current Director. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company, Albany, N. Y. Application filed January 28, 1901.

The mechanical features of the switching mechanism are described.

752,005. Electric Arc Lamp. Frederick Sindingchristensen, Brooklyn, N. Y., assignor of one-half to Francis F. Storm, Maywood, N. J. Application filed August 29, 1902.

An electromagnet is supported by the frame. A magnetic clutch for the movable carbon of the lamp comprises a moving member in magnetic connection with the armature of the electromagnet but located at a point outside of the direct influence of attraction of the magnet and operated by the repulsive force exerted between the armature and moving member, due to their similar polarity.

752,008. Induction Coil. Charles F. Splitdorf, New York, N. Y. Application filed July 15, 1902.

In an induction coil is an insulating medium intermediate the primary and secondary windings, comprising a sheet of non-conducting resilient material rolled upon itself in form of a multiply cylinder and adapted to contract about and inclose the primary winding.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on February 15, 1904:

357,572. Electric Heater. W. Leigh Burton, Richmond, Va.
357,576. Electromagnetic Brake. George F. Card, Covington, Ky., assignor to Henry K. Lindsey, Cincinnati, O.
357,627. Cut-Out for Secondary Batteries. George B. Prescott, Jr., Newark, N. J., assignor to the United States Electric Lighting Company, New York, N. Y.
357,646. Galvanic Battery and Apparatus Connected Therewith. Alfred R. Upward, West Kensington and Charles W. Pridham, Kensington, County of Middlesex, England.
357,682. Telephone Switch. James W. McDonough and Horace H. Eldred, New York, N. Y.
357,687. Desk for Telephone Use. Charles A. Patterson, Detroit, Mich., assignor of one-third to John E. Patterson, Detroit, Mich.
357,705. Dynamo Electric Generator. James W. Easton, New York, N. Y.
357,726. Electrical Circuit. Jacob F. Mehren, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.
357,760. Circuit System for Electric Brakes. George F. Card, Covington, Ky., assignor to Henry K. Lindsey, Cincinnati, O.
357,789. Telegraph Sounder. Reuben C. Rutherford, Quincy, Ill.
357,815. Electric Burglar Alarm. Edward E. Carr, Chalmers, Ind.
357,821. Multiple Switchboard. William S. Ford, Denver, Colo.
357,838. Electric Temperature Regulator. Charles E. Lee, Rochester, N. Y.
357,873. Device for Regulating the Flow of Electric Currents. Eli T. Starr, Philadelphia, Pa., assignor to the Electrical Accumulator Company of New York.
357,881. Electric Railway Signal. Edward D. Wells, Westminster, Md.
357,885. Electric Clock System. Theodore J. Zoeller, Louisville, Ky.
357,922. Electrical Signal Device. William Hand, Hamilton, and Marcus C. Wright and Francis A. Pocock, Toronto, Canada.
357,960. Electric Fire Alarm. William L. Horne, Meriden, Conn.
357,976. Electrical Car Brake. George F. Card, Covington, Ky., assignor to Henry K. Lindsey, Cincinnati, O.
358,002. Electric Amalgamator. Theodore H. Trauernicht, Lead City, Dak.

WESTERN ELECTRICIAN

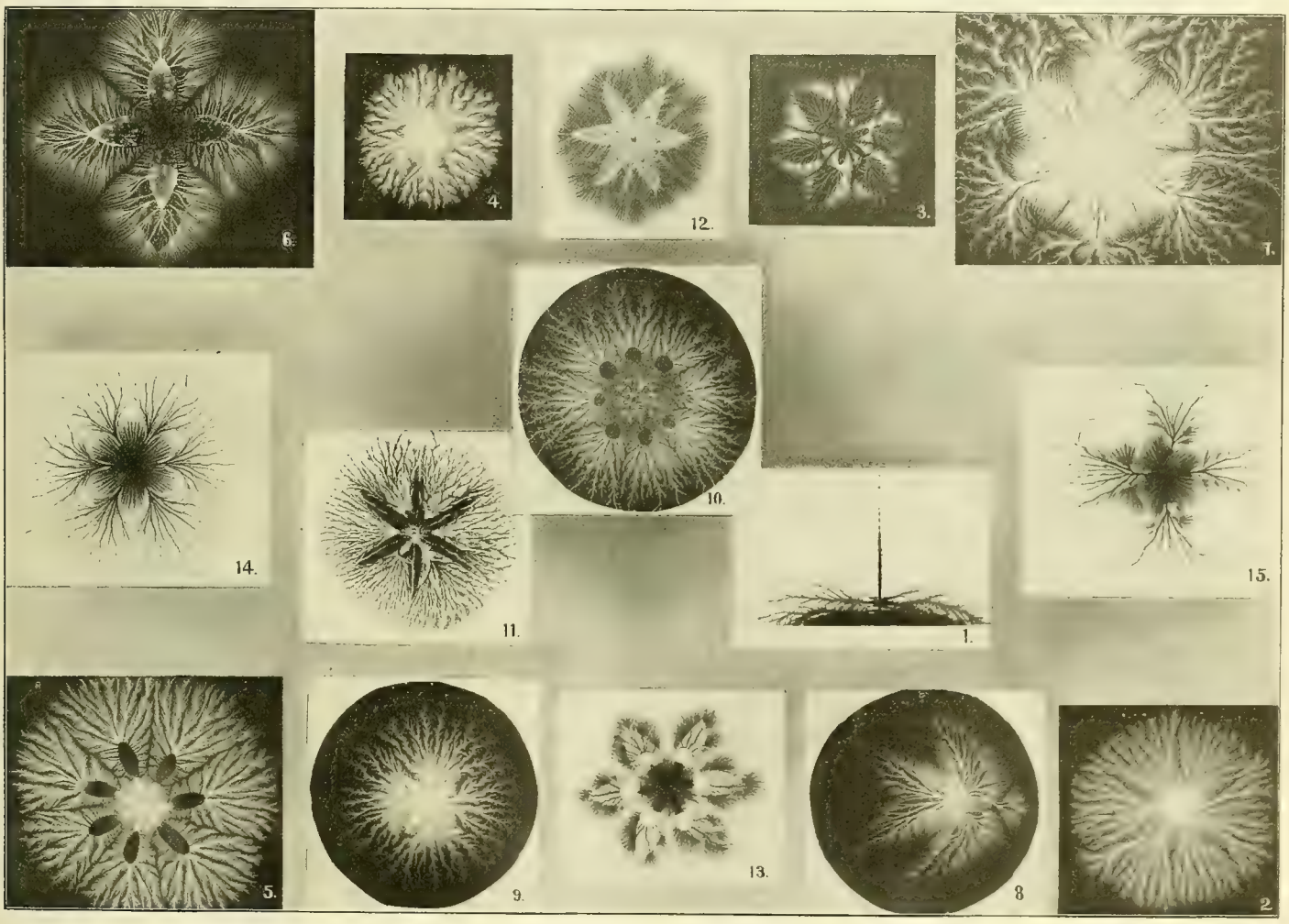
EVERY SATURDAY

Vol. XXXIV. CHICAGO, FEBRUARY 27, 1904 No. 9

Artistic Electrical Discharge Designs.

By Frank C. Perkins.

By the use of the Ruhmkorff induction coil or by utilizing a static machine, very beautiful and artistic designs have been obtained by electric discharges on sensitive photographic plates and paper. In the accompanying group illustration are shown some of the beautiful designs obtained by this process. Fig. 1 is from a photograph showing the plate and wire terminal with the brush electric discharge as seen from the side or edge of the plate, while Figs. 2 to 7, inclusive, represent negatives. In Figs. 8, 9 and 10 the negatives are provided with circular mats. These ornamental designs show the electric discharges in white on a dark background, while those presented by Figs. 11 to 15 are positive prints showing the various patterns in black on a white background. These photographs are the result of the artistic work of Dr. Stephane Leduc, a professor in the School of Medicine at Nantes, France, and were recently shown to the Société Francaise de Physique.



ARTISTIC ELECTRICAL DISCHARGE DESIGNS.

The method of procedure in obtaining these ornamental designs by electric discharge was first to cut out a regular design of simple pattern in cardboard, placing it over a sensitized plate in a photographic dark room and sprinkling the plate covered by the mat with an insulating powder, such as sulphur, starch or a metallic salt. The mat, with the cut design, is then removed from the sensitive plate, leaving the pattern on the plate wherever the powder remains. While these symmetrical designs cut from the pasteboard are not at all intricate, the electrical discharges do the embellishing, making most exquisite figures. A metallic sheet or leaf is connected with one pole of the induction coil or static machine and the prepared sensitive photographic plate is placed on the metallic leaf with the non-coated side down, while a metallic point connected with the other pole of the electrical machine or Ruhmkorff coil is placed in the center of the symmetrical figure outlined with the insulating powder.

Fig. 1 shows a side view of the electric discharge and gives a good idea of the arrangement of the sensitive plate, powder and top central connecting wire and point. By reversing the poles and changing their sizes and shapes, very different results are obtained, as well as by employing different-cut designs. The figures are also varied by the fineness as well as by the density of the powders, the finest lines being produced by means of the most compact powders, while very interesting results are obtained by placing pieces of lead, copper, silver or other metals on the sensitive surface.

Only one discharge is necessary, it is stated, and a very small coil or static machine is sufficient for producing most satisfactory results. As soon as the electrical discharges have acted upon the plate, the powder is removed and the plate is developed as usual with X-ray or other photographs. The metallic leaf, as well as the upper wire or point, form parts of a condenser, the dielectric being represented by the plate coated with gelatino-bromide of silver.

It will be noted by the accompanying illustrations that Dr. Leduc, who is vice-president of the Board of Hygiene of Liore-Inferieure, has obtained some most interesting results in his experiments with specially treated plates exposed to electrical discharges. These unique designs are very easily produced and furnish motifs for ornamentation, which may be of great service in artistic decoration, as a great variety of different figures may be obtained in this way.

Chicago Electrical Association Unites with the Western Society of Engineers.

Final action was taken by the Chicago Electrical Association on February 19th upon the question of the proposed affiliation with the Western Society of Engineers which had been placed before the members of the association for consideration at a previous meeting. By a unanimous vote it was decided to take the step, and as a consequence the members of the Chicago Electrical Association are now members of the Western Society of Engineers, being admitted as active, junior or associate members of that organization according to their ability to meet the requirements as specified in the by-laws of the Western Society. In addition to this the new members will form what is to be known as the Electrical Section of the Western Society of Engineers, and each member of the electrical section will have a vote in all matters of his particular section, though only those who can meet the requirements for active membership are allowed a vote in the affairs of the society as a whole.

The last meeting of the association, which was held at the Albion Cafe, was an interesting and enjoyable one, 39 members being present. The members took dinner together before the business affairs of the evening were taken up.

President W. B. Hale called the meeting to order, and with a few well-chosen remarks expressed his feelings in regard to the proposed change. He believed that a strong business organization, such as is afforded by the Western Society, is a necessary adjunct to any association, and that such organization had never been attained by the Chicago Electrical Association. He believed, therefore, that the proposed union with the Western Society was in

the interests of electrical engineering in the West. He then called upon some of the older members of the society to express themselves.

Professor P. B. Woodworth of Lewis Institute was first called upon. His views upon the affiliation were in the affirmative, provided that the association could still keep its integrity. He eulogized the engineer and the part which he plays in public affairs and favored the proposed step as being a means of more closely uniting the engineering fraternity in this part of the country.

Albert Scheible was next called upon, and he expressed himself as strongly in favor of the proposed change. One of the charter members of the organization, W. Clyde Jones, was sorry to see the society give up its name and identity, although he appreciated the advantages to be derived.

Others who were called upon to speak were G. A. Damon, J. R. Cravath, H. G. Dimick, Harold Almert and A. L. Tucker, after which the question was opened for general discussion. The members expressed themselves freely and all were in favor of the move. A rising vote was then taken, which was unanimous, and to the accompaniment of an appropriate toast to the new relationship the Chicago Electrical Association became a thing of the past. The remainder of the evening was passed in a social manner.

Edison Storage Battery Discussed in England.

The paper read by W. Hibbert before the Institution of Electrical Engineers in London November 26th and published in the Western Electrician of December 19, 1903, attracted widespread attention. The discussion of the paper was postponed until January 28th, after some of the defects pointed out in the test had been remedied. An abstract of the discussion follows.

Before the discussion was opened Mr. Hibbert said a few words in regard to the improvement of the cell. During his tests he had discovered that the cell was not balanced, one of the plates having a greater capacity than the other. Upon writing to Mr. Edison, he later found that the defect has been remedied and the cell now contains six negative and 10 positive plates, which is a decided improvement in balancing the cell. Dr. J. A. Fleming regretted that the discussion had been delayed so long. He then described some tests made by him on one of the new cells at University College, London, from September, 1903, to January, 1904. The cell was given him in July, but remained idle for some months until he could begin the work. When making the experiments the cell was discharged in each case down to 0.8 volt on closed circuit except in one case, where the initial charge was 0.7 volt and final 0.3 volt. Practically the same results were obtained as those arrived at by Mr. Hibbert. The experiment was performed to see what can be done with a single cell; to ascertain if high discharges bring about any permanent loss of capacity or displace any of the active material from the pockets, and to discover if any local action takes place between the active material and its supports. The results of these tests are shown graphically in the accompanying illustration. These experiments show, as did Mr. Hibbert's, that the cell has a wonderful capacity for taking up a heavy charge for a short time; also that a heavy discharge brings about a temporary diminution of the capacity. At the end of 20 discharges it was found, however, that the cell comes back nearly to its original capacity. In summing up the results, Mr. Fleming stated that, as far as weight and capacity are concerned, the advantages of the cell are not distinctly greater than those of many light-weight lead cells, but that there is evidently much greater durability and much less disintegration and the local action between the active material and supports is practically absent.

E. J. Wade would have been glad if Mr. Hibbert had said more of the theory of the cell instead of telling only what it accomplished in the tests. He believed that though the Edison cell possesses decided advantages, it by no means puts the lead cell out of the race. In his opinion, if a more porous active material could be obtained, it would be possible to do away with the reduction of capacity at high discharge rates, which at present exist with the lead cell, and bring it more up to what the Edison cell gives. He had lately prepared some lead cell with three or four times the porosity of the ordinary cell, and the discharge rate was very much the same as in the Edison cell. This showed it must be the exhaustion of the electrolyte in the lead cell that brought down the output at the high rates, and the absence of that caused it to be maintained in the Edison cell, because there was no reduction of the strength of the electrolyte.

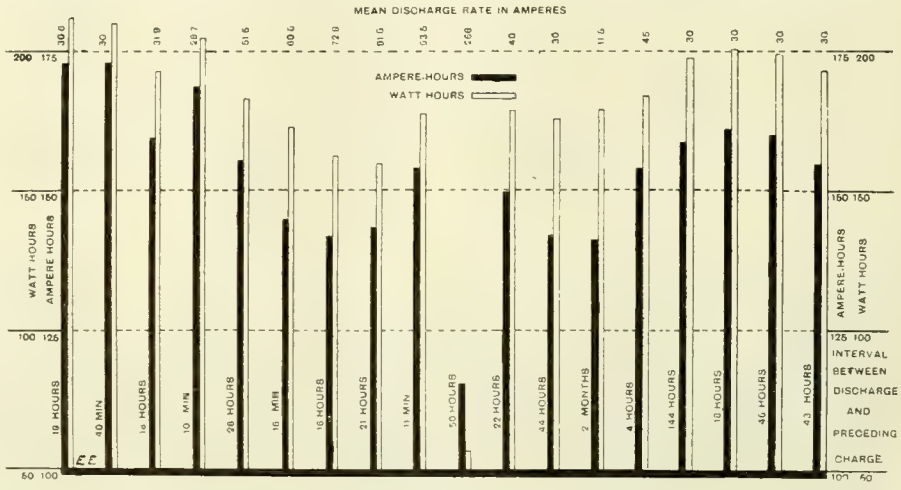
Another who had made tests on the Edison cell was H. L. Joly. He believed that careful gas analysis would prove of considerable value in investigating the internal behavior of the cell, and he had obtained some endrometric data, which tended to confirm this opinion. He also thought it interesting to investigate fully the comparative behavior of the plates by means of an auxiliary electrode; cadmium was tried, but the use of the container itself gave more reliable figures. This method showed a drop on the negative electrode and a rapid recovery, at the same time as the potential difference dropped on the nickel plate, and settled at the lower level. From some experiments, it appeared that one might anticipate a second flat on the potential-difference curve, if the iron electrodes had a smaller capacity than the nickel-oxide plates, this flat being then due to the iron. The time necessary to form the plates he did not regard as excessive.

W. R. Cooper said the paper was interesting from two points of view—one as a cell and the other from the point of view of automobilism. Everyone hoped that electric automobiles had a future, except those misguided individuals who went in for petrol. Mr. Hibbert had given details of some experiments on an electric runabout, but unfortunately they were not as interesting as they might be, because the runabout seemed to have been badly designed for the work. It was much heavier than runabouts generally were for the length it could go. It only went 34 miles on one charge, which was very little. However, the author had proved most of his points except that dealing with heavy discharges. He had related one experience which he said he would never forget, but there was only that one experience to go on apparently. He thought it depended upon the basis on which one took these discharges. If the weight of the cell was taken as the basis, then the discharges were certainly heavy, but the tendency in automobile work was to diminish the weight quite as much as to increase the capacity, and, therefore, the capacity should be taken into account rather as a basis, and the discharges should be considered from that point of view. The efficiency of the motor was put at 85 per cent. in Mr. Hibbert's tests, which seemed rather high.

W. H. Patchell, speaking of the exhaustion of the electrolyte in lead cells, expressed the view that in recent years battery work has improved very much, owing mainly to the better class of materials used. He also referred to the spacing of the forks in lead batteries and to the tendency to increase the distance between them. He thought that in large cells one of the features of success is due to the wide spacing and improved circulation.

Mr. Hibbert, in reply to the arguments, said that there were lapses in his paper which had not filled out because at the time he had not the facts to do so. He knew nothing of the formation of the cell. He had used it as he had received it, after long exposure to the air with the liquid poured out. One of the cells, after running 3,000 miles, was broken open, and it was found that the active material at the bottom of the cell was one two-thousandth of the whole. As to the possible objection to testing single cells, he stated that on the automobile he had worked 38 and then increased them to 60, and although he did not know the number of cells distributed over Europe, it must be quite 80 or 90. In view of this fact, and remembering also that all who had tested them had found results which had been almost repetitions, it seemed to him that the single-cell testing objection had already fallen to the ground. Mr. Wade had remarked on the fact that all the data given in the paper referred to external circumstances. This was simply because he knew nothing about the internal. The chemical data were vague. They were vague even with reference to the oxides of nickel, which had been prepared by pure chemical processes and were amenable to straightforward examination, and he suspected that when the task of examining these electrochemical oxides had really been carried through it would be found that a higher proportion of nickel oxides existed than had been indicated in the formula he had used.

With regard to the 85 per cent. efficiency of the motor, Mr. Hibbert had put the case as strongly as he could against the cell. He had no information on the possible changes produced by temperature on the active materials or alkali, except that the change of resistance of the potash solution with temperature was known to be of the order of two per cent. per degree Centigrade, and therefore he could only refer to that well-known figure in this connection. It would be remembered that he said in his verbal epitome of the paper that, after he had done with the cells and had resumed his ordinary winter's work, they were placed on a cab in London, which was given special duty with the object, if possible, of knocking the cells to pieces. Practically the instruction was that they were to break them down by running them about, if possible. Well, five out of the 60 had been somewhat injured as regards capacity. They were distinctly lower than at the time he turned them over. Since then he had had nothing to do with them, but that afternoon he had made an experiment on one of the cells, whose capacity had fallen from 160 ampere-hours to 70 or 80. By a simple process of regeneration he had brought it back to 122, this process being to simply give it a big discharge and a reversed current for a short period of time



EDISON STORAGE BATTERY DISCUSSED—RESULTS OF TESTS BY DR. FLEMING.

Motor with Adjustable Fields.

A somewhat unique method of changing the relation of the fields to the brushes in an electric motor has been embodied in an invention recently patented by Christian Fleischmann of Bloomfield, N. J. The object of this invention is to provide a motor in

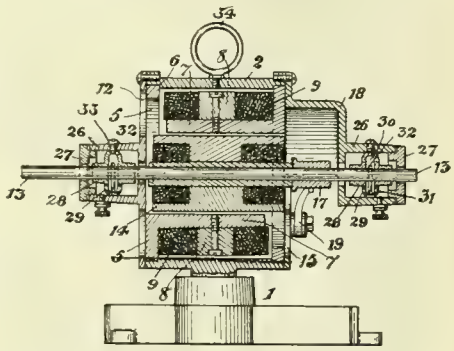


FIG. 1. MOTOR WITH ADJUSTABLE FIELDS.

which the field magnets shall be movable instead of the brushes, thus enabling adjustment to be made by shifting the field magnets to avoid the use of a rocker arm.

The motor proper (see Fig. 1) comprises a cylindrical casing open at both ends and having at its lower side a stem adapted to enter a supporting pedestal. Into each of the opposite ends of the

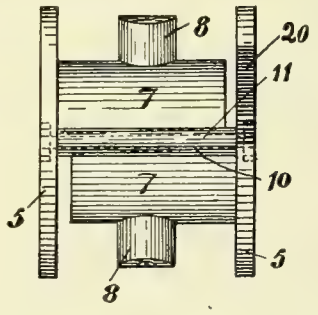


FIG. 2. DETAIL OF MOTOR WITH ADJUSTABLE FIELDS.

casing is inserted an annular frame (5). Each of the frames carries a semi-cylindrical projection (7), better seen in Fig. 2. The projection (7) and studs (8) form the poles of the field magnets.

The armature (14), mounted upon the shaft in any usual manner, lies within the semi-cylinrical field-coil carriers (7) (7).

At one end of the casing is an end plate (15),

upon the lower portion of which are brackets (19) supporting brushes adapted to engage a commutator (17). Instead, however of the brushes being movable, as usual, they are fixed in position. An upper portion of the end plate upon the brush end of the motor projects outwardly to form a casing to enclose the commutator and brushes.

In adjusting the motor, the field coils (9) (9), Fig.

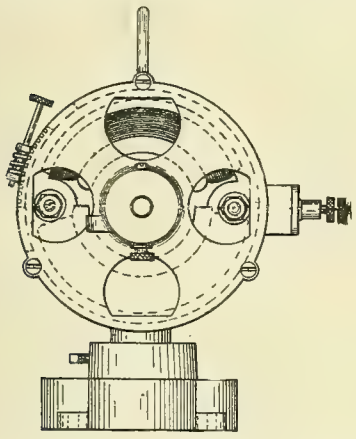


FIG. 3. MOTOR WITH ADJUSTABLE FIELDS.

1, are shifted by rotating their carriers within the casing of the motor, as seen in Fig. 3. To effect the oscillation of the field carriers in a regular manner and determinate amount, an edge portion of one of the frames is provided with rack teeth, which engage a worm journaled on the casing. The worm has at one end of its shaft a milled finger piece for turning, and thus it will be seen that the field coil will be shifted very gradually and uniformly upon the turning of the worm. Furthermore, the worm will not permit an inadvertent displacement of the field-coil carriers and provides sufficient power to move them under all conditions.

Aluminum Welding by Cowper-Coles Process.

Aluminum welding, as accomplished by the new method of S. O. Cowper-Coles, was described in the Western Electrician of February 6th, including a picture of his apparatus. A description of the process was given by Mr. Cowper-Coles in a paper read by Mr. Jonas before the Farady Society in London. In the discussion which followed the reading of this paper some points of interest were brought out.

D. A. Sutherland was of the opinion that great difficulty would be encountered in welding large pieces of aluminum, as was also Murray Morrison, he having welded joints in this manner without the quenching apparatus. He found that pressure was necessary in welding.

Mr. Blount said that when drawn wires are welded it is essential that the joints be drawn or worked in some way.

E. Kilburn Scott believed that the important point to remember is the value of the hard outer skin of the metal. If aluminum wires are used for transmission of electricity, uniformity of section is unimportant, and the blob at the weld need not be removed. But otherwise, if used as trolley wires, it will be necessary to harden the joint in some way; this might be done by burnishing with agate.

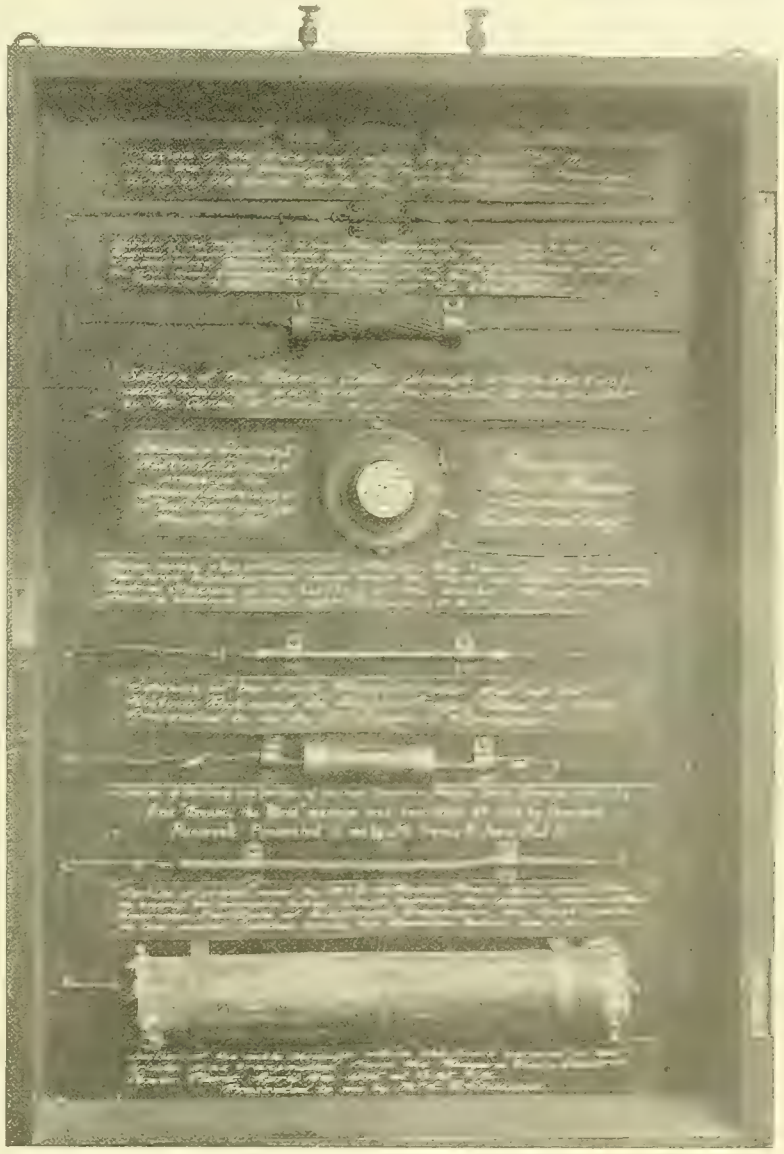
Mr. Jonas in his reply drew attention to the tests of tensile strengths of jointed rods given in the paper. In reply to Mr. Blount, he stated that the joints proved to be the strongest part of the rods. He remarked also that the quenching was an essential feature of the process and one which distinguished it from all others, the process being primarily a fusing process.

Steam and Electric-railway Co-operation in the Chautauqua Region.

At a meeting of the passenger agents representing the transportation companies interested in summer excursion business for Chautauqua Lake and Niagara Falls, which was held in Cambridge Springs, Pa., on February 19th, it was voted to recognize the Chautauqua Traction Company. This action of the steam-railroad men signifies that the electric company will in the future be entitled to vote on all railroad matters that come up at the annual meeting of the passenger men. The steam roads and their connections will interchange business with the traction company, which will also sell tickets through to New York, Chicago or other distant points. The traction-line route when completed will reduce the time between Jamestown, N. Y., and the Chautauqua Assembly Grounds by about one hour.

A Unique Collection of Historic Cables.

The photograph reproduced herewith is that of a case containing sections of the wires which at various times formed parts of electrical circuits famous in the history of electricity. The exhibit is the property of Mr. William J. Hammer, consulting electrical engineer of New York city, and the various sections, connected into a continuous circuit, were used on the evening of Thursday, February 11th, on the occasion of the dinner given in honor of Thomas A. Edison by the American Institute of Electrical Engineers at the Waldorf-Astoria. Mr. Edison sent his response to the greeting of the Institute through this circuit. This act added to the historic interest of the collection. It will be noticed, moreover, as a suggestive coincidence that the wires shown appertain to various branches of the electrical industry with which Mr. Edison has been directly connected, as telegraphy, telephony, electric lighting and electric railways.



A UNIQUE COLLECTION OF HISTORIC CABLES.

At the top of the case is a piece of the wire over which Professor S. F. B. Morse sent the first message by the Morse telegraph. This relic was presented to Mr. Hammer in 1893 by a son of Mr. Alfred Vail, Professor Morse's old partner. Immediately below it there is a length of a few inches of the wire through which Professor Alexander Graham Bell and Mr. T. A. Watson, his assistant, made all their early experiments in the transmission of audible speech in the years 1875 to 1877 at No. 5 Exeter Place, Boston, Mass. The first audible speech transmitted by the Bell telephone went through this wire. The authenticity of this fragment is attested by the fact that it was given to its present owner by Mr. Emile Berliner. The third of these historical mementos is a section of the Atlantic cable over which the first successful message was sent between the old and the new worlds. The specimen as presented to Mr. Hammer in 1880 by the late Cyrus W. Field, through whose efforts the cable was laid.

In the center of the photograph will be seen a safety fuse or plug used in London, England, on January 12, 1882, to close the circuit of the first incandescent lamp ever lighted from an electric-lighting central station in the history of electricity. This interesting event took place at the Holborn Viaduct central station, and it was Mr. Hammer himself who made the connection, the lamp being one of 3,000 incandescent lamps of the earliest Edison type. Beneath the fuse is a portion of the first trolley circuit used at the historic plant at Richmond, Va., in 1888. This wire was presented to Mr. Hammer by Mr. Frank J. Sprague. The sixth is perhaps the most interesting of all the relics, being a section of the deep-sea portion of the new American Pacific cable, 8,300 nautical miles in length, over which President Roosevelt on July 4, 1903, sent the first message by telegraph that ever went around the world. To add to the interest, it should be stated that this historic message passed through all the wires which then constituted Mr. Hammer's collection as displayed in this photograph.

The remaining wires are also of eminent historic interest, although they do not as yet rank among great electrical curiosities. One of them is a section of a circuit used on April 22, 1896, at the American Institute of Electrical Engineers to illuminate the lecture room the first time in history solely with vacuum tubes. The last specimen is a section of the cable through which electrical power was first transmitted from the Niagara Falls electrical-power plant on April 16, 1895.

A new street-car crossing signal has been tested in Dresden, Germany, and is described as follows: "A box two feet long and one foot wide is suspended from the wires at the center of the crossing, and at a certain distance the approaching car automatically turns on the current and from the opposite sides of the box is shown in red letters the word 'Halt,' to warn the car coming at right angles as well as teamsters and pedestrians. When the car reaches the center of the crossing, the light is extinguished."

Interesting Canadian Power Plant at Niagara Falls.

Work upon power development of the Horseshoe Cataract (Canadian side) at Niagara Falls as outlined by the Electrical Development Company is now progressing rapidly. The company was incorporated one year ago with a capital stock of $6,000,000 for the purpose of generating electricity from the Canadian Falls to the extent of 125,000 electrical horsepower.

FIG. 1. INTERESTING CANADIAN POWER PLANT AT NIAGARA FALLS. GENERAL PLAN OF WORKS.

It was recognized in the beginning that the chief difficulties would be encountered in the building of the cofferdam and the work on the main tailrace tunnels. Both of these problems have been solved satisfactorily, it is thought. In the original estimates eight feet of water was assumed on the line of the cofferdam, as a maximum, so that it was thought necessary to locate the cofferdam in the midst of the rapids above the falls. This dam, with the exception of a few short spurs, was completed December 12, 1903. During the progress of its direction it was found that 26 feet of water is available, which is much more than is necessary for the number of horsepower which will be developed. Fig. 1 of the accompanying illustrations (reproduced from the Canadian Electrical News) is a sketch showing the general plan of the works, including the cofferdam and the tailrace, which is directly under the riverbed.

When planning the tailrace it was deemed impossible by many engineers to place the portal under the falls, for many reasons. One of these reasons was that at times notable explosions are seen to occur at the base of the falls which are thought to be due to compressed air. This, it was thought, would prevent the opening of a portal underneath the falls. In order to ascertain the exact condition, it was decided to construct a subsidiary tunnel out to the line of the proposed main tunnel. This was done, as seen by Fig. 1, and it was found that the conditions at the base of the falls were favorable. Fig. 2 is a sketch showing the conditions at the construction shaft and at the mouth of the drift.

Part of the tailrace tunnel has been constructed and plans for the power house have been prepared. The latter, as represented by the architect's drawing (Fig. 3), presents a striking appearance, resembling some handsome public building rather than a power plant. The building will be 500 feet long and 70 feet wide with an elevation of about 40 feet.

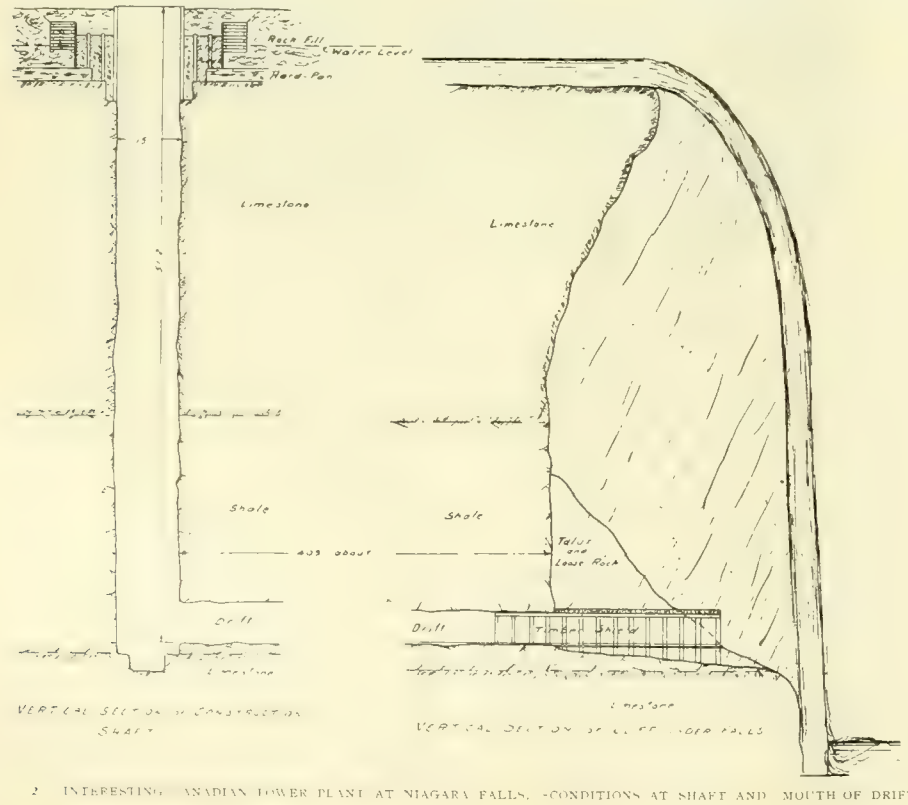
The water, gathered by the cofferdam into a large pond, will be led through steel tubes to the waterwheels located in the bottom of the wheel-pit, and the differences of level provided by the design are such that, after deducting losses from friction and the velocity of approach and discharge, there will remain an operating head of 143 feet to be used by the turbines. In order to obtain this operating head the design calls for the construction of the wheel-pit through solid rock. This wheel-pit is provided with masonry lining, and the provision that the turbines and all of the machinery above them shall rest upon solid-rock foundations, instead of artificial supports, as has hitherto been the practice, is an element newly adopted for this construction.

Ultimately, 11 generators will be installed of 12,500 horsepower each, revolving at 250 revolutions a minute. The connections between each turbine at the bottom of the pit and the generator at the top will be by a hollow shaft approximately 115 feet in length.

After having performed its work the water will be discharged through steel draft tubes to two branch tailrace tunnels emptying into the main tunnel, making it possible to close down one-half the station for repairs independently of the other half.

The location of the route for the transmission line to Toronto, which will be built by the Toronto and Niagara Power Company, has been completed. The distance from the power house to Scarlet Road, Lambton, on the northwestern confines of the city of Toronto, is 75½ miles. The location has been selected with a view to the utilization of the right-of-way lands possessed by the Toronto and Niagara Power Company not only for electric power-transmission lines, but for railway purposes, and it is stated that the country traversed does not present serious engineering difficulties. About 85 per cent. of the right-of-way, having a minimum width of 80 feet, had been purchased by December 31st.

FIG. 3 PROPOSED POWER HOUSE AT NIAGARA FALLS (CANADIAN SIDE).



2 INTERESTING CANADIAN POWER PLANT AT NIAGARA FALLS.—CONDITIONS AT SHAFT AND MOUTH OF DRIFT

Congress and Hawaiian Franchises.

Owners of public utilities in Hawaii are complaining of the attitude of Congress toward franchise legislation by the territorial Legislature. The House of Representatives recently refused to enact the legislation required to make valid the franchise of the electric-light and power company on the island of Oahu. The chief objections were the long term of 35 years and the provisions as to rates. The Honolulu Advertiser says: "This attitude seems on the whole rather unfair to the islands, because the organic law has imposed upon owners and holders of franchises the duty of coming to Congress to have bills passed by the territorial Legislature, approved by vote of Congress. In the case of other territories, the grants of franchises by their Legislatures stand, unless Congress interposes. There is quite a distinction between the two requirements. For Hawaii there must be an affirmative vote by Congress. For other territories, if Congress does not vote at all on the franchises, these franchises stand as valid."

Electrical Utilities for Harbin.

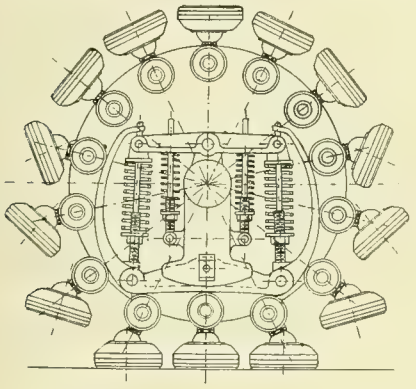
A private corporation having a capital of 250,000 rubles ($128,750) is planning, unless prevented by war-time conditions, to provide an electric-light system for the city of Harbin, Manchuria, which is the principal base of the Russian army. This city is divided into three sections known as the old town, the river town and the administration town. It lies 600 miles north of Port Arthur on the Trans-siberian railway, and has been developed by the Russians so rapidly that it has become a center of industrial force in the affairs of Northeastern Asia. The corporation mentioned also plans to construct an electric street railway, connecting the three sections of the city, and an automobile line is ready to start four machines to operate between the old town and the administration city. The Russo-Chinese Bank has a fine stone building in the city and has a steam-heating and electric-light plant of its own.

Diplock's Pedrail

Electrical men and others interested in traction work are watching the development of an ingenious invention of B. J. Diplock of London, to which the name "pedrail" has been given. The accompanying illustrations are reproduced from a report on the subject by James Boyle, United States consul in Liverpool.

Professor Hele-Shaw of the engineering department of the Liverpool University is an authority on mechanical locomotion; therefore his unequivocal and enthusiastic indorsement of the new invention has attracted wide and respectful attention in England, not only among the general public, but among scientific engineers. Professor Hele-Shaw recently gave an address before the Liverpool Self-propelled Traffic Association on the pedrail, illustrated by models, drawings and cinematograph pictures. Had the door spaces in the university lecture hall been wide enough and the floors strong enough, the professor would have had a pedrail for actual demonstration. He asserts that it was quite possible for it to have climbed up the steps and walked into the hall.

The pedrail is variously described as a "walking locomotive," a "half-traction engine and half-walking machine," a "combination of an endless railway and a trotting machine" and a "rail moving on wheels." Professor Hele-Shaw says that the inventor some years since conceived the idea of a locomotive with rails moving on wheels. He encountered great difficulties, but these difficulties, the professor asserts, Mr. Diplock has surmounted. It is declared that the pedrail is "a revolution in mechanical locomotion." The device, it is said, can be used with advantage not only for ordinary freight haulage on common roads, but is thoroughly practicable as a traction engine over bad roads, and even in districts where there are no roads at all and where progress by the ordinary traction engine would be absolutely impossible. It would, for instance, as claimed, be suitable for hauling minerals



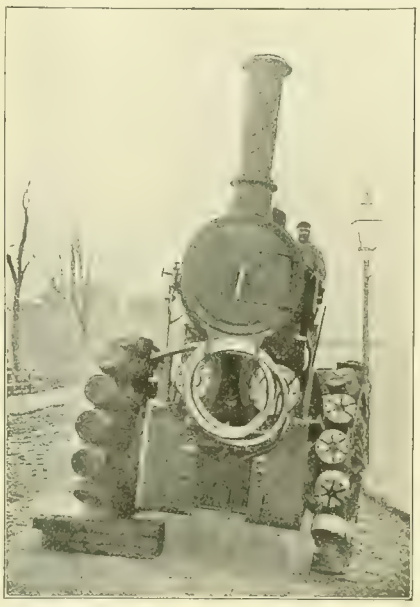
DIPLOCK'S PEDRAIL.—DIAGRAM SHOWING FRAME ON ROLLERS.

from newly developed mines and heavy lumber from partly cleared forests, and would successfully meet the rough emergencies of military operations.

While Professor Hele-Shaw is convinced, after an intimate and close study of road locomotion and the properties of the wheel for many years, that no contrivance can take the place of the wheel and the pneumatic tire in circumstances where the road service is good and the conditions suitable, he is also convinced that the wheel itself has reached its utmost limits of carrying power, both in regard to weight and speed upon the ordinary roads, however well the roads may be constructed or however perfectly the wheel may be made.

The pedrail indicates by its name that it is a rail carried upon feet, and the principle of its action may be explained in a few words. It is simply this: Instead of having a permanent rail carried for the whole of its length on permanent feet, that is, ties or sleepers, and wheels running upon this rail, the process is inverted. The feet are (as in the case of the railway) placed upon the ground, but instead of the rails being carried upon the feet, these feet support wheels, and the wheels thus supported act as bearers for a short length of rail attached to the moving carriage.

The fundamental idea itself is not a new one. "You may see in many timber yards," says Professor Hele-Shaw, "that the logs are moved about by being pushed over supports which carry wheels, and by shifting these supports from place to place the heaviest logs of timber can be rolled upon the wheels to any required part of the yard. The pedrail invention, however, does more than this. The feet and wheels which they support are attached to the moving carriage itself, so that, by an automatic process, the feet are carried round after the rail is moved over them and placed again in front of the machine, thus affording a continuous track of wheels upon which the supporting rails can be carried in any direction in which the vehicle is steered.

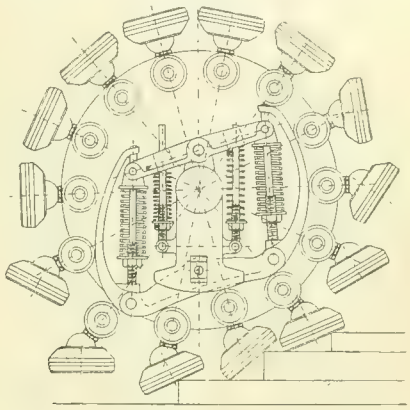


DIPLOCK'S PEDRAIL.—ENGINE CLIMBING OVER OBSTACLE

"Briefly, the invention might be described as replacing the wheels of an ordinary traction engine by revolving frames carrying sliding spokes, each spoke having at its end a circular foot, and on the spoke itself, at a little distance above the foot, a small wheel or roller. In connection with each series of revolving spokes a fixed frame is attached to the side of the traction engine. This fixed frame somewhat resembles in form an inverted heart. When the axles revolve the spokes are carried round, and in turn place the feet upon the ground. At the same time the wheels, which run round in contact with the heart-shaped frame, when brought underneath it—that is, under what may be described as the broader portion of the heart—act in turn as supports for the heart-shaped frame to glide over. Hence the engine is itself supported in turn through the wheels by the spokes which happen at the time to be resting with their feet upon the ground.

"The pedrail consists of two main parts, one of which is a railway which is fastened to the axle box, and does not revolve, and the other part is a kind of circular box carrying sliding spokes, rollers and feet in such a manner that the rollers and feet are placed in succession on the ground, and the rail runs over them. It has attached to it a four-ton crane, so that it can lift and carry heavy goods, minerals, or agricultural produce. * * *

"This engine I have myself tested at Stoke-on-Trent under the most trying conditions. I took it up the steepest hill—practically a mountain—which I could find in the neighborhood, threw down large stones in its path, over which the feet simply set themselves at an angle and did not crush them, though the wheels of a heavy traction engine immediately crushed and distorted the road surface. I made this machine walk over three-inch, then six-inch, and finally a nine-inch balk of timber thrown down in its path, and I could scarcely believe that the whole structure was not permanently distorted and damaged, whereas it was well within the limits of play allowed by the mechanism. Finally, it walked up the lane to the works in the softest ground, where there were ruts of eight and 10 inches deep, with the greatest ease.

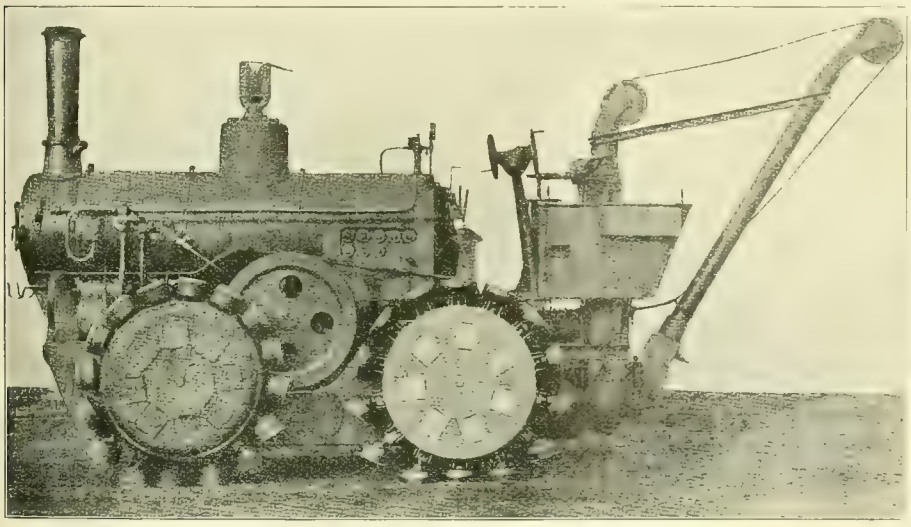


DIPLOCK'S PEDRAIL.—POSITION OF FEET IN MOUNTING STEPS.

"On another occasion, in a trial at Lincoln, owing to the unskillful handling of the man at the wheel, the engine got into a position in which I thought it must infallibly overturn in the soft bank into which it had fallen, and while I was discussing how it should best be got out, the application of steam by the driver caused it to walk out of its difficulties in a way which I can only describe as like that of a cat.

"The action of the pedrail on the road is very remarkable. Whereas the ordinary traction engines destroy roads to such an extent that they have been forbidden in many parts of this country and also in various parts of the world, and heavy motor wagons and traction engines have been severely taxed by local authorities and made to contribute to the repair of the roads, the pedrail positively improves the road over which it walks. This has been proved by actual experiment, and it is more than probable, from the remarks of an eminent municipal engineer, that the pedrail is destined to entirely replace the road roller for repairing roads, as the action of stamping or ramming is much better than rolling for this purpose."

It is said that the pedrail can, by certain modifications, be attached to any ordinary traction engine. Obviously, it is perfectly well adapted for electric drive, a source of current being provided.



DIPLOCK'S PEDRAIL.—SIDE VIEW SHOWING FEET ON WHEELS.

New Northern Illinois Electric Railway.

It is probable that during the coming season the Aurora, DeKalb and Rockford Electric Traction Company will build its proposed electric railway connecting the three cities named. The route is 26 miles long and lies in one of the most prosperous districts of Northern Illinois. The fact that there are no steam roads in the territory to be served by the proposed road, except at the terminals, has led the officials to believe that an extensive freight business can be conducted in connection with the passenger traffic, and this branch of the project is receiving special attention. At present plans are being drawn preparatory to letting the contract for construction. W. D. Ball of Chicago is the consulting engineer. Although the system to be used on the new line has not been definitely decided, Mr. Ball states that either the third-rail (direct-current) or single-phase motors will be used. The company does not expect to build a power house at present, but is negotiating for the purchase of power from one of the power companies at the terminals.

The Chippewa Valley Electric Railway Company has mortgaged its property for $750,000 to the Security Trust Company of Camden, N. J. The property mortgaged includes all the property owned by the company in Eau Claire and Chippewa Falls, Wis. Of the sum, $250,000 will be used for building new lines.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

American Institute of Electrical Engineers (next meeting of the Chicago branch), rooms of Western Society of Engineers, Monadnock Building, March 8th.

Iowa Telephone Association (annual convention), Savery House, Des Moines, March 8th, 9th and 10th.

American Electrochemical Society (annual business meeting), Washington, D. C., April 7th, 8th and 9th.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

WITHOUT in any way reflecting on the merits of the other candidates, the Western Electrician may be permitted to express its pleasure that the members of the American Electrochemical Society have presented to them the opportunity of electing as their president such a worthy candidate as Dr. Henry S. Carhart of the University of Michigan. Dr. Carhart announces his candidacy in this issue of the Western Electrician. He is professor of physics and director of the department of electrical engineering at the University of Michigan and a man who needs no introduction to the electrical fraternity. He attended the Paris Exposition of Electricity of 1881 as one of the international jurors of award for the United States and was one of the official delegates to the International Electrical Congress held in Chicago in 1893. In 1889 he was president of the Physics Section of the American Association for the Advancement of Science. His standard cell for the measurement of electromotive force is now in use in all of the leading physical laboratories of the United States. Dr. Carhart is the author of several books on physics and more purely electrical subjects and is justly regarded as one of the leading physicists of his country. He is well worthy of the position of president of the American Electrochemical Society, not only by reason of his professional attainments, but because he is a man possessing the true scientific spirit combined with the highest ideals of character and conduct—ideals of the sort that scientific and technical societies should cherish jealously in this intensely commercial era, when money-getting is apt to be given undue prominence in the scheme of human affairs.

A BRITISH medical journal directs renewed attention to an old subject—the need of a universal language. It points out that "The linguistic difficulty has become one of the greatest hindrances to scientific progress, and the steadily increasing number of workers throughout the world, while tending to make research more fruitful, at the same time limits more and more the diffusion of knowledge of its results. The cause of the evil being the multiplicity of tongues, the remedy is clearly to be found in the use of a common language."

This is true of all branches of science, including physics, and of engineering. The time lost in acquiring foreign languages is very great, and the misunderstandings that arise between individuals and nations, owing to imperfectly communicated ideas, is incalculable. It is a great pity that this confusion of tongues exists, and a universal language would be of stupendous advantage to the human race.

It is too much to expect that there will ever be an absolute universal language—that is, only one language in use in the whole world; but it is barely possible that, by concerted action, the various peoples might adopt a common language as a secondary mode of speech. Thus every nation might retain its own vernacular, while all international intercourse, all books of science and serious literature could be transacted or printed in the world language. But while the scheme is a possibility, and is worthy of some study, it is beset with enormous difficulties. What language shall be chosen—the English, the French, the German, the Spanish? Each of these will have its advocates, and there will be pleaders for other tongues also. To meet this objection a brand-new language may be invented. But made-to-order languages have been tried before this, and have failed to arouse anything like world-wide interest. A still more serious objection is that even if a common speech could be agreed upon, there would still be, of necessity, a great body of literature in each country which the world language would not reach. It is but too evident that the attainment of a really universal language seems absolutely hopeless, while the path to the universal use of a secondary language in such a way that a man would need to learn but one language besides his native tongue seems to be beset with almost insurmountable difficulties. But how great a thing it would be if, for instance, the student of electrical literature in this country had open to him the electrical books and publications of the whole world, printed in a language in which he and every other boy had been instructed in the primary schools! For, of course, if a common language could be adopted, instruction in that language would begin in the earliest grades of the elementary schools. Perhaps the nations of the world might, acting in concert, contribute the price of a small cruiser to pay the expenses of a congress of philologists to determine whether something cannot be done to draw nearer to a goal so rich with benefit.

FIVE men were indicted by the grand jury as being responsible for the terrible fire in the Iroquois Theater on December 30th, by which 575 persons lost their lives. Three of these—Manager Davis, Treasurer Noonan and Stage Carpenter Cummings—are connected with the theater company and are charged with involuntary manslaughter. The remaining two—Building Commissioner Williams and Building Inspector Laughlin—are City Hall officials and are charged with misfeasance in office. No bills were voted in the case of Mayor Harrison and Fire Marshal Musham, held by the coroner's jury, as direct responsibility could not be traced to them. Electrical men will observe with much interest that the jury did not indict McMullen, the man who operated the arc "spot light" from which the stage drapery caught fire. It was held that while this man might be technically guilty, in that he did not refuse to operate the light, knowing it to be in dangerous proximity to the drapery, yet the fact that he reported the danger exculpated him in fact, if not in law, from responsibility. It is gratifying to note that the grand jury finds the electrical apparatus in no wise in fault. It is shown that in its incipiency the flame could easily have been extinguished by the use of proper apparatus for extinguishing fire, and which are required by the city ordinances, and, further, "That in spite of every other agency, accident or cause, if any, the approximate cause of death met by the 575 victims was the neglect to provide the fire apparatus required by the ordinances." It is thus officially determined that this awful fire was not of electrical origin. All electrical men will rejoice that such is the case.

A FEW evenings ago a high-tension wire became crossed with a telephone line in a large western exchange. Seventy-five miles away the unwelcome current entered the toll switchboard of a city office and set fire to one of the celluloid designation strips. Fortunately the toll operator at hand possessed a cool head and whipped out the flames with a dust cloth instead of becoming panic-stricken, running away from the danger point and letting a calamity loose upon the company's business, as another might have done.

Three striking lessons are born of this incident. The operator's presence of mind is a strong argument in favor of strict discipline; the absence of specific fire protection points to the necessity of greater precautions in future inside telephone offices, and, finally, the breaking out of a fire so far from the place of contact is a grave comment upon the dangers of improperly protected high-tension crossings with signaling circuits. It is not so difficult to secure properly disciplined operators, and the installation of fire extinguishers, sand pails, blankets, etc., is a matter of comparatively small expense and good judgment. These, however, are cures rather than preventives. The fact is that telegraph, telephone and power companies are to-day approaching a serious situation in relation to the protection of their lines. While it is true that the power company has little to fear from the physical crossing of its lines with signaling currents, it is equally evident that it may be liable to heavy financial damages in case it is at fault, while the signaling company is in every case vitally concerned in keeping heavy currents off its circuits.

Unless systematic measures are taken to relieve all crossings of lines carrying 5,000 volts and upward from the dangers of falling upon or permitting contact with signaling wires, we may hear of heavy fire losses and perhaps the sacrifice of human lives as time goes on. The means of protecting signaling circuits from high-tension crosses are well suggested in the latest regulations of the National Board of Fire Underwriters, and it is gratifying to note that these instructions have often been carried out with great thoroughness, particularly in some of the Rocky Mountain regions of Colorado. In no instance that can be mentioned is the old adage about the ounce of prevention more applicable than in the separation of power telegraph and telephone lines beyond possibility of contact.

Great Northern and City Electric Railway of London.

[From the London correspondent of the Western Electrician.]

London, February 10.—Since the opening of the Central London Railway in 1900 means of underground communication in London have remained at a standstill so far as the practical operation of new lines is concerned. Of course several new tube railways have been authorized, including those which have been acquired by Mr. Yerkes, but these latter are not in a particularly forward state of construction. One of the lines for which parliamentary sanction was secured some years ago, however—the Great Northern and City Railway—will be opened for public service in about a month's time. The inauguration was confidently anticipated to take place at the beginning of February, but at the last moment the inspecting officers of the Board of Trade were not satisfied with a few of the details, and the necessary alterations will occupy about a month.

In point of length the line is of no great importance, but there are several interesting features in connection with the railway. In the first place it forms an important and additional means of communication to the city from the northern suburbs of London. From north, south, east and west complaints have long been heard that the existing steam-railway companies are totally unable to adequately cope with the enormous traffic which leaves the suburbs in the morning and returns in the evening. In the north of London the Great Northern Railway Company, an old-established steam concern, has a terminus for its several urban lines at Finsbury Park, and from this point trains coming from three or four different suburbs have to travel over the same set of rails to the city. Obviously great delay must, and does, occur, but the Great Northern and City Electric Railway has been designed to commence at Finsbury Park, and from thence it travels to the city by a shorter and more direct route, and will afford just the relief which has been so badly wanted for many years. Owing also to the connection which the railway will make with the main lines of the Great Northern Company, it is anticipated that over the short distance of under five miles considerably more than 10,000,000 passengers will be carried per annum.

A feature of engineering interest is the size of the tunnels, for it is the first electric railway to be built in this country with tunnels of sufficient size to accommodate the ordinary rolling stock of steam railways. The tunnels are 16 feet in diameter against 11 and 12 feet on other underground electric railways. This extra sectional area also has permitted of a concrete footpath being placed between the running rails, so that the degree of danger present in the older tube railways from fire or any accident from other causes is largely eliminated, as the passengers are thus afforded a means of egress from the tunnels without fear of electric shock. Another modification of existing tube-railway practice is the use of two conductor rails, but a few of the chief engineering details will be dealt with later.

The line was sanctioned by Parliament as far back as 1892, when there was some talk of considerable financial help from the older Great Northern Railway Company, the object being to run through trains from the steam on to the electric lines, and so obviate the necessity for a change at Finsbury Park. For some reason the negotiations were broken off, and consequently the electric-railway company, without private financial assistance, had to remain quiescent during the period of "slump," which occurred between the years 1892 and 1900 in electric traction. Consequently it was not until 1899 that the construction of the railway was commenced. The capital subscribed for amounted to over $10,000,000. The Great Northern Railway Company did, however, provide some capital eventually, and it will still be possible for a through service to be run.

Dealing first with the power house and its equipment, it may be stated that the site is situated a little away from the center of the line toward the city and is well supplied with water from the canal. There are four main engines of the vertical cross-compound type having a normal capacity of 1,250 horsepower, directly coupled to over-compounded railway generators, each of 800-kilowatt capacity. There are also two smaller sets, the dynamos of which have an aggregate capacity of 240 kilowatts for lighting the power house and driving the auxiliary machinery. There are 10 Economic boilers, each capable of evaporating 11,200 pounds of water an hour. They are fitted with automatic stokers. An electrically driven coal-conveying plant has been installed. The switchboard has 16 panels, and the cables are run down a special cable shaft into the railway tunnel. The generating plant of course runs condensing

The working tunnels are 16 feet in diameter, as already stated, but at the stations they have a diameter of 23 feet. The running rails are of the standard gauge. The conductor rails, which are two in number, are placed on either side of the running rails outside and are of soft steel, supported on eathenware insulators. Current is fed to the conductor rails directly from the generating station at 500 volts. In all other London tube railways the conductor rail is placed between the running rails, the latter being used as the return.

The trains, which will consist of three motor cars and four trailers, will have a seating capacity of 386 passengers. The distribution of the motor cars will be one at each end and one in the middle of the train. They are all of the corridor type, with transverse seats. Each motor car is equipped with two 125-horsepower motors. The multiple-unit system of control has been adopted. There will be a three-minute service, the journey occupying about 14 minutes.

The tunnels are provided with lamps every 100 feet, and the circuits are quite distinct from the traction bus bars at the generating station, although special switches are provided for transferring the lighting load to the conductor rails. All the tunnel lamps are incandescents, the stations being illuminated by means of arc lamps. G.

Waterpowers of Low Head.

In Switzerland the electrical engineer is steadily co-operating with the waterpower engineer, and all over the country, writes Philip Gibbs in the London Express, electrical installations are rapidly increasing in number, so that already the largest and most prosperous factories derive their motive energy from this means. The rivers and falls of Switzerland are, of course, mere driblets compared to those of Canada, the United States, New Zealand, Norway and Sweden, India and Central and Southern Africa, where the great sources of the world's waterpower are stored.

But Professor Steiger, who is largely responsible for the Swiss installations, expresses the opinion that "excellent results may be obtained from a very low fall, even so low as three feet." This distinguished engineer has arranged a turbine installation at Brantham Mills, near Manningtree, in Essex, England. It is a modern flour mill on the banks of the River Stour, which has a tidal fall of four feet 10 inches at the ebb tide. The amount of power required for the electric motors is equal to 40 horsepower, yet this has been produced successfully by a fall of only 32 inches. Similar turbines have been erected by this electrician at Norwich, Reading and Lewes.

In Professor Steiger's opinion a vast amount of waterpower is running to waste even in England, where the rivers are comparatively small and the fall is low.

It must be said, however, that the general opinion of electricians in England, headed by Professor S. P. Thompson, is against the Swiss electrician's opinion that the manufacturing industries of Great Britain may be carried on to any large extent by the waterpower of these islands. They considered that the rainfall is too variable, and the fall of the rivers too insignificant to be a trustworthy source of electric energy. Nevertheless, Mr. Gibbs concludes by the observation that it is not too much to say that the world powers of the future will be determined by the watersheds of the earth's surface.

COMMUNICATION.

Dr. Carhart Announces His Candidacy.

To the Editor of the Western Electrician:

In common with most of the directors of the American Electrochemical Society I signed a petition for a constitutional amendment making the president, vice-presidents and managers ineligible for re-election. I must therefore decline to be a candidate for re-election to the office of vice-president, for which, I am officially informed, I have been nominated.

At the same time, in view of the very handsome vote which my friends have cast for me in nomination for the presidency of the society, and of the fact that the board of directors is not indorsing anyone for that office, I announce myself as a candidate for the presidency. HENRY S. CARHART.

University of Michigan, February 16, 1904.

[The next annual business meeting of the American Electrochemical Society will be held in Washington, D. C., April 7th, 8th and 9th.]

During a recent severe sleetstorm which passed over Louisville, Ky., a few days ago the street-car service was wholly suspended for a short time. The service was resumed, however, by placing a man on top of each car to remove the ice from the trolley wire, only a few cars being run at first.

Electrolysis for the Separation of Metals.

"Some Applications of the Theory of Electrolysis to the Separation of Metals from One Another" was the title of a paper by Mr. Hollard recently read in abstract by Dr. F. M. Perkin before a meeting of the Farady Society in London.

The only principle hitherto involved in electrolytic separations has been based on the method of successive potentials, each metal depositing at the potential proper to that metal. In practice this principle has only been applied to metals (copper and silver, silver and bismuth, mercury and bismuth), whose polarization potentials are lower than that of hydrogen. Metals whose polarization potentials are higher than that of hydrogen cannot be separated by gradual increase of the electromotive force on account of the extremely small fraction of the current then used to precipitate the metal, hydrogen ions carrying most of the current. The author has therefore made use of three other applications of the theory of electrolysis.

One of these methods is by the reduction of the resistance of the bath by suppressing the formation of gas at the anode. The current may thus be increased in two ways. (1) By suppressing the liberation of oxygen at the anode. To effect this a reducing agent such as sulphurous acid may be introduced. The same potential will then greatly augment the current and hasten precipitation. The method has been successfully applied to the separation of nickel from zinc. (2) By the use of soluble anodes. The anode must replace in the solution the metal that is to be separated, and that only, and it must be immersed in the solution of an indifferent salt, a membrane separating the anolyte and catholyte. Obviously an external source of electricity is unnecessary. The nickel-zinc separation is again given as an example, the operation being described in detail. In this case there is a limit to the relative quantities of zinc and nickel that can be separated. For, by Nernst's formula,

$$e = \frac{k}{v} \log \frac{P}{C} - \frac{k}{v'} \log \frac{P'}{C'},$$

where e is the electromotive force between the metals, k a constant for a definite temperature, v and v′ the valencies, and C and C′ the concentrations of the precipitating and precipitated metals. When the concentration C of the zinc in the inner cell increases e will diminish. There must not, therefore, be too much nickel to deposit. The phenomenon is complicated by secondary reactions, which must be taken into account in the cases of other separations, such as concentration electromotive forces, increase of electromotive force due to local action, and migration.

Another application of the theory of electrolysis made use of by Mr. Hollard is the influence of the nature of the cathode. By suitably choosing the metal for the cathode, the liberation of hydrogen may be completely avoided, and the conductivity may be so much increased that the separation of the metals becomes possible. The division of metals into two groups, which can and cannot be deposited from strongly acid solutions, has for its basis the position occupied by hydrogen in the polarization potentials of the metals. But this, as Caspari has shown, varies with the metal of the cathode. Hence by suitably altering that metal, metals can be made to pass from one group to the other, and thus separations, impossible with a platinum cathode, may be effected. The separation of zinc and cadmium (impossible on a platinum cathode) is given as an example. Platinum gauze covered electrolytically with tin and cadmium forms the cathode.

Finally, metals may be prevented from precipitating by the formation of complex salts which dissociate to give not the metallic ions, but complex ions containing the metal. As an example, the separation of antimony and tin in a solution of sodium hydrogen sulphide may be cited.

In the discussion which followed Mr. Blount remarked that Mr. Hollard's method of preparing the cathode by throwing down on it the metal that is to be deposited is one of extreme interest. The accuracy of the first method described was not sufficiently high for ordinary analytical purposes.

Dr. T. M. Lowry, referring to the backward migration of the ions, said that as a rule this is much more strongly marked with a membrane than with a porous-pot partition. Hittorf has recently been again working on this very subject.

Five Men Indicted for Iroquois Fire.

Of the eight men held responsible for the Iroquois fire by the coroner's jury, four have been indicted by the grand jury. They are Will J. Davis, president of the Iroquois Theater Company; James E. Cummings, stage carpenter; George Williams, commissioner of buildings, and Edward Laughlin, inspector of buildings. Thomas J. Noonan, treasurer and assistant manager of the theater company, is also indicted. A "no bill" was voted in the case of William McMullen, [illegible] flood lights, one of which set fire to the draperies. In the case of the five men against whom true bills were voted, three—Davis, Noonan and Cummings—are held for involuntary manslaughter; Williams is held for misfeasance and Laughlin for malfeasance.

PATENT LITIGATION.

Oil-cooled Transformers.

Judge Adams, in the United States Circuit Court for the Eastern District of Missouri, has recently handed down a decision favorable to the Wagner Electric Manufacturing Company as defendant in a case brought by the Westinghouse Electric and Manufacturing Company based on the fourth claim of United States patent No. 366,362 granted to George Westinghouse "for new and useful improvements in electric converters." The relief asked for was an injunction restraining the defendant from infringing the claims and an accounting. This litigation was started by a suit against the Union Carbide Company of Niagara Falls, which the Wagner company defended. The decision in that case was favorable to the Westinghouse company on one of the five claims of the patent (claim 4), the other four claims being withdrawn in the litigation. The Wagner company thereafter modified its transformer construction, but two years later the Westinghouse company endeavored, through proceedings in St. Louis, to apply the decision to the Wagner Company's present form of oil-cooled transformers. An effort was made to secure a preliminary injunction against the Wagner company's present transformer, but Judge Amadon denied the injunction, and the case went on to final hearing on the merits. Judge Adams' decision is the next step. As the case is of considerable interest to the electrical fraternity, an abstract of the opinion is here given:

"The present action is based on the same claim (4) and no controversy is now made except on the issue of infringement. Defendant contends that this present device is so different from the device involved in the carbide case that the judgment in that case is not res adjudicata of the present issue of infringement, and that in fact the defendant's device does not infringe claim 4. The only question for decision therefore is—whether the defendant's device constitutes an infringement of claim 4 of the patent in suit. The invention of the patent relates, according to the specification, 'to the construction of a class of apparatus employed for transforming alternating or intermittent electric currents of any required character into currents different therefrom in certain characteristics,' and the object of the invention according to the specification is 'to provide a simple and efficient converter which will not become overheated when employed for a long time in transforming currents of high electromotive force, and which will be thoroughly ventilated.' The claim in question is as follows:

"'(4) The combination, substantially as described, of an electric converter constructed with open spaces in its core, an inclosing case, and a nonconducting fluid or gas in said case adapted to circulate through said spaces and about the converter.'

"Complainant claims that the converter, now commonly called a transformer, manufactured by the defendant, infringes claim 4 in three particulars: First, because there is an open space between the coils themselves; second, because there is a rectangular opening inside of the core through which the coils pass, and third, because there are open spaces between the core and the coils.

"The question for determination is: Whether either of these three spaces or openings constitute 'open spaces in its core' within the true meaning of claim 4 of the patent. I have reached the conclusion that the defendant's transformer does not, by reason of either one or all of the above-mentioned features, have 'open spaces in its core' within the true meaning of the patent in suit."

Judge Adams then compares the two devices at length, pointing out a great dissimilarity, and after reviewing the litigation up to date continues:

"If the patent in suit were a broad and valid patent for a circulatory system throughout the heat-producing parts of a transformer, the two devices might be the mechanical equivalent, but it is not such a patent. It is distinctly a patent for a machine involving physical elements, and I cannot bring myself to think the spaces of the defendant's device between the core and the coils are the same as the open spaces in the core of complainant's device, or the mechanical equivalent thereof. They may perform the same function, but they do it by means of different physical elements, and the defendant's device is constructed at the expense of efficiency which the complainant's device avoids.

"The problem for years before the grant of complainant's patent was to devise efficient means for cooling the heat-producing surfaces of the transformer and for protecting the insulation of the

"The complainant invented the physical means shown in claim 4. The defendant adopted the totally different physical means shown in its model. In view of the foregoing I cannot construe the opinion in the Carbide case as giving the complainant the monopoly of all means by which the external and internal surfaces of the heat-producing parts of a converter can be cooled. This view would preclude the use of any and every other device looking toward the accomplishment of the main object, namely, the circulation of oil throughout the heat-producing parts of a converter. * * *

"My conclusions are: First, that the transformer now being used by the defendant is not within the true meaning of the patent itself an infringement of claim 4; second, the construction which I have placed upon this claim is in harmony with the cotemporaneous and continuous construction placed upon the same claim by the patentee himself, and by the complainant; third, the complainant by its own conduct is estopped from claiming the contrary.

"The decree will be that the defendant be enjoined from manufacturing or selling the transformer like that declared an infringement in the Carbide case, and for the usual accounting, but will be so framed as to exclude from its operation the transformer now manufactured by defendant, which has afforded the only issue before the court in this case.

"I am not disposed to work out the question of costs through the statute relating to disclaimer, as that involves a lengthy consideration of the question whether the complainant should not before bringing this suit have entered a disclaimer as to claims 1, 2 and 5 of the patent. * * * I think an equitable disposition of this matter is to require each of the parties to pay its own costs, and it will be so ordered."

Tesla Patents.

Judge Seaman of Milwaukee, in his decision adverse to the Westinghouse Electric and Manufacturing Company in its case against the National Electric Company asking for a preliminary injunction under a bill alleging an infringement of the Tesla patents for electrical transmission of power and for specific motors, gives the first adverse ruling on the Tesla patents. The patents in the suit are Nos. 381,968 and 382,280 for the fundamental invention, and Nos. 381,969 and 382,281 for specific means. A report of the ruling in this case was published in the Western Electrician of February 13th, but the following abstract of Judge Seaman's opinion will be of interest:

"The fundamental patents (so called) have been upheld and the scope of invention therein passed upon in several cases. They were directly involved in the New England Granite Company case in the Second Circuit, and the decree on final hearing (103 Fed., 951) was affirmed (110 Fed., 753) on appeal; both opinions are instructive, and in respect of the validity of the patents at least are deemed controlling for the purposes of this motion. Upon application for a preliminary injunction in Royal Weaving Company case, in the Rhode Island district (115 Fed., 733), the French patents of Dumesnil and Cabanellas (which were not before the courts in the first-mentioned case) were introduced, and are well considered and distinguished from the invention in suit in the opinion of Judge Brown granting an injunction. In the case against H. C. Roberts and Sangamo Electric Company, in the Eastern District of Pennsylvania, subordinate patents were involved, but Judge Archibald reviews the question of fundamental invention in an excellent opinion upon final hearing.

"The present application is governed by the settled rule in this circuit, which entitles the complainant to the benefit of these adjudications by way of presumptive right to an injunction against other infringers of the patents so upheld when the infringement is undoubted. Such rule, however, excludes the specific patents (Nos. 381,969 and 382,281) from consideration in so far as the issue of infringement rests upon the devices there shown, for the reason that neither adjudication of their validity, no public acquiescence therein, as demanded by the rule, appears in evidence. The presentation of these derivative patents in the bill does not aid the motion for preliminary injunction under the rule referred to, whatever may prove to be their bearing upon the issue of infringement at final hearing, but infringement for the purposes of the motion must be tested alone by the patents which have been adjudicated and in the light of their construction as there given, with the modifications imposed by the production of the Dumesnil and Cabanallas patents. Whether the inquiry is materially simplified by such exclusion I am not prepared to say.

"The great advance in the art which was made by Tesla's discovery is not fairly questionable, but difficulty arises, nevertheless, in ascertaining the essence of the invention when the contentions and opinions in the prior cases are read in connection with the record and arguments in the case at bar. * * *

"The defendant's machine, which is alleged to be an infringement of the patents, is used as a generator and then as a motor alternately. It is claimed that it was constructed for the purposes of a generator, but subsequently utilized to serve as a motor; that it 'always operates as a generator during the period of starting;' that 'at one instant it will be generating currents and at the succeeding instant it will be running as a motor;' that 'in both cases identically the same principles of operation are employed, and they are principles of operation which were well known in the prior art;' that as a motor it is distinctively synchronous and not self-starting, and thus neither within the adjudication cited nor within the contentions on which they were predicated. In other words, the contention is that the Tesla rotating field is not employed in the operation of the motor in the way or for the purposes of the Tesla invention. It is undisputed that the infringing motors in each of the prior adjudications were nonsynchronous; that no case involving the use of a motor operated in synchronism has been brought to final hearing, though such use constantly appeared, while litigation was vigorously prosecuted against nonsynchronous infringers, one instance appearing of continuous manufacture of synchronous motors by a defendant who was under injunction against infringement by a nonsynchronous motor in suit, and this without interference until recently. Explanations of the fact that no such case of alleged infringement has reached hearing is made on the part of the complainant, and while the explanation is not unreasonable the fact remains and must enter into consideration upon this motion.

"The question of infringement in the present case under the fundamental patents depends upon the scope of invention and involves a broader construction than was involved in either of the prior cases. I am not sure that the contentions on behalf of the complainant in the prior cases are consistent with the construction now sought to reach the alleged infringement. In this view I am not prepared to conclude that infringement appears beyond question or unreasonable. Recognizing the protection due to the owner of the patents on the strength of the decree upholding their validity and scope—of special importance under the circumstances disclosed here—I have carefully examined to that end much of the expert testimony, and while I am impressed with the force of the contention urged on behalf of the complainant as to the true advance in the art made by the Tesla discovery and the scope of invention therein, the issues now raised require hearing upon complete proofs. So considered, discussion of the merits of the present controversy is unnecessary and inadvisable, and the motion for preliminary injunction must be denied."

Repulsion-motor Patent.

Another decision favorable to the Wagner Electric Manufacturing Company was handed down by Judge Adams in St. Louis on February 13th. The case was brought by the Thomson-Houston Electric Company (now, of course, absorbed in the General Electric Company) and involves Thomson patent No. 363,186—the so-called Thomson repulsion-motor patent. Under this patent a decision favorable to the General Electric Company was secured against the Dayton Fan and Motor Company several months ago. This proceeding, brought in the St. Louis court, was an effort to enjoin the Wagner company on the ground that its motor was the practical equivalent of the Dayton fan motor.

Judge Adams denied the preliminary injunction, saying that as there is a sharp conflict between the parties as to whether the defendant's motor is an infringement of complainant's patent, the issue is dependent for its determination upon the correct application of the laws of physics, and practically those governing the action and application of the electric current, and must therefore await a hearing on the merits.

The complainant's patent will expire on May 16, 1904. The defendant has for six years been manufacturing and selling the motor now said to be an infringement. In view of these facts Judge Adams concludes:

"I think it would be a very harsh and inequitable remedy to now, before final hearing, enjoin the defendant as prayed for and interfere with the prosecution of its established business for the short period of three months only. The benefit or advantage to complainant of such an injunctive order is out of proportion to the injury and disadvantage which the defendant would necessarily suffer if such an order should be made. The granting of such an order at the present time and under the conditions already referred to would, in my opinion, be an abuse of discretion."

National Electric Light Association.

Recent additions to the active membership of the National Electric Light Association comprise the following-named companies: Montgomery Light and Water Power Company, Montgomery, Ala.; Hot Springs Water Company, Hot Springs, Ark.; Monterey County Gas and Electric Company, Monterey, Cal.; Moscow Electric Light and Power Company, Moscow, Idaho; Freeport Railway Light and Power Company, Freeport, Ill.; Richmond Light, Heat and Power Company, Richmond, Ind.; Keokuk Electric Railway and Power Company, Keokuk, Iowa; Waterloo and Cedar Falls Gas and Electric Company, Waterloo, Iowa; Electric Railway, Light and Ice Company, Junction City, Kan.; Clinton Gas Light Company, Clinton, Mass.; Great Barrington Electric Light Company, Great Barrington, Mass.; Edison Sault Electric Company, Sault Ste. Marie, Mich.; Edison Electric Light and Power Company, Amsterdam, N. Y.; Allegheny County Light Company, Pittsburg, Pa.; Newport and Fall River Street Railway Company, Newport, R. I.; Bristol Gas and Electric Company, Bristol, Tenn.; Burlington Light and Power Company, Burlington, Vt.; Washington Water Power Company, Spokane, Wash.

Ford, Bacon & Davis and the American Conduit Company of New York city, and B. D. Nath and William Thomas Taylor of Schenectady have been elected associate members.

Nearly 200 questions have already been received for the question box of the twenty-seventh convention of the association to be held in Boston on May 24th, 25th and 26th. The preliminary list will be sent out soon and answers called for. If Mr. Hartman is as successful in getting answers as he

has been in gathering questions he will far surpass even the excellent work he did last year in this department.

Electricity in Mines in Great Britain.

[From the London correspondent of the Western Electrician.]

London, February 10.—For the last two or three years reference has frequently been made in the technical press here to the development and possibilities of electricity in mining work. Whether England has been more backward in this matter than other countries, I do not pretend to know, but it is a fact that hitherto the application of electricity to mining operations has been under no official supervision, and that the only regulations imposed upon a colliery owner who chose to adopt electrical methods, were those evolved by the fire insurance company. As the result of one or two more or less serious accidents, and the greater attention paid to electrically driven mining machinery by manufacturers, this peculiar state of affairs was brought to the notice of the government, and in October, 1902, a committee was appointed to inquire into the use of electricity in coal and metalliferous mines and the dangers attending it, and to report what measures should be adopted in the interests of safety by the establishment of special rules or otherwise. The committee consisted of a Home Office official, two mining experts, one electrical engineer and two of his majesty's inspectors of factories. For six months the committee heard evidence from various people, and the report which it has just issued makes interesting reading.

In all, 56 gentlemen were examined, and these were classified as follows: (1) Scientific experts, electrical engineers, and manufacturers of electrical apparatus; (2) colliery proprietors and managers; (3) miners' agents and miners; (4) safety and electrical fuse makers, and representatives from an insurance company. A large number of visits were paid to collieries in South Wales, the Midlands and the north of England.

The report starts off by dealing with the uses of electricity, and concludes from the evidence that at the present time there is a strong leaning on the Continent of Europe to the use of three-phase current, whereas in America the tendency would appear toward the use of continuous-current plant. In England, the committee states, the use of the three-phase system has been somewhat restricted, but it seems probable that in the near future its employment will be largely extended, owing to the advantages it presents for transmitting power from a central generating station to scattered collieries, and its adaptability for obtaining varying voltages by means of transformers. In the committee's opinion this system deserves the careful attention of all who intend to install electricity in mines.

After a deal of comment as to the dangers of electricity and the necessity for regulation, the general principles governing installations are discussed. These are set out as follows: (1) The electric plant should always be treated as a source of potential danger. (2) The plant in the first instance should be of thoroughly good quality, and so designed as to insure immunity from danger by shock or fire, and periodical tests should be made to see that this state of efficiency is being maintained. (3) All electrical apparatus should be under the charge of competent persons. (4) All electrical apparatus which may be used when there is a possibility of danger arising from the presence of gas should be so enclosed as to prevent such gas being fired by sparking of the apparatus. Where any machine is working every precaution should be taken to detect the existence of danger, and, on the presence of gas being noted, such machines should be immediately stopped.

Observations are then made, in the report, upon the various applications of electricity to mining work, and the general principles which should be followed are laid down. It is unnecessary to follow these through in detail, as many of them will be obvious to those who study the subject, but a few extracts here and there will be interesting. For the purpose of this portion of the report, the subject is divided into nine groups: (1) Generating stations; (2) cables, switches, fuses, etc.; (3) stationary motors; (4) portable motors for coal cutters, drills, etc.; (5) electric locomotives; (6) electric lighting; (7) shot firing; (8) signaling; (9) electric re-lighting of safety lamps.

It is recommended that all high-voltage conductors should be painted some distinctive and conspicuous color. In connection with the cables it is suggested that they should be placed out of reach. Except where locomotives are employed, or under other very special circumstances, an earthed return is inadmissible. Preference is given to the cables being carried down the downcast shaft, but where existing circumstances involve an alteration of such a recommendation—such as where the downcast shaft is much encumbered with the timber—the committee shrinks from making it a hard and fast rule in this matter. Fuses or circuit-breakers to each motor are advised, but, from the purely electrical point of view, warning is given against overloading the motors of coal-cutting machinery. Fuses are not entirely reliable, but in any case a waste of time is occasioned.

With regard to haulage, it is pointed out that, although electric haulage has been successfully employed in America, it has not yet come into use in this country. It is quite conceivable that where the roads are so tortuous as to render haulage by ropes difficult or impossible, the most feasible method of drawing the coal or mineral to the shaft bottom will be by means of electric locomotives. Sparking at the trolley wire, however, renders this system impossible in mines where there is danger to be apprehended from the ignition of gas. Therefore its employment in mines free from firedamp can only be considered. In these circumstances it is only necessary to keep inflammable material away from the wires and electrical apparatus. The question of electric shock presents some difficulties, but by keeping the trolley wires seven feet above the track, or by totally prohibiting traveling along the roads during the time haulage is taking place, the risk of accidental shock will be largely eliminated.

The rules recently issued by the Institution of Electrical Engineers are considered by the committee to be amply sufficient to insure immunity from risk by fire. Electric miners' lamps, however, are not so thoroughly recommended, owing to the disadvantage of their not being gas detectors.

Electric signaling is also favored, but at the conclusion of the report the committee says that it wishes to impress emphatically on both colliery owners and managers that the ultimate responsibility of installing or using electricity in mines should, and must, rest with them. All that the rules proposed can do is to provide for general conditions and circumstances.

The report also deals with the somewhat important point of what shall be done with existing installations. The opinion is expressed that although these may not conform in all respects to the standard regulations suggested, it will be fair to leave them whenever it can be done without danger to the workmen. The committee therefore thinks that the case will be best met by giving the inspectors power to require such parts of the existing installation as they think necessary to be brought into conformity with the new rules.

The set of rules attached to the report is very long, and deals in detail with the mine headings mentioned above, as well as some other general and miscellaneous details. G.

Allis-Chalmers Company Makes an Important Announcement.

As before published, the Allis-Chalmers Company, which has hitherto confined itself principally to the manufacture of steam engines, pumping and mining machinery, has now widened its scope to include the manufacture of steam turbines, hydraulic machinery, gas engines and electrical machinery. The plans of the company are outlined in the following official announcement issued by Vice-president W. J. Chalmers:

"As regards steam turbines, we have become associated with and form part of the Steam Turbine Advisory Syndicate of England, which is composed of the Yarrow Shipbuilding Company of England; the Tweedie (Vulcan) Shipbuilding Company of England; Willans & Robinson, engineers and well-known engine builders of England; Mr. Fullager, formerly chief engineer Parsons Steam Turbine Company of England, now consulting engineer for Steam Turbine Advisory Syndicate, and the Allis-Chalmers Company.

"Our turbine is of the horizontal type, which is the type Parsons of England and Brown-Boverie of Switzerland manufacture. We are convinced, after an investigation by our engineering staff in Europe and elsewhere, extending over a period of two years, that we have a steam turbine that is, at least in efficiency and economy, equal to the best make of Parsons or Curtis, which are the two types most known. We are now prepared to enter into the building of steam turbines of the following sizes: 500, 750, 1,000, 1,500 and 5,000 kilowatts, and can, if required, build up to units of 10,000 kilowatts. The largest size that has ever been built of any type of turbine is 5,000 kilowatts. Our license from the Advisory Turbine Syndicate concedes to us all of the United States, Canada and Mexico, with equal rights and privileges in South America, and rights to do business elsewhere in the western hemisphere.

"We have concluded arrangements with Escher, Wyss & Co. of Zurich, Switzerland, whereby we become the sole licensees for the western hemisphere of their famous hydraulic machinery, several types of which have been installed at the Niagara Falls plant of the Cataract Construction Company, aggregating 85,000 horsepower. Escher, Wyss & Co. have long enjoyed, and still enjoy, the reputation of being the best-known manufacturers of turbines in the world. We only mention Niagara Falls as one of the plants employing thousands of horsepower installed by Escher, Wyss & Co.

"We have bought the American patents, and have become sole licensees for the western hemisphere of the Nuremberg Machine Company, Nuremberg, Germany, for its gas engines, and are now prepared to make gas engines up to any required horsepower. At the present time we are prepared to build gas engines from 250 to 1,500 horsepower. These engines are suitable for consumer gas or taking the waste gas from blast furnaces and utilizing same with economy and efficiency. It is in the blast-furnace trade that we expect the largest business to result. The engine is not an experiment, but engines of 1,500 horsepower are now in operation in Germany, and it was after two years investigation by our engineering staff of the various gas engines, that we selected the Nuremberg, and have engaged in its manufacture. It is a prime mover either for blowing engines in blast furnaces or for direct-connected dynamos in generating electricity, or for any other purpose where power is required.

"We have engaged in the manufacture of generators, motors and electrical apparatus in all its branches, both for stationary and railroad work, power-house installation for transportation purposes and electric lighting. We have engaged to take charge of this department of our business Mr. John F. Kelly, formerly of the Stanley Electric Company, Mr. William Stanley of the same company as consulting engineer, and Mr. John H. Kelman, formerly superintendent of the Stanley company as superintendent of this department. In addition, we have engaged others of the late Stanley company's staff whose services we can use, and have drawn a further supply from the best electrical establishments in this country and in Europe, so we are fitted out with a complete engineering staff in every branch of the electrical business, and we believe that Messrs. Kelly and Stanley are recognized in the profession as standing equal to the best.

"From the above it will be observed that we have entered the field not only in the line of prime movers, embracing reciprocating engines, in which field we have always led, but also with steam turbines, gas engines and hydraulics; and, with electrical apparatus combined with any one of these prime movers, we are now prepared to estimate upon and accept contracts for complete plants of all description and furnish the best of their respective kind."

I. A. Bennett.

I. A. Bennett, general sales manager for the Electric Appliance Company, Chicago, has resigned his post, to take effect March 1st, and will open the Chicago office of the Phelps Company of Detroit, Mich., manufacturer of the Hylo turn-down lamps and other specialties. Mr. Bennett resigned a position that he has held with the Electric Appliance Company for a considerable length of time, having altogether served with this company for about 11 years, having previously been connected with the Ansonia Electric Company.

I. A. BENNETT.

Mr. Bennett's energy as a sales manager and originality as an advertising man have made him one of the best-known men in the electrical business in the West. Mr. Bennett has also accepted the presidency of the Central Station Publishing Company, which is being formed for the promotion of central-station advertising. His new offices will be located in the Monadnock Building. He will carry a complete line of Hylo lamps and specialties, making shipments from Chicago stock.

The New Approach in Science.

At present the phenomena of physics are, as it were, divided into two camps—acoustics and heat, which are explained from the laws of mechanics, and electricity, with its subdivision, light, which has not been satisfactorily thus explained. For half a century we have tried to explain electricity mechanically, and may be said to have failed. Let us now try to explain mechanics electrically, and see where that will lead us. Perhaps it is a mere matter of words whether we say that all matter is electrically charged or that all matter is modified electricity. But it may lead to the most far-reaching conclusions if, in explaining phenomena, the laws of electricity should be taken as the premise from which we start, instead of, as hitherto, the inertia of matter.—Nineteenth Century.

Telephone News from the Northwest.

It is rumored at Arlington, Minn., that the Nicollet County Telephone Company will build to Arlington, and there establish a local exchange.

The Barron County Telephone Company of Barron, Wis., has been reorganized and the capital stock increased from $2,500 to $25,250. New lines are to be constructed in the spring and improvements made.

An Independent telephone line is planned from Menomonie, Wis., to Rice Lake.

The Dunn County Telephone Company of Ridgeland, Wis., has been incorporated with $10,000 capital stock.

An Independent telephone line out of Garretson, S. D., is projected, to connect with the neighboring towns and townships.

The Northwestern Telephone Exchange Company has just installed a visual-system switchboard at the office in St. Cloud, Minn.

Labor leaders of Duluth and Superior plan a movement against the Bell telephone interests to secure an eight-hour day instead of nine hours, as at present. A strike of electrical workers occurred a year ago, and the Bell companies did not grant the request. It is thought that the trouble may extend to other cities.

The Minnesota Central Telephone Company will reconstruct its telephone system at New Ulm, Minn., at a cost of $10,000.

The Electric Phone Company of Stewart, Minn., has incorporated with a capital of $25,000. H. E. Posely is interested.

The Enterprise Telephone Company was granted a franchise recently at Edgerton, Minn.

The Rural Telephone Company of Flandreau, S. D., is receiving supplies for the construction of a line in the spring.

The Kellerton (Iowa) Mutual Telephone Company will rebuild its system.

The Northwestern Telephone Company will build a line from Hamill to Warren, Iowa.

The Farmers' Mutual Telephone Company has been organized at Palmer, Iowa.

The Marne and Elkhorn Telephone Company of Rorbeck, Iowa, was granted a franchise at Exira, Iowa.

A telephone company has been organized at Sully, Iowa, and will construct lines to Kellogg, Newton and Pella. F. Sherman is president and William Forsythe, secretary.

The Reasnor Telephone Company has been granted a franchise at Monroe, Iowa.

The Winona (Minn.) Telephone Company will build a line to Wiscoy.

L. Trautman, Jr., of Wabasha has bought the Melrose (Minn.) telephone exchange.

The Cokato (Minn.) Telephone Company will construct several rural lines this season.

A farmers' telephone line will be built from Climax, Minn., to Fisher and Crookston.

There is talk of building a line from Lawton, N. D., to Linstad.

The Winona (Minn.) Telephone Company and the Tri-State Telephone and Telegraph Company have entered into a contract and propose to build a line from Winona to Minneapolis and St. Paul. R.

Ohio Telephone Notes.

The Hicksville Telephone Company of Hicksville has increased its capital stock from $25,000 to $40,000.

Representative Judy has introduced a bill in the Legislature providing that the maximum rental for telephones in this state shall be $72 a year.

A combination has been formed between the Hamilton Home Telephone Company of Hamilton, the Darrtown Telephone Company, the Oxford and Indiana Telephone Company and the Morning Sun Telephone Company by which subscribers of any one may use all the others free of charge. The combined system covers about 20 of the best towns within 40 miles of Hamilton.

The directors of the Massillon Telephone Company of Massillon have arranged for the issue of $75,000 new stock, making the total $150,000. This will be sold at once for the purpose of making improvements and extensions.

The Portage County Telephone Company has now 1,566 subscribers in Portage County, and since March 1st over $9,000 has been spent in improvements.

The Waldo Home Telephone Company of Waldo was recently incorporated with a capital stock of $25,000. The incorporators are William Klingle, A. Osborn, M. Lewis, W. D. Kraner and S. Schwanderer.

The plant of the Crooksville Telephone Company will likely be in operation by March 1st. Several farm lines and a toll line from Crooksville to New Lexington will be built at once. The officers recently elected are: President and general manager, J. B. Rhodes; vice-president, H. A. Skidmore; secretary, William Harris; treasurer, J. L. Bennett. C.

Southwestern Telephone Progress.

The Indian Territory Telephone Company, with headquarters at Vinita, has completed its new toll line, from Tulsa to Muskogee. The line runs parallel to the Missouri, Kansas and Texas railroad.

The Oklahoma Rural Telephone Company, with a capital stock of $30,000, has been chartered, with headquarters at Enid. The incorporators are M. M. Davis, W. H. Hatch, G. W. Holliday, S. H. Herrick and T. K. Perry. They propose to build rural lines out of Enid, extending to all parts of Garfield County.

The Glasco Telephone and Telegraph Company of Glasco, Mo., has been chartered, with a capital stock of $6,000. The company will construct and operate telephone and telegraph lines in that vicinity.

The Norwich Telephone Company of Norwich, Kan., has been chartered with a capital stock of $3,000. An exchange in the town and rural lines connecting the surrounding territory will be built. W. A. Meaker is president.

Several Independent companies in Oklahoma and Indian Territory have merged and chartered the Pioneer Telephone and Telegraph Company, with headquarters at Guthrie. The company will build, own and operate telephone lines and district-telegraph or messenger systems. The capital stock was fixed at $3,000,000. The incorporators are James Noble, Oklahoma City; James F. Noble, Shawnee; E. D. Nims, Muskogee; E. E. Westervelt, Perry; Henry E. Asp, Guthrie; George W. Barnes, Toledo, Ohio, and David McKinsley, Perry. K.

Indiana Telephone Items.

The following-named telephone companies were incorporated last week: Liberty Center Telephone Company; capital stock, $2,500; will build and operate an exchange and lines in Liberty Center and Wells County; James P. Mounsey, L. A. Minnear and others are directors. Farmers' Co-operative Telephone Company; capital stock, $1,500; will build an exchange in Wilkinson and lines in Hancock, Henry and Madison Counties; Samuel M. Overman is president. Vernon Township Farmers' Telephone Company; capital stock, $1,000; will build an exchange in Jackson School House and lines throughout Vernon Township; George M. Rumler of Greenfield, Ind., is chief promoter.

The Zionsville Telephone Company has notified its patrons that the rates will not be raised, as had been announced.

The Landessville Rural Telephone Company has increased its capital stock for the purpose of making extensions and improvements. Henry Wine is president, and Rudy Freeman, secretary.

A stockholders' meeting of the Connersville Telephone Company was held at the office of the company recently and subsequently the directors elected George M. Sinks, president; W. T. Edwards, vice-president, and L. A. Frazee, secretary and treasurer. The company has now over 700 telephones in operation.

C. C. Huff, a teacher in Van Buren Township, Grant County, has used the telephone successfully in teaching absent pupils. For about two weeks the family of James Hewitt has been quarantined because of smallpox in the family. Two of Hewitt's sons are anxious to graduate, and therefore Mr. Huff, for the last two weeks, has assigned the lessons to the boys and heard them recite in the evening over the telephone. F.

MANUFACTURERS AND DEALERS.

The Western Telephone Manufacturing Company has leased quarters in the Atlantic Building, 42 West Jackson Boulevard, Chicago, and will move its factory and office to this address on March 5th.

The Ackerman-Boland Telephone Company, with headquarters in Chicago and a capital of $6,000, has been incorporated for the manufacture of telephone and electrical apparatus. The incorporators are Charles A. Ackerman, James F. Boland and J. W. Liggett.

Of much practical value is the little booklet issued by the Stromberg-Carlson Telephone Manufacturing Company, Rochester, entitled "Telephone Troubles." All the more familiar sources of trouble peculiar to bridging telephone lines are given with the remedies, which, in a majority of cases, will be found to put the telephone in working order. Ten "troubles" are enumerated, with several remedies for each.

At the recent annual meeting of the stockholders of the Sterling Electric Company of Lafayette, Ind., a new board of directors was elected, consisting of William Wallace, Charles Murdock, H. A. Taylor, W. E. Doolittle, C. H. Ankeny, W. R. Coffroth, John Wagner, Jr., John Schnaible and A. M. Ramsey. The officers elected by the directors for the coming year are: President, W. E. Doolittle; vice-president, H. A. Taylor; secretary and treasurer, W. R. Coffroth. The capital stock of the company was increased from $150,000 to $200,000. After the recent lull in business activity the Sterling company seems to have recovered rapidly, and it reports an active trade in the line of telephone switchboards and supplies.

G. C. Hodge, superintendent of the Nelson and Vernon (B. C.) Telephone Company, is installing a new metallic-circuit system and metallic switchboard at Traill, B. C.

Ohio Independent Telephone Association.

The second annual convention of the Ohio Independent Telephone Association was held in the Grand Hotel, Cincinnati, on February 18th, 19th and 20th. The meeting brought together nearly 200 enthusiastic Independent telephone representatives from Ohio, Indiana and Kentucky. The convention was called to order by President W. G. Thompson of Lebanon, who, in his annual address, reviewed the remarkable progress made by the Independent companies during the last year. He said the Independent people of Ohio have 100,000 stations in the state outside of Cincinnati. He added that the worth of Independent telephones to the cities of Ohio was incalculable and that the city of Cincinnati was the loser by reason of its seclusive policy, and that he hoped by the time of the next convention an open-door policy will permit an Independent company to gain a foothold in that city.

Following the annual report of Secretary Knox a paper was read by J. B. Hoge of Cleveland on the "Independent Telephone Situation." Mr. Hoge said that when the Bell patents expired nine years ago there were less than 300,000 telephones in operation in this country. Today there are millions. During 1903 there were over 1,000 Independent telephone companies organized in the United States, and during the last four years the Independent long-distance lines have grown as rapidly as the exchanges. He said the farmer's life has been revolutionized, especially in small exchanges, giving them connection with the postoffice, county seats and the larger marts of trade. "It is conceded," said he, "that the service of the United States Telephone Company of Ohio, the New Long-Distance Telephone Company of Indiana, the Independent long-distance lines of Kentucky, and other Independent lines is as good as was ever in existence. The through business is handled the same as coupon tickets are sold over the railroads, and freight is billed over various lines. There are today over 2,000,000 Independent telephones in operation in the United States against 1,000,000 Bell telephones, and the business is yet in its infancy."

In the afternoon John B. Rhodes of Zanesville read a paper on "Party Lines," which brought out considerable discussion. Heavily loaded party lines were not considered advisable, and it was said that party lines had been the means of rendering the service in certain localities unsatisfactory.

The question box was next opened and proved of general interest, as the questions opened up a wide field and a large variety of subjects for discussion. The exchange of ideas and experiences was very helpful.

An interesting paper on "Consolidation" was next read by David Prewitt of Winchester, Ky., who is regarded as one of the pioneer Independent telephone men of his state. He advocated the consolidation of all the Independent lines in the country into one gigantic company, and insisted that it would be far better for the Independent men to work together after the plan of the Bell company than to have numerous companies in each state. Mr. Prewitt's paper brought forth considerable discussion. The delegates were not sure of the advisability of such a course and advocated a liberal system of exchange and connections rather than consolidation.

The subject of future legislation was more thoroughly discussed than any other matter that came before the convention. Nearly every delegate had a suggestion to make and when the expressions were summed up it was manifest that all were opposed to the telephone legislation now before the Ohio Legislature. A committee composed of J. S. Brailey of Toledo, Frank Beam of Columbus, O. M. Bake of Hamilton, W. L. Carry of Cleveland, and Cyrus Hurling of Columbus was appointed to proceed to the capital at once and oppose the Ely bill and all other measures calculated to effect the standing and business of the Independent systems.

The question of Independent telephones in postoffices was discussed and all agreed that a combined effort should be made to have the department at Washington permit the use of both telephones. The executive committee was instructed to go to Washington if necessary and make a fight to retain the Independent telephones.

The delegates spent considerable time in inspecting the various exhibits and passing comment on the great improvements made.

The matter of a more thorough organization was left with the executive committee and a meeting was arranged for next May in Columbus for that purpose. The present officers were retained until the May meeting. It is probable that the next convention will be held in Cincinnati, as the delegates were well pleased with their treatment, and it is the purpose of the Independents to keep knocking at the door until their long-distance lines are admitted to that city.

The social sessions and smoker were held at night in the banquet room and all carried away pleasing recollections of the excellent entertainments provided. F.

A new telephone line has been built by Salvador Montero of Tuxtepec from Tuxtepec, Mexico, to Sanctuario, via El Hule. The line will be extended still further and improvements inaugurated.

Electric Power for Idaho Towns.

President M. J. Shields and Manager E. S. Aldrich of the Moscow (Idaho) Electric Light and Power Company have about completed arrangements with the Lewiston (Idaho) Water Power Company to furnish them with electric power to the amount of 1,000 horsepower for distribution in the territory north of the Clearwater River. This power will be generated by a large waterpower plant to be installed at the mouth of the Grand Ronde River and will be brought to Moscow, Genesee and other towns at a pressure of over 20,000 volts on a three-phase circuit. It is expected that power can be delivered in Moscow and Genesee by July 1st, as construction work will begin by April 1st on the lines from Lewiston, and power will be supplied from the present plant of the Lewiston company at Asotin until the large plant at Grand Ronde can be installed. Twenty-five thousand horsepower can be developed at the proposed plant.

Bell Telephone Output for January.

The instrument output of the American Telephone and Telegraph Company for the month ended January 20th shows a material decrease compared with the exhibit for the corresponding month a year ago. In common with the railroads and railways, the telephone companies have found the winter's weather conditions adverse and their work has been hampered in construction and output lines. Comparative figures follow:

January.	1904.	1903.	1902.	1901.
Gross	90,644	129,837	87,412	66,048
Returned	36,854	43,286	34,796	25,766
Net	53,790	86,551	52,616	40,282
Outstanding January 31	3,833,307	3,236,871	2,578,626	1,993,098

Reorganization of Michigan Bell Company.

The Michigan State Telephone Company has been permanently organized and will now take over the affairs of the old Michigan Telephone Company (Bell). The permanent organization was effected at a recent meeting of stockholders, when the following-named officers were elected: President, W. A. Jackson of Chicago; vice-president, T. H. Newberry of Detroit; secretary, Elwood T. Hance of Detroit; treasurer, John T. Shaw of Detroit; chairman of board, N. W. Harris of Chicago; chairman of executive committee, W. C. McMillan of Detroit. The active management of the company will be under the supervision of W. A. Jackson.

Iowa Telephone Convention.

The eighth annual meeting of the Iowa Telephone Association will be held in Des Moines on March 8th, 9th and 10th. The meetings will take place in the Savery House, and it is hoped that the attendance will be even greater than at previous meetings. The attendance of represntatives from the smaller companies is especially desired and the exhibits of the latest apparatus will alone be worth while. A banquet is planned for the last evening for members and their ladies. The president of the association is Henry S. Herr; vice-president, J. C. Sullivan; secretary and treasurer, Charles C. Deering. Mr. Deering may be addressed at Des Moines. An interesting programme has been prepared.

TELEPHONE MEN.

LeRoy W. Stanton, consulting and constructing telephone engineer of Cleveland, Ohio, has opened a branch office in Chicago, with Byron B. Carter, in the Monadnock Building.

J. Malcolm Forbes died at his home in Milton, Mass., on February 19th. Mr. Forbes was nearly 60 years of age and was a director and heavy stockholder in the American Telephone and Telegraph Company.

The Central Union Telephone Company has installed H. E. Ensminger as local manager in Crawfordsville, Ind. Steps will be taken at once to increase and improve the service. The district superintendent announces that the company will erect a new exchange building of its own within a year.

GENERAL TELEPHONE NEWS.

A bill has been introduced in the Legislature of South Carolina fixing a monthly schedule of telephone rates for city and country on a basis of $1.50 for residences and $2 for places of business in exchanges of less than 250 subscribers, and $2.50 for residences and $3.50 for business houses in exchanges of 1,200 subscribers or over. A proportionate scale for intermediate exchanges is provided.

In comparing London and New York telephone systems some interesting figures are brought out. In New York within an area of 429 square miles there is a population of perhaps 4,000,000, while London with its 640 square miles contains 6,500,000 people. New York, in spite of its smaller size and population, is covered with no less than 200,000 lines, while London can boast of but 80,000. As regards efficiency, the London service is said not to compare with that in New York.

Electrical Manufacturing by Anglo-American Enterprise.

At the annual meeting of the stockholders of the British Westinghouse Electric and Manufacturing Company, held on February 5th, George Westinghouse made some observations which will be read with interest on this side of the Atlantic.

Mr. Westinghouse attributed the delay in holding the meeting to the great demands upon his time by the American Westinghouse companies, whose developments and operations were of great value to the British company's interests. With regard to the British company, under the direction of those connected with the American company, and with the authority and support of the directors, there had been created in four years a vast manufacturing plant, and, at the same time, there had been developed a management and business which would have been otherwise impossible, or would have required, as in the case of the American company, at least 15 years. The most potent factor in delaying the completion of the plant, singular as it might seem, was the phenomenal activity in business which began in America the year the British company was registered. This activity absorbed, in a large measure, those most skilled in building and in managing manufacturing plants, and caused great delay in delivery of material and machinery required to complete the plant. The American Westinghouse companies had, in consequence of the delay, furnished a large amount of apparatus, and had made a special allowance, or deduction, of £60,000 as an offset to the manufacturing profit which should have resulted from an earlier completion of the works. This allowance had contributed to the profit required to pay the interim and preference dividends for the year ended July 31st last. The dividend for the present year depended on final results, and it was not, therefore, contemplated to pay an interim dividend. With regard to the issues of further capital, the directors had considered it of the highest importance to secure a large amount of business so as to fully utilize the manufacturing facilities at the company's disposal, and to that end a large selling staff had been created and local offices established in important centers. Success had attended these efforts to secure new business. The orders in hand not executed on January 31, 1904, amounted to £1,608,256.

Mr. Westinghouse was satisfied, considering all things, that the results achieved justified the expenses so far incurred. The factory was practically in full working order, and he looked forward to results comparable to those obtained by the great companies in America, where the electric industry had a stability and prosperity excelling that of older-established businesses. As to the great size and extent of the works, he was of opinion that no less an enterprise was required to carry on the business. The works at present gave employment to about 7,000 hands, and the buildings had been so planned that extensions could be made at comparatively small expenditure. At present, it was true, the works had a surplus capacity, but in the near future there seemed reason to believe that they would not be large enough. They not only manufactured for the home trade and the colonies, but they had supplied apparatus to other Westinghouse companies. Of the railways in this country which he referred to last year as having taken steps to use electricity for the operation of some of their trains, only one—the Mersey—had so far put the new service into operation. In view of the development of a cheaper, safer and better system of electrical distribution for railway operations, the passing last session of the railways (electrical power) act was of great importance, as the act would enable the railways of any district, by conjoint action, without necessity for further parliamentary power, economically to utilize electricity for the operation of numerous urban and suburban services, and this enlarged field of operation would undoubtedly receive renewed attention from railway managers. In connection with the development of the electrical industry, the speaker wished again to state his conviction that the gas engine would prove the most important instrument for the cheap production of power. As to the general prospects of the company, the output from the works at Manchester for the first three months of the year would show a loss, as it had only just been started; but since then the returns, month by month, had been increasing satisfactorily. There might be a period of waiting and delay, but he considered the business a sound one in every respect.

New Power Plant for Spokane, Wash.

The Washington Power Company is to have a strong competitor in furnishing electric power from the Spokane River for the lighting of Spokane, Wash., and other purposes. Davis Wilson is now in the East perfecting arrangements for the installation of a large power plant, and it is announced that the new plant will be in operation before the end of the year. The promoters of the project own about 2½ miles of river frontage, where a fall of 33 feet is available. Complete surveys have been made and the route for pole lines to Spokane decided upon. The engineers have reported that a minimum of 20,000 horsepower can be secured at the point where the plant will be established. Besides competing for the lighting of Spokane, the new company will furnish electricity to a number of smaller cities. The main object, however, is to furnish power to a number of flour mills in the Big Bend section. Franchises from the city and county have not yet been secured.

Annual Report of the Chicago City Railway Company.

The year 1903 was not a good one for the Chicago City Railway Company, as shown by the figures of the annual report submitted at the recent meeting of the stockholders of that company. Only a small margin above the nine per cent. dividend was earned, and the earnings applicable to stock were the smallest percentage thereon since 1886. Contrary to the records of previous years, which showed an average increase in construction of from four to nine miles annually, there was no new trackage built last year. The total miles of road at the end of the year was 218.71.

The number of passengers carried showed for the year an increase of but 206,646 pay fares, whereas ordinarily there is a gain of from 7,500,000 to 11,000,000. President Hamilton said that the poor showing was due to the strike in November and to the severe winter. The strike lasted 14 days and cost the company about 5,000,000 passenger fares. This amount, if added to the total number carried, would partially account for the showing made. A comparative statement of the passengers carried for the last two years is as follows:

	1903	1902
Fare	128,304,445	128,007,699
Transfer	66,883,346	55,793,562
Totals	195,187,791	183,801,261

A feature is the fact that transfer passengers were 52.13 per cent. of the pay passengers, and the number of transfers increased 11,296,430 over 1902.

Instead of the customary increase there was an actual loss in car-miles run, comparing 1903 with 1902. The figures for the last year are: Cable, 13,865,473; electric, 18,595,440; horse, 74,210. The cable car-miles decreased 378,417, while the electric increased 261,578 car-miles. During the two weeks of the strike there was a direct loss of about 1,300,000 car-miles on the whole system.

The financial statement submitted to the meeting is as follows:

Earnings:	1903.	1902.
From passengers	$ 6,381,246	$ 6,367,558
From other sources	54,319	45,623
Totals	$ 6,435,565	$ 6,412,181
Operating expenses	4,648,341	4,336,504
Net earnings	$ 1,757,224	$ 2,076,677
Depreciation	100,000	180,000
Earnings on stocks	$ 1,657,224	$ 1,896,677
Dividend	1,620,000	1,620,000
Surplus	$ 67,224	$ 276,677
Capital stock	18,000,000	18,000,000

President Hamilton in his report announced that large expenditures had been made in equipment, including underground-feeder conduits, completion of the new repair shops, an addition to the new electric-power plant at Twenty-first and Dearborn Streets, 80 new double-truck electric cars with electric equipments, work cars, and other miscellaneous equipment. He also pointed out that in order to pursue the policy of the management, further large sums would necessarily be expended in 1904.

Concerning the franchise situation, Mr. Hamilton said: "During the last year negotiations were entered into, on the part of the company, with the city authorities, with reference to the 'franchise question,' and a tentative ordinance is under consideration, by which, it is hoped, a fair and businesslike settlement of the questions involved may be made. Pending the settlement the company proposes to efficiently maintain its plant and equipment and make such improvements as will enable it to furnish the best service possible under existing conditions."

Owing to a lack of a quorum, no officers were elected. The following-named directors were elected: Samuel W. Allerton, Arthur Orr, A. W. Goodrich, George T. Smith, D. G. Hamilton, Lawrence A. Young, Joseph Leiter.

Electricity versus Compressed Air for Mines.

Although compressed air is largely used for power transmission in mines, a recent issue of Science and Art of Mining points out anew that this is not an economical method of power transmission. The explanation is that in the operation of compressing the air some of the energy developed in the cylinder of the engine is converted into heat, giving rise to an increase in temperature in the air undergoing compression. This in itself would not be a serious matter if the air could be used immediately, with its high temperature; it cannot, however, be so used, and the heat is lost by radiation. In this way a considerable portion of the originally expended energy is wasted. In the case of electricity, on the other hand, there is no loss of such a nature; the losses are practically those of ordinary mechanical friction, together with some small amount of leakage of current and loss due to resistance in the cable. But these latter sources of loss are not so serious as the leaky joints, often unavoidable in compressed-air pipes, and the friction of the air [illegible] the pipes.

Some Possibilities of the Alternating-current Single-phase Railway Motor.[1]

By A. H. Armstrong.

During the last few years there have been developed several types of single-phase alternating-current motors having speed-torque characteristics even better adapted for railway work than that of the direct-current series motor, and, furthermore, providing ample starting torque with any voltage variation liable to occur in practical electric-railway operation. As these motors can be operated with a single trolley and ground return, and can, furthermore, be operated satisfactorily on either direct or alternating current, it makes their field of usefulness much greater than their direct-current series competitor.

Having such a motor with practically no restriction as to voltage, it is possible to break away from the exclusive field of electric traction with frequent service and small units and consider the operation of freight and passenger trains over our regular steam lines. In order to arrive at some general conclusions not limited by the local considerations of a specific case, this paper is devoted to a somewhat brief and general discussion of the operation of our steam lines by the alternating-current railway motor.

To make the conclusions general, trains of different weight have been taken, operating at different speeds and varying headway over a level track. As being typical, train weights of 2,000, 1,000, 500 and 250 tons of 2,000 pounds have been selected.

From a number of tests a steam consumption of approximately 30 pounds per indicated horsepower-hour is taken as the basis of all locomotive work. It is assumed that locomotives are compound, as this steam consumption could hardly be expected with simple engines under average conditions. To make all results comparable, further assumptions are made of an evaporation of seven pounds of water per pound of coal, an engine efficiency of 85 per cent., and cost of coal $2 per ton of 2,240 pounds. The price of fuel will vary, and this is considered later. As we are figuring upon actual performance of the locomotive, that is, work done in overcoming train friction, it will be necessary to introduce a factor allowing for coal wasted in making up and damping fires, and general waste incident to locomotive practice when standing idle for a large part of the 24 hours. Furthermore, a steam locomotive is called upon to operate throughout the year at varying temperatures of the surrounding air, and coal consumption during the winter months is in excess of that during the summer. This excess may reach 20 per cent. as an average during the cold weather, and hence 10 per cent. additional fuel is charged to the locomotive for the work assumed, to take care of the different conditions of operation which the electric locomotive does not have to contend with.

The next item of considerable expense in steam operation is the labor account. As it is immaterial to the train crew whether steam or electric locomotives are supplied, this item will not be entered into. The engineer and fireman, however, are greatly influenced by the character of the motive power. In steam operation a crew working 10 hours a day average for the railroad company will not be in actual service on the road more than 40 or 50 per cent. of the time, the remainder of the time being taken up in caring for the locomotive. In electrical operation the full time of the crew can be utilized for active duty, and hence a considerable saving effected in this item. In steam operation a crew costing $8.50 for 10 hours' labor has been assumed to be in active commission for five hours per day, while in electric service the crew is assumed to be in commission 8.3 hours per day out of the 10. For shorter hours of labor the same proportion would hold true, and the crew for the electric locomotive will cost but 60 per cent. of that for the steam locomotive.

The items of oil, waste and water are not determined here at length, but are introduced in the final values obtained for operating expense.

Each weight train can be run at a certain speed with a minimum expense for operation, this speed varying with the weight of the train. This economical speed will, of course, vary with any variation of the constants assumed above, such as the price of coal, labor, etc., but the values obtained are instructive and are given below:

Speeds of Economical Operation.

250 tons	35 m.p.h.
500 tons	25 m.p.h.
1,000 tons	2[illegible] m.p.h.
2,000 tons	1[illegible] m.p.h.

Considerable latitude is given above and below these speeds without greatly increasing expense per 1,000-ton-mile for operation.

Coming now to the determination of the cost of operating an electrically propelled train, under the same conditions, we arrive at some very interesting results due to the low first cost of electrically equipping the proposed steam line afforded by the alternating-current single-phase motor.

The same friction values are used as for steam operation. From these values the kilowatt capacity of each train is determined for the different speeds and varying weights of trains. From these values the cost of trolley copper, step-down line transformers and generating station are determined. The electrical system consists, in brief, of a generating station, controlling 100 miles of track, that is, feeding 50 miles in either direction. At intervals of approximately 12 miles are installed step-down transformers reducing the transmission potential to 3,000 volts or more for the trolley potential. This trolley potential is assumed at 3,000 volts for a good majority of the results, but for heavy work, that is, 1,000 and 2,000 ton-miles, the voltage is somewhat increased, but nowhere exceeds a safe operating value. The transmission potentials also are kept entirely within practical limits. The generating station does not get excessively large and the electrical system throughout presents no features of unusual interest.

The cost of installing the electric system complete, including generating station, transformer sub-stations, transmission line, poles, bonding of track, etc., is given in the following table:

Cost of Electrical Installation.—Cost Per Mile Single Track.

M.P.H.	Five Trains Each Way.	10 Trains Each Way.	20 Trains Each Way
2,000-ton Train.			
10	$ 5,600	$ 7,020	$ 9,860
20	6,520	8,430	12,430
30	8,510	9,840	14,580
40	11,6[illegible]	11,910	16,770
1,000-ton Train.			
10	$ 4,[illegible]	$ 5,500	$ 6,920
20	5,200	6,200	8,100
30	6,250	6,900	9,400
40	7,600	7,700	10,600
50	[illegible]	9,820	12,700
500-ton Train.			
10	$ 4,[illegible]	$ 4,700	$ 5,400
20	4,500	5,100	6,000
30	5,100	5,500	6,800
40	5,900	6,000	7,500
50	7,100	7,100	8,600
250-ton Train.			
10	$ 4,200	$ 4,400	$ 4,800
20	4,700	4,600	5,000
30	4,600	4,[illegible]	5,400
40	5,100	5,200	6,000
50	5,700	5,700	6,600

The above tables are given at length, as they form very interesting reading, showing how the cost increases with the size of the unit rather than by the frequency of the trains. Also, it is very necessary to arrive at an initial cost of electrical installation somewhat accurately, as this constitutes a funded debt upon which the saving, if any, between electrical and steam operation must pay dividends.

In determining the cost of electrical operation it has been necessary to consider the cost of producing power, and a sliding scale has been taken for the different kilowatt outputs, ranging from four mills per kilowatt-hour to nine or more, with coal at $2 per ton, depending upon the kilowatt capacity of the generating station. It is assumed that steam turbines and modern methods of generating-station construction are used, looking to the greatest economy of operation. Wages of engine crew, as stated, are taken at 60 per cent. of those for steam operation.

It is obvious that, as there is a fixed charge of five per cent. depreciation and repair account on the entire electrical installation, it is necessary to consider the frequency of travel over our proposed route. In order to make it as general as possible, it has been assumed that there will be five, 10 and 20 trains per day each way. The cost of operation expressed in cents per 1,000-ton-mile does not vary greatly with the different frequency of trains, but the dividend account must be based upon a selected train frequency. For convenience, a train frequency of 10 per day each way is taken, and the cost of electrical operation given. For other frequency of trains, the cost of operation per 1,000-ton-mile will not vary more than one or two cents either way from the results given and they are, therefore, of fairly general application.

As compared with steam operation, a considerable saving is shown, giving varying dividends, depending upon the frequency of travel, weight of train, maximum speed, etc. In fact, frequency of travel and weight of train are the determining features in considering the adoption of electric transportation. In order to show the dividend-earning power, that is, the saving in electric operation over steam as the percentage of the cost for electrical installation, the three following tables have been prepared for a frequency of train service of five, 10 and 20 trains each way per day:

Interest on Electrical Investment.

M.P.H.	2,000 tons. Per Cent.	1,000 tons. Per Cent.	500 tons. Per Cent.	250 tons. Per Cent.
Five Trains per Day Each Way				
10	[illegible]	8.17	9.25	9.22
20	[illegible].88	4.02	5.73	6.02
30	1.81	3.82	4.1	4.85
40		2.47	3.68	4.07
50	....	....	3.36	3.74
Ten Trains per Day Each Way.				
10	[illegible]	[illegible]	17.5	18.[illegible]
20	4.08	8.85	11.05	11.0
30	1.1	7.2	8.1	9.65
40	.	6.8	7.62	8.14
50	....	....	6.72	7.48
Twenty Trains per Day Each Way.				
10	[illegible]	22.1	31.4	34.5
20	2.6	12.9	19.1	22.1
30		9.8	13.65	17.8
40		9.77	12.8	15.0
50	....	....	11.25	13.7

As shown by the above tables, electric locomotives cannot compete with steam for trains of 2,000 tons at higher speeds, owing to the enormous cost of equipping the road electrically with the constants chosen. Should such heavy railroading be contemplated electrically, it would be necessary to adopt longer transmissions than the 50 miles either way from the power house assumed, and which is very conservative; also the use of higher voltages on the trolley than the 5,000 or 6,000 volts maximum assumed in arriving at the tables. The scope of the paper has been limited, however, to the use of standard apparatus and voltages met with in everyday practice. The results given thus represent the practice of to-day and not what electrical engineers may be able to do some time in the future. The consideration of the operation of 2,000-ton trains at speeds of 50 or 60 miles per hour is hypothetical, as no steam locomotive could be constructed that would furnish sufficient power to haul a train of this weight at the speeds considered. The problem is feasible from an electrical standpoint, as the weight of the locomotive could be distributed among a number of units distributed throughout the train to lessen the draw-bar pull without exceeding a permissible weight per axle.

The discussion of the paper has been limited thus far to the use of coal costing $2 per ton for both steam and electric-locomotive work. It is a well-known fact that generating stations can use cheaper coal than it is economical to use on steam locomotives, and hence it is interesting to follow through the results with varying prices of coal. In figuring the cost of coal, it is assumed that coal will be charged to operation at the price for which it could be sold in the wholesale market at the locality used. Coal at $2 per ton is somewhat cheap, especially for some of the western roads, and the same method of figuring has been used in determining the earning capacity of the electrical installation for $3 and $4 coal as well. As the saving in electrical operation and its percentage of the cost of installing the electrical system are of fundamental importance, the tables for interest-earning capacity expressed as percentage of the electrical installation is given in the following tables, both for $3 and $4 coal:

Coal at $3.00 per 2,240 Lbs.—Interest on Electrical Investment.

M.H.P.	2,000 Tons. Per Cent.	1,000 Tons. Per Cent.	500 Tons. Per Cent.	250 Tons. Per Cent.
Five Trains per Day Each Way.				
10	8.75	10.6	10.8	9.6
20	6.77	6.8	[illegible]	6.4
30	4.25	5.8	4.85	5.02
40	8.12	5.8	4.94	5.0
50			4.7	4.67
Ten Trains per Day Each Way.				
10	12.8	17.7	17.5	[illegible]
20	8.77	12.1	13.2	13.0
30	7.[illegible]	10.75	10.0	11.1
40	6.0	10.75	10.47	10.[illegible]
50	.	. . .	[illegible]	[illegible]
Twenty Trains per Day Each Way.				
10	14.[illegible]	27.8	38.4	[illegible]
20	8.2	17.7	22.6	27.8
30	7.[illegible]	18.0	17.0	20.1
40	6.25	18.2	17.[illegible]	18.1
50		. . .	2[illegible]	16.[illegible]

Coal at $4.00 per 2,240 Lbs.—Interest on Electrical Investment.

M.P.H.	2,000 Tons. Per Cent.	1,000 Tons. Per Cent.	500 Tons. Per Cent.	250 Tons. Per Cent.
Five Trains per Day Each Way.				
10	11.0	11.65	11.6	10.2
20	9.65	8.65	8.15	7.1[illegible]
30	7.04	7.74	6.35	5.72
40	5.64	7.54	6.2	5.75
50	.	.	6.17	[illegible]
Ten Trains per Day Each Way.				
10	16.8	20.8	21.4	2[illegible]
20	13.4	15.2	15.8	14.7
30	12.[illegible]	[illegible]	12.2	12.7
40	10.72	15.0	12.8	11.8
50	.	....	12.2	11.2
Twenty Trains per Day Each Way.				
10	21.1	33.2	38.4	[illegible]
20	14.8	22.[illegible]	27.4	25.6
30	16.8	20.3	20.3	22.6
40	12.4	20.9	21.1	20.7
50			2[illegible]	20.1

A study of the above tables brings out the fact that, for very infrequent service, that is, five trains per day each way, or less, it would hardly pay to equip the road electrically, there being a dividend of from four to seven per cent. on the capital invested. With more frequent service, however, the saving in electrical operation becomes more marked, until, at from 15 to 20 trains per day each way, the interest-earning power of the electrical investment is worthy of very careful consideration. It should be borne in mind that all these figures do not contemplate increase in the present traffic of the road, and, therefore, do not take into consideration one of the chief characteristics of electric traction, that is, developing short-haul local traffic, and thus increasing the dividends by increasing the receipts rather than by cutting down operating expenses. The well-known ability of electric roads to greatly increase previous steam traffic has led them to be installed, in many cases, without too close an investigation into their economical installation. Taking into account, therefore, that the electrically equipped road, while caring for the heavy through-freight traffic with an earning capacity of from four to seven per cent. on the investment, can also build up a local traffic, both freight and passenger, with practically no additional cost and showing very large returns.

Taking up the possibilities of the alternating motor in general-haul work, the problem had to be treated in a very general way in order not to lose sight of

[1] Abstract of paper read before the electrical section of the Canadian Society of Civil Engineers at Montreal November 19, 1903.

the scope of the problem in considering local details. The average specific problem has its local conditions, which must be carefully considered in detail, and, in many cases, would show a greater return for the money invested than indicated in this paper. For instance, all power is supposed to be generated from coal from power house devoted to the interests of railroading alone. Along many of our roads exist waterpower facilities which could be advantageously developed and furnish power much cheaper than the figures assumed from coal generation. Furthermore, the cost of power in the smaller generating-station capacity has been assumed as high as one cent per kilowatt-hour or more, and should a generating station supply other industries, such as mining, lighting, general power distribution, etc., the cost of purchasing power would be considerably decreased with a consequent reduction in cost of operating electrically. The results given in the table therefore, are of general application only, and may be considerably modified when considering the local aspect of a given proposition. It is believed, however, that the results as obtained are based upon conservative assumptions; in fact, most of these assumptions were obtained from operating conditions, and, with the figures given, outline somewhat briefly the possibilities of the alternating-current single-phase motor in the railway field.

Electrifying Steam Railroads.[1]

"The officer responsible for the security of the investment in his steam railroad is taking considerable risk if he does not keep a sharp eye on the sure and steady advance in the knowledge of the use of electricity." This was written more than a year ago, and surely the "steady advance" is accelerating at a rate that needs attention. For heavy-railroad work the electric art has not advanced sufficiently to warrant the electrification of any railroad trunk line, and the first of the experimental branch lines so treated happens not to have proved successful. Nevertheless, a fact developed during the last year that, in a given case on a large scale, passengers can be hauled for 30 per cent. less by electric power (fixed charges disregarded) is undeniable, and in the end its results are unquestionable. But the cost of the change is in most cases simply appalling to those called on to furnish the money, and it is safe to say that such changes will be made only when, for one reason or another, they are compulsory.

For long-distance heavy freight trains the time for using electric motors is farthest off, and without further and unexpected developments the time for changing the power on existing freight tracks may never come. For suburban-passenger trains and spur lines it is imminent; for longer distance passenger trains it is not at all improbable. All of these predictions of slowness to change are based on existing conditions and the enormous loss due to setting aside the present locomotives and the plant for their care. If we could imagine the present inhabited country with no railroad equipment and a chance to put in service immediately the most profitable motive power, it is safe to say that not many steam locomotive would be set at work.

Those who have followed this subject closely will remember the report of Mr. Bion J. Arnold to the New York Central last year on the proposed electrification of the New York terminal. His study showed that "while there would be a slight annual saving in operating expenses in favor of electricity, it is not sufficient to warrant its adoption on the ground of economy in operation alone, although its adoption can be justified on other grounds." The topographical characteristics of the land near the New York Central's terminal make it necessary for all trains entering and leaving the station to pass through a tunnel. The smoke and gases from the locomotives not only annoy passengers and residents, but also destroy the track and constitute an element of danger. For these reasons, alone, electrification was forced on the Central. The study of the Pennsylvania leading to the adoption of electricity in the tunnel under Manhattan Island and its rivers is not at hand, but it may also be safely assumed that convenience, comfort and safety, and not economy of operation, were the controlling elements. It well may be that ultimately the New York Central will profit by its investment in plant and in copper and electrical apparatus, for the road passes through a picturesque and attractive territory north of New York city, which has unusual possibilities as a suburban-residence district and to which electric lines will bring enormous increases. The company is wise in proposing to extend its electrification scheme into this territory, but the project would have been considered too radical pioneering if the millions of dollars were to be spent for the sole purpose of getting a possible, but not certainly sufficient, additional traffic.

The report of Mr. Arnold showed that, neglecting fixed charges, the use of electricity would save about 25 per cent. per locomotive-mile over present cost of operation. But when interest and depreciation in both cases were considered the saving almost disappeared. These figures referred to a direct-current system, which was considered to be the only system sufficiently tried or developed to warrant its use. To be more exact, Mr. Arnold's figures for the cost per locomotive-mile of operating the division, were as follows:

	Steam.	Electricity.
Operating expenses	23.05	15.80
Fixed charges	1.13	7.83
Total	24.18	23.63

This shows clearly to the engineer that the point of attack is the excessive 7.83 cents cost per locomotive-mile, due to excessive cost of electric installation. The capital invested in boilers, engines, generators, transmission lines, motors, etc., can be greatly reduced by the use of alternating current, but engineers have been unable, so far, to make practical a motor which will operate with a single-phase alternating current and fulfill the rigid requirements of railroad work. Many attempts have been made to perfect this type of motor and several of the larger electrical companies claim to have solved the problem, but experience has not yet demonstrated the correctness of these claims. Three-phase systems have been built, notably the Berlin-Zossen experimental line, but, after all, these systems are but a step from direct current to single-phase. It has been the history of many of the world-advances in applied science, that having once demonstrated and proved first principles, the means of utilizing them were soon forthcoming. With the brightest specialists of the world working for the perfection of the single-phase motor, it is expected to become a reality. Not until then will the steam-road manager need to consider the advisability of discarding the steam locomotive for through-freight and passenger traffic. Even then there is a nice problem to be solved, and all conclusions will have to be reduced to a dollars-and-cents basis. To induce voluntary transformations, electrification must show a saving in cost of operation equal to the interest on the new property and on the loss in disposing of the old property. When congested terminals, such as the Pennsylvania and the Central in New York city, and short branch lines are electrified extensions of the system may be based on ascertained advantages.

1. From the Railroad Gazette. This article is of interest as showing the drift of sentiment among steam-railroad men.

Power Possibilities of the Victoria Falls of the Zambesi.

English technical journals discern a great future for the project to utilize by electrical transmission a portion of the enormous power of the cataract known as Victoria Falls on the Zambesi River in South Africa—"a cataract," says Feilden's Magazine, "situated entirely within British territory, and admitted to be the most magnificent waterfall in the world."

Described in the native language as Mosisa-tunya —"smoke sounds there"—this cataract is bounded on three sides by lofty ridges, which, together with numerous islands scattered over the river, are thickly covered with luxuriant vegetation. The falls are caused by a gigantic rent, extending across the river, in the basaltic rock which forms the bed. The cleft in the rock is upward of 400 feet in depth, and nearly a mile in length. Into this chasm, nearly 2½ times the depth of Niagara, the river plunges with a thunderous roar, sending aloft columns of spray that may be seen for a distance of 20 miles, it is said. Immediately below the falls the flow of the river is checked by a rocky wall, the only outlet being a narrow channel cut through this barrier.

Interesting as the Victoria Falls may be to the sightseer, they possess still greater interest from an engineering point of view. The total energy running to waste has been estimated by Mr. Francis Fox at 35,000,000 horsepower, and, even allowing for a great reduction in the dry season, the available source of power is practically illimitable. Compared with the available capacity of 7,000,000 horsepower at Niagara, the Victoria Falls stand forward as the greatest available source of energy in the world, and it is interesting to learn that steps are being taken by the African Concessions Syndicate for the purpose of preparing for the establishment of a power station on the Zambesi River. Before anything can be done the site must be carefully surveyed, and it is estimated that the total expenses in this direction will amount to about £10,000. The Trunk Railway is now completed to within 70 miles of the falls, and before next March it should have reached that point, when the surveying expedition will be sent forward. On completion of the survey the details of the power scheme will be arranged, and the power company will be incorporated.

Large markets for power are, of course, necessary for the purpose of making the proposed company a commercial success, and it is fortunate that the main essentials exist in the shape of a fertile and well-watered country, possessing an excellent climate, and in every way suitable for the growth of a white population. Those who are well acquainted with the country speak of it as one that, within a reasonable radius of the falls, is more richly endowed than any other equal area of the earth's surface with minerals, and more particularly with gold, copper, iron and coal. These features inevitably mean a large increase of population, and the creation of important industries, which will afford scope for the operations of the power company. The existing Rhodesian railways will probably be large consumers of energy, and the various gold-mining centers should take a considerable amount of power.

It is declared that the gold-mining industry of Rhodesia is in a most satisfactory condition, and that the output has reached the total of 23,000 ounces monthly. The gold-mining future of Rhodesia will probably be largely connected with the extensive deposits of low-grade ore, which, as experience in the Rand has shown, is more profitable in the long run than showy patches of highly mineralized reef, and, of course, requires power for suitable working. With regard to copper, it may be mentioned that a belt, 50 miles wide, has been traced for a distance of 100 miles, some 250 miles north of Victoria Falls. This will, no doubt, constitute one of the chief copper fields in the world, and in due time it will inevitably attract a large population, and account for a large consumption of energy. Extensive iron fields have been discovered close to the falls, and the working of these will give rise to a very considerable demand for power. Moreover, as at Niagara, various manufacturing industries may be established near the central source of power, and these will constitute an important market for electrical energy.

But the possibilities of the proposed power station are still greater, for by the long-distance transmission of power, various other districts of South Africa could be supplied with current. It is considered probable that a transmission of 600 miles could be accomplished if the need were to arise, as it certainly would after the Victoria Falls power station had been inaugurated. A transmission system of 300 miles would cover the Wankie coal fields, Bulawayo, the Gwelo, Sebakwe, Selukwe, Lomagunda and Hartley gold fields, the newly discovered northern copper fields, and nearly 1,000 miles of railways. The various gold fields mentioned have been discovered and opened up within a period of 10 years over a tract of country about the size of Central Europe, but with a population of a few thousands, and it is not difficult to imagine what will happen when millions are at work instead of thousands. A transmission system of 600 miles radius would include the whole of the gold fields of South Africa and a large proportion of its railways. The area covered would be inclusive of all Rhodesia, Bechuanaland, and the Transvaal, as well as the greater part of Portuguese Mozambique, German Southwest Africa, Portuguese West Africa and the Congo.

The ultimate development of the scheme is so enormous that it is somewhat difficult to grasp its probable future. The project will require the expenditure of millions, and many years will elapse before it can be fully developed; but the fact remains that in a country combining great natural advantages, there is a central source of power sufficient for all purposes.

BOOK TABLE.

Testing of Electromagnetic Machinery and Other Apparatus. By Bernard Victor Swenson and Budd Frankenfield. New York: The Macmillan Company. 1903. Pp. (5½ by 8½ inches), 420, with 147 illustrations. Price, $3.

The testing of direct-current electromagnetic machinery is treated in this work, more particularly for the benefit of the college student in pursuing his laboratory courses, though at the same time it may be used as a work of reference by engineers. A major portion of the matter contained is upon dynamo-electric machinery and is based upon notes which were previously used by the authors in their work in the laboratories of the University of Wisconsin.

After a few pages upon the general methods to be followed in making and properly writing up an experiment and also upon the laboratory instruments used the book contains 96 experiments upon direct-current machinery. Each experiment is complete in itself, which is an important feature; that is, no references are made in one experiment to data contained in another, so that it is possible for the instructor in using this book to arrange the order of the work to conform to his ideas and the individual needs of his students. In general, the order followed in each experiment is first to give references for parallel reading; next, the object of the experiment is stated; this is followed by a brief discussion on the theory and method; then the apparatus to be used is described, with the connections, followed by a sample set of readings, the data being similar to those the student may expect in his particular test. Following the data, curves are drawn where possible to represent the results graphically. The book is well illustrated with pictures of the different apparatus and curves showing results of tests.

Electric Coal-carrying Road in Indian Territory.

The Indian Territory Traction Company of South McAlester, Ind. Ter., has completed nine miles of road and 12 more miles is to be immediately constructed. The completed portion touches at five coal-mining towns, and when completed the system will serve as a connection for all of the coal-mining towns and camps in that section. The road is operated under a franchise which was granted by the federal government. It has a right-of-way of 100 feet width through the country and 60 feet wide through the towns. In addition to passengers the company will haul the mails and express matter. A freight service may be inaugurated when the road is completed. M. E. Williams of South McAlester is superintendent.

CORRESPONDENCE.

Great Britain.

London, February 13.—For the Underground Electric Railways Company of London an order has just been placed for a number of electric elevators for the tube railways which will be worked by the company from its power house at Lots Road, Chelsea. The order amounts to $1,750,000 and is said to be the largest of its kind ever placed either in England or abroad. At some stations along the tube railways in question there will be four elevators and at others there will be six. All the cages will be of non-inflammable material.

The opening of the Great Northern and City Electric Railway has had to be postponed for a month, greatly to the disappointment of all concerned. The reason is that the inspecting officers of the Board of Trade are not quite satisfied with some little details, and to put them in proper order will take a few weeks.

As stated a few weeks back, a taxpayers' meeting of the St. Marylebone (London) Borough Council rejected a proposal to continue the council's bill in Parliament for the acquisition of the company's electric-supply undertaking in its area, although the local authority was ordered to do so by an award of the arbitrator appointed to settle the price to be paid. The only thing left to do then was to take a poll of the whole of the taxpayers, and this has now resulted in a majority of over 1,000 in favor of continuing the bill. The way is therefore cleared at last to some extent, although the manner in which nearly $6,000,000 is to be borrowed is not very clear. As before pointed out, the Electric Supply Company can, by an order from the courts, call for an immediate settlement, which would mean the levying of a special rate of nearly $5 per taxpayer. Little further is likely to be attempted, however, until the council's bill has received parliamentary sanction.

The conference which I noted was to take place at the instance of the engineering standards committee was duly carried through. There was a very large attendance of consulting engineers, manufacturers and central-station engineers on both days during which the conference was held. An animated discussion took place upon the various questions already mentioned, and the meeting did not break up until late in the afternoon. On the second day the question of standardizing motor cars and speeds was dealt with at great length. It is proposed that the committee shall consider the various points raised and then present a report. The meetings were not open to the press, so that no further details are available until the report in question is presented.

A great shock was experienced when it became known that Mr. McMillan, the respected and hard-working secretary of the Institution of Electrical Engineers, had died. A fortnight ago he was present at the fortnightly meeting, and his death is more sad because of the strong suspicion that it was accelerated by overwork.

The dates and details of the visit of the Iron and Steel Institute to the United States upon the invitation of Mr. Andrew Carnegie have now been settled. The autumn meeting of the Institute will take place in New York on October 24th, 25th and 26th next, after which there will be an excursion to Philadelphia, Washington, Pittsburg, Cleveland, Niagara Falls and Buffalo, returning to New York on November 10th.

Last year the London County Council promoted a bill in Parliament to enable it to carry out a scheme of "free" or assisted wiring. This was strongly opposed by the London contractors, as I have more than once reported. Now, however, a conference of the London borough councils is to be held to urge the County Council to resuscitate its last year's bill. All that can be said is that if it revives the measure in the same form it will be a further waste of the taxpayers' money. On the other hand, if the County Council agrees to acquire the statutory authority to carry on free wiring, but gives the actual work to the contractors, the proposal would go forward unopposed.

The Admiralty is erecting a wireless-telegraph station on the southwest coast of Scotland. This station will command the Irish Channel.

The Fife Electric Power Company, another of the large electric-power companies in the United Kingdom, has just accepted a tender for a 2,000-horsepower plant. G.

New York.

New York, February 20.—During the week of April 4th the Automobile Club of America will conduct a service test of motor wagons in this city. The test will be restricted entirely to automobile wagons used for commercial purposes, and electric, gasoline or steam vehicles will be admitted, both foreign and American made. The wagons will be placed under the working conditions of two local express companies. Six classes have been arranged, the various classes requiring loads of from 1,000 to 6,000 pounds dead load. Awards will be made in each class for the best performance, based on the economy of operation in time and fuel, ratio of paying load, ton mileage, and general reliability and availability for service. Entry blanks may be obtained from S. M. Butler, secretary, 753 Fifth Avenue

Preparations are being made by the Navy Department at Washington to transfer the space-telegraphy school for enlisted men from Newport, R. I., to the Navy Yard at New York, where better facilities are afforded for this work. It is intended to assemble here all men under electrical instruction both in space telegraphy and other branches.

A decision of the Appellate Division of the Supreme Court which is of importance to Independent telephone interests was handed down recently, affirming an order by Justice Clarke at Special Term denying a motion for a peremptory writ of mandamus asked for by the Independent Telephone Company of New York to compel Robert Grier Monroe, then commissioner of water supply, gas and electricity, to issue a certain permit. The company had asked for a permit to lay and maintain telephone wires in the low-tension subway and have additional subways of the kind constructed in various localities. Commissioner Monroe refused to grant the permit on the ground that he had been advised that the company had no franchise or right to construct and maintain such structures and fixtures as were asked for.

The State Board of Railroad Commissioners has made public its report for the quarter ended November 30, 1903. According to the report, conditions have greatly improved on the Interborough in the Borough of Manhattan since the last report, owing to the purchase of additional power from the Interurban. The attention of the Brooklyn Heights Company was called to the improper ventilation of a number of its recently constructed cars, and these have since been supplied with proper ventilators. The operation of cars with flat wheels, causing annoyance to residents, has been taken up with the various companies and a more thorough inspection and removal of such wheels has been ordered by the board. During the quarter ended November 30, 1903, 1,367 pairs of new wheels were placed under the electric cars of the Interurban Company. The total number of passengers carried in the city of New York for the three months ended November 30th last was 263,841,936 as against 245,644,142 for the corresponding period of last year, an increase of 18,197,794

New companies have been incorporated recently as follows: United Electrical Manufacturing Company, capital, $50,000; directors, E. F. Buchanan, A. O. Brown and L. G. Young. Physicians Electrical Manufacturing Company, capital, $10,000; directors, F. E. Hodgskin, G. A. Wingate and A. B. Reed. Polyphase Ignition System Company, capital, $50,000; directors, R. L. Heitemeyer, G. G. Schreiber and W. B. Symmes.

The model of the rapid-transit subway which is to be displayed at the St. Louis Exposition is now completed and is on exhibition at the rooms of the rapid transit commission. The interior of the model is lighted with small electric bulbs. Looking through the spectator will get a view back into a section of tunnel, equipped with tracks, signal appliances and lights, and with tiny electric trains at intervals. A brass plate on the front of the table explains that this is the New York subway, designed by William Barclay Parsons, chief engineer. O.

New England.

Boston, February 20.—There was a prolonged debate in the Massachusetts House of Representatives on Thursday of this week over the proposition to limit the franchises of all public-service corporations to a 20-year period. Dr. Garst, the member who is sponsor for the bill, was able to secure a roll-call record of the members of the House, with quite a flattering vote in support of his contention, although the verdict went against him.

The Legislature defeated this week the scheme for an electric railway through the North Shore summer resorts of Massachusetts, which met with opposition from a large number of the wealthy summer residents of the communities threatened with "invasion."

Complaints from the city of Salem relative to the service of the Boston and Northern Street Railway Company in Essex County have been investigated by the railroad commissioners and they have assured the petitioners that they concur in the matter and will insist upon the carrying out of plans which the company has in contemplation for the remedying of defects brought to the commission's attention.

Payment of the claims of creditors of the Worcester and Southbridge Street Railway Company began this week, and steps were also taken to form a new company, with $700,000 capital, to acquire the property at the auction sale which is contemplated for the securing of a good title to the franchise and equipment. The new company will take the name of Worcester, Southbridge and Sturbridge Street Railway Company and will acquire the Southbridge and Sturbridge and the Rochdale and Charlton Depot roads. It is understood that W. E. Rice, who has been prominent in the adjustment of affairs, will be president of the new company. General Rockwood Hoar, Charles H. Thayer, Fred Thayer of Woonsocket, R. I., and George W. Wells are among the directors.

The annual report of the New Hampshire railroad commissioners, made public this week, gives a summary of the operations of the electric roads of that state for the last year which is not very satisfactory. The Manchester Street Railway Company is the only one of the 18 in New Hampshire which earned a dividend. The electric railways of the state operate 228 miles of track. They report $3,552,119 stock, $2,066,000 bonds, and $1,109,003 liabilities. The gross income was $834,894; operating expenses, $796,795; taxes and interest, $103,250; deficit, $65,161.

At Springfield, Mass., in the Superior Court, suit has been brought against the Springfield Street Railway Company to recover damages for alleged noise and jarring experienced by residents in property adjacent to the company's power house. There are four cases, and the sum named is $2,000 in each.

The electric-light commissioners of Massachusetts have authorized the Malden Electric Light Company to issue $100,000 additional capital stock at $145 a share.

The Westerly Railway and Lighting Company of Stonington, Conn., has filed a certificate of incorporation with the Connecticut secretary of state. The capital authorized is $200,000 common and $200,000 preferred. B.

Ohio.

Cleveland, February 20.—The appointment of George T. Bishop as receiver of the Eastern Ohio Traction Company a few days ago did not cause much surprise among traction men here. Mr. Bishop was until a short time ago president and general manager of the company. Last year the profits from operating the properties were about $3,639 less than the fixed charges. The outstanding bond issue is $1,893,000, and if the stockholders are not willing to put in the extra money the property will probably be sold for the benefit of the bondholders. The Eastern Ohio Traction Company is made up of the Cleveland and Eastern, the Cleveland and Chagrin Falls and the Chagrin Falls and Eastern.

The Cuyahoga county commissioners have let the contract for lighting the county buildings to the Cleveland Light and Power Company at 12½ cents a kilowatt, less 60 per cent. Under the old contract with the Williams Publishing and Electric Company the scale was the same, less 50 per cent. The Cleveland Light and Power Company is the successor of the Williams company.

W. G. Wagenhals is interested in an extension of the Ohio River and Columbus road from Aberdeen through Manchester to Portsmouth, where it is planned to connect with the Cincinnati, Georgetown and Portsmouth. People along the line will be asked to take a certain amount of stock.

The Youngstown and Southern has purchased a site at Youngstown for its power house. Together with the right-of-way the consideration is $38,000.

The survey of the Springfield, Troy and Piqua Traction Company's line has been completed. General W. P. Orr of Piqua is interested in having the line built, and at a meeting called a few days ago he assured the officers of support from his city. This is one of the lines in which the late ex-Governor Bushnell was interested.

The Snell Motor Car and Truck Company of Toledo has been incorporated with a capital stock of $125,000. Samuel Snell and others are interested.

The Lagonda Western Railway Company of Springfield has been incorporated to build a line from Mitchell Avenue to Lagonda Avenue in Springfield. The capital stock is $25,000, and the incorporators are George R. Glessner, A. C. Funk and others.

The following-named officers have been elected by the Electrical Contractors' Association of Ohio: President, C. C. Bateson, Cleveland; vice-president, M. S. Brown, Columbus; treasurer, J. C. McMaster, Columbus; secretary, T. D. McCall, Toledo.

The Cincinnati Gas and Electric Company has awarded another contract for 20,000,000 bushels of coal, making 60,000,000 bushels ordered within the last few months. It is to be delivered within the next five years at the rate of 3,000,000 or 4,000,000 bushels a year.

All traction companies in Ohio have made a poorer showing for January than last year, owing to the enormous increase in expenses, due to the extremely cold weather. February may be better, but there has been so much cold weather that it cannot be a great improvement over the previous month. The return of favorable weather conditions will likely result in a better showing for the remainder of the year.

The Findlay, Forest and Marion Railway Company has been incorporated with a capital stock of $10,000. Claude Meeker, the well-known broker of Columbus, H. E. Armbruster, M. B. Earnhart and others are among the incorporators. O. M. C.

Michigan.

Detroit, February 20.—The DeForest company proposes to erect a station in Port Huron for the transmission of messages. The station is to be operated in connection with the marine service.

There was a rumor, which was started in Chicago, that the Michigan Central Railroad Company would build a third track on its right-of-way between Detroit and Jackson for an electric line. Michigan Central officials say this is not true. The road needs all the trackage facilities it can get for its steam business, and there is no prospect of going into electric transportation in the territory mentioned.

The Michigan suburban railway, running between St. Johns and Lansing, is again in regular operation, after having been out of commission for about

three weeks on account of the snow and cold weather.

W. H. Seymour of Flint has bought the Union Traction Company's property and franchise in Tuscola County at sheriff's sale, to be used for the Lapeer branch of the Saginaw-Flint electric road. The Union Traction Company tried to build a road between Flint and Saginaw two years ago.

Despite the talk of a municipal lighting plant, the Common Council of Mt. Clemens voted unanimously to give a five-year contract to the Mt. Clemens Electric Company at $57.12 a light, a few cents cheaper than the former contract.

The electric-light plant at West Branch is out of commission. The big dam owned by the electric-light company went out Monday, and the upper dam is so blocked that the machinery of the plant cannot be run.

The Chicago Railway Equipment Company, which took over the Monarch Brake Beam Company of Detroit and the Sterlingworth Supply Company of Easton, Pa., will, it is understood, remove all its plants and headquarters to Detroit, where it has a new power plant adjoining the Solvay Process Works. The company has branches in Jersey City, Walkerville and Montreal.

The race bank gave way Monday at Centerville, leaving the Centerville Water and Electric Light Company without power. The town would have been without lights entirely and without fire protection had not power been supplied from the Michigan Central Woolen Company.

The Buchanan (Mich.) Power Company has submitted a proposition to the directors of the Chicago and South Shore Railway Company to furnish power from its plant at Buchanan sufficient to operate cars on the interurban system. It is proposed to run a heavy copper cable a distance of 26 miles and to establish stations at Laporte and Michigan City. There is a report that in the event of such a contract being made capitalists will organize a company to build an electric line from Michigan City to Buchanan and other Michigan points.

Henry C. Hayes of Dexter, Mich., has entered into the Eclipse Manufacturing Company of Detroit, and the company, with increased capital, will go into the extensive manufacture of a patent trolley base which it controls. The product has been limited, owing to lack of capital to extend the business. The officers are: President and manager, James Kermath; vice-president, Thomas E. Piper; secretary and treasurer, Henry C. Hayes. Among the directors are A. F. Beal, Fred. Wittmaack and Walter Oxtoby. C. G. W.

Indiana.

Indianapolis, February 22.—The Fountain and Warren Traction Company is preparing to build an interurban line from Covington east to Lafayette during the summer. It is understood that the line will ultimately be extended to Danville, Ill.

The surveying corps of the Columbus, Greensburg and Richmond Traction Company has reached Richmond and completed the preliminary survey of the road. This line is to be the middle link of a line reaching east into Ohio and southwest to Louisville.

At a meeting held in Ft. Wayne on the 17th inst. by the owners of the Ft. Wayne Traction Company it was voted to change the name to the Fort Wayne and Wabash Traction Company. This change was made to include the interurbans running to Logansport and ultimately from Lima, Ohio. George F. McCulloch, president of the Union Traction Company, no longer holds interests in Ft. Wayne and other northern lines. The real heads of the traction interests in Ft. Wayne and vicinity are Philadelphia capitalists and Henry C. Paul and F. B. Flemming of Ft. Wayne, and James Murdock of Lafayette. These men also control the city lines at Wabash, Logansport and Lafayette and own the Wabash and Logansport interurban line, the Wabash River traction line and the Rochester and Northern traction line. It is the intention to extend the interurban service into Elkhart, St. Joseph, Fulton, Marshall and Kosciusko Counties. Engineers are now working on the extension of the new line, and developments during the coming summer are expected to be proportionately large.

Numerous suits have been filed in Madison and Delaware Counties on account of the recent increase in the fares demanded by the Indiana Union Traction Company. The complaints all set forth that the conductors refused to accept five-cent fares and ejected passengers from the car. It is charged that the fares are not uniform throughout the system. Business men of Anderson will bring a suit to determine whether a car line that is a common carrier can charge more in one county than it does in another on lines connecting two county seats. It is generally believed that the company will be compelled to revise its schedule of fares or encounter so much trouble on the cars and in the courts that the increased fares will be more than consumed by litigation. The company has already reduced the fare between Alexandria and Orestes from 10 to five cents, the former price.

Judge Plummer of the Wabash Circuit Court has decided that the $20,000 voted to the Wabash River Traction Company by the taxpayers of Noble Township three years ago, is to be refunded to the taxpayers. There are singular circumstances connected with this matter. The company refused the money, after being voted and paid into the country treasury, and no explanation for its action was ever given, the line being built precisely as required under the franchise. The real cause is a matter of conjecture among the county officials.

Farmers in many portions of Indiana complain of the scarcity of farm labor. They say that the interurban lines which are being constructed have attracted the young men who have formerly been employed on the farms.

City Attorney Warrum of Indianapolis has advised the Board of Public Works that it has full power, without appealing to the council, to order the Indianapolis Traction and Terminal Company to make any reasonable extension of its lines after hearing both sides.

The Indiana Supreme Court has held that the franchise granted by the city of Boonville to the Boonville Electric Light and Power Company to supply the city with light, power and heat, is void, because the ordinance was not published, as provided in the statute. The court says that the act of 1899, which gives the citizens power to reject by popular vote any franchise granted by the Town Board, on the filing of a petition for a popular election within 30 days, applies to such an ordinance. Therefore, ordinances to take effect in the future, must be published. F.

Southeastern States.

Charlotte, N. C., February 20.—The announcement that work on the Appomattox diversion scheme near Petersburg, Va., will be affected by the recent orders issued by Frank Jay Gould is incorrect, it is stated, for the reason that his company, the Virginia Passenger and Power Company, has no connection with this work, for which $200,000 has been appropriated by the federal government.

The Birmingham (Ala.) Railway, Light and Power Company's directors have resolved on $1,000,000 bond issue, and a meeting of the stockholders has been called for March 21st to take action on the resolution of the directors. The money is for improvements.

The development of two important waterpowers near Covington, Ga., on Alcova River, is said to be practically assured. N. S. Turner, W. C. Clark and C. H. White are the incorporators of a company which expects soon to begin the work of development of the two falls. Thirty thousand dollars has already been subscribed to the stock of the company, and this sum will be considerably increased. It is proposed by the promoters to supply power for lighting the city of Covington and for operating the Covington and Oxford street railway and other plants.

The new electric-light plant at Halls, Tenn., has been completed.

The Gainesville (Ga.) electric street railway may make an extension to its lines out Broad Street soon. L.

Texas and Mexico.

Austin, Tex., February 18.—The Mexican Traction Company of the City of Mexico will extend its system of electric railway to the suburb of Colonia del Pasee and will traverse a number of streets of that place. Application has been made by the company to the municipal authorities for the necessary authority.

Application has been made by the Electric Tramways Company of the City of Mexico to the Department of Public Communications for authority to build a line of electric railway from Nino Perdido, on the south side of the city, to Los Angeles on the north side, and to thus form a complete circuit of the city.

It is reported that Charles Kratz, who owns an extensive tract of land situated near Guadalajara, Mexico, is organizing a company in St. Louis, Mo., to build and operate an electric railway line from Guadalajara to his property.

The electric railway which is being built from the plant of the Torreon Smelting Company to Torreon, Mexico, will be completed in about two months. The grade for the road is nearly finished. The power will be furnished by the electric-power plant at Lerdo.

An electric-power plant will be installed at Irapuato, Mexico, by Richard A. Barkley for the purpose of furnishing power to operate his four large flour mills, paint works and other industrial concerns.

An electric-power plant to cost about $50,000 is to be installed at Vilardena, Mexico, by the American-Mexico Mining and Development Company to furnish power for the machinery at its mines. Dr. W. S. Phillips of Chicago is president of the company.

The United Mining and Development Company of America will install a 300-horsepower electric plant in addition to the 400-horsepower plant which is now being put in at its mines situated in the Maconi district of the state of Queretaro, Mexico.

The Rio Tamasopa Sugar Company will install an electric-light and power plant on its large plantation situated near Tamasopa, Mexico. The proposed plant will also furnish power for operating an electric-freight railroad, which is to extend to different parts of the plantation. Among those interested in the company are Dr. John B. Cattic of Anderson, Ind.; C. A. Smart of Wild Rose, Wis., and Colonel Russell B. Harrison of Indianapolis, Ind.

An electric-light plant is to be installed at Uvalde, Tex., by W. H. Rose. He also contemplates building a street railway there.

C. J. Spettae of Panhandle, Tex., is arranging to install an electric-light and power plant at Port Lavaca, Tex. A 40-year franchise for the use of the streets and alleys of the town, which was held by L. Seabrook, has been transferred to Mr. Spettae. The establishment of a complete waterworks system is also proposed by Mr. Spettae.

Governor Bernardo Reyes of the state of Nuevo Leon, Mexico, and the municipal authorities of Monterey, Mexico, are anxious to have the street-railway systems at Monterey converted into electric lines. It is authoritatively announced that Governor Reyes will be most liberal in granting such concessions as may be necessary to protect and encourage the investment of capital in that enterprise. It is stated that the properties of the two street-railway companies now operating there can be acquired cheaply. A long exemption of time and other municipal advantages can be relied on by a new company that will absorb the existing ones and apply to the government for a new concession to change the system to electric transit. Monterey has a population of more than 80,000 people and is the greatest manufacturing and industrial center in Mexico. Many millions of dollars of American capital is invested there in smelters, iron foundries and other manufacturing plants. It is claimed that the American population of Monterey exceeds 10,000 people. The city has been thoroughly Americanized in its business methods, style of architecture of its buildings, etc., during the last 15 years.

Henry T. Lecert, representing a New York syndicate, is investigating the situation at San Cristobal, Mexico, with the view of establishing an electric-light and power plant at that place. H.

Northwestern States.

Minneapolis, February 20.—The city of Lexington, Neb., will advertise for bids for a franchise to install an electric-light plant.

The Union Light, Heat and Power Company of Fargo, N. D., has arranged for improvements to the plant. Machinery has been ordered, including a 1,500-light motor-generator. A car of transformers has also been ordered.

The Sutton Electric Light and Power Company of Sutton, Neb., has been granted a franchise for an electric-lighting plant in that city, and will proceed with construction at once.

On March 7th the city of Shenandoah, Iowa, will vote on granting a franchise to the Shenandoah Artificial Ice Company for a plant for lighting, heating, cooling and for power purposes.

The McBride-Downing Electric Company of St. Paul was awarded the contract for installing a high-tension electric-lighting system at Fort Russell, Wyo., for $23,065.

A company will be formed for the purpose of building an electric line from Springview, Neb., to Newport. The company will be capitalized at $3,000,000. E. Lear is president and H. L. Millay, secretary.

Capitalists at Cresco and Osage, Iowa, will build an electric railway from Decorah, via Cresco and Osage, to Forest City.

Leo Arimond has sold his electric-light plant at Dundee, Wis., to the Dundee Water, Power and Electric Light Company.

The Central Electric Company has leased its plant at LaCrosse, Wis., to the LaCrosse Gas and Electric Company for 18 years.

An ordinance has been passed permitting the Fond du Lac and Northeastern Railway Company to build an electric line into Fond du Lac.

The Chippewa Valley Electric Railroad Company has filed a mortgage for $750,000, given to the Security Trust Company of Camden, N. J. Of this amount $250,000 will be used for the construction of new lines. R.

Pacific Slope.

San Francisco, February 18.—T. D. Petch, superintendent of the Eureka Lighting Company, while in San Francisco on business stated that the company has decided to go ahead with its power-plant project on the Trinity River. This plant is to cost about $500,000 and the preliminary surveys have already been made.

The management of the North Shore electric road has let the contracts for the construction of additional storage-battery plants at Sausalito and San Anselmo, which, when finished, will give the company ample power to meet the requirements of the anticipated increase in traffic over the suburban system. The work of establishing these auxiliary stations will be completed late in the spring, in time for the summer service.

The Santa Clara Valley Transit Company has filed articles of incorporation, and the long-talked-of electric railway between San Jose, Palo Alto and Alviso seems to be an assured fact. The capital stock of the company is placed at $1,000,000. Rights-of-way have been secured and the necessary franchises secured.

The Sierra Nevada Water and Power Company has been incorporated with a capital stock of $5,000,000, with Phœnix, Ariz., as the principal place of business and San Francisco as a branch office.

At the regular annual meeting of the United Gas and Electric Company held in San Francisco, J. E. Green was elected president, and C. H. Pennoyer,

secretary and superintendent. A good financial showing was made.

The first cars for local service over the new San Jose, Los Gatos and Interurban electric road at San Jose have been put in operation, running between the Market Street depot of the Southern Pacific railroad and a point outside the city limits. The cars are for local traffic exclusively, and add about 2½ miles of road to the traction facilities of the city.

A franchise has been granted to Daniel Murphy by the supervisors of San Bernardino for the construction of an electric-light and power plant in Needles, Cal.

The city trustees have accepted the offer of the California Gas and Electric Corporation to light the city of San Rafael on a 50-year contract at the rate of $4,500 per year, a saving of $300 a year. This calls for 30 arc lights and 251 incandescent lights of 20 candlepower each. Extra arc lights to be furnished at the rate of $82.80 each and extra incandescent lights at $6 each. A.

PERSONAL.

Percival E. Fansler, chief clerk of the Department of Electricity at the St. Louis Exposition, is in Chicago. Mr. Fansler reports that the demand for space in the Electricity Building exceeds the supply and that the display will be most instructive and attractive.

Edward N. Lake, formerly chief switchboard draftsman for the Western Electric Company and more recently of the engineering staff of the Chicago Edison Company, has assumed the management of the switchboard department of the J. Lang Electric Company of Chicago.

John F. Dusman, chief electrician of the York County (Pa.) Traction Company and the York Street Railway Company, has tendered his resignation to accept a position with one of the street-railway companies of Baltimore. Mr. Dusman is an attentive student of electrical problems and a familiar figure at electrical conventions.

William J. Hammer, the electrical engineer and investigator of New York, was in Chicago earlier in the week on his way to Denver, where he was booked to lecture on "Radium and Other Radio-active Substances" before the Colorado Scientific Society on February 26th. Next week Mr. Hammer will lecture on the same subject in Duluth. Mr. Hammer has delivered this his latest lecture with great success before the Geographical Society of Johns Hopkins University at Baltimore and the Academy of Arts and Sciences at Pittsburg.

Walter G. McMillan, secretary of the Institution of Electrical Engineers, died at Streatham, England, recently after suffering for a short time from pleurisy. He was born in 1861 and received his education in Kings College, devoting much of his time to scientific work. Previous to the time (1897) of accepting the secretaryship of the Institution of Electrical Engineers, when he also undertook the editing of the institution journal, he held several lectureships in chemistry and metallurgy in various British colleges. He was a member of many scientific and engineering societies and the author of valuable papers and books, principally on electrochemistry and electrometallurgy.

ELECTRIC LIGHTING.

Major R. B. Turner will receive bids until March 16th for the installation of an electric-lighting system at Fort Des Moines, Iowa.

An electric-light company has been organized at Ness City, Kan., for the purpose of furnishing light to the city. The plant is expected to be in operation in two months.

The Utah County Light and Power Company of Lehi, Utah, has engaged E. M. Jones to superintend the construction of the addition to its plant at the mouth of American Fork Canyon.

The town of Waddington, N. Y., at a special election, has voted to sell its municipal electric-light plant and waterpower and rights to a Canadian company for $3,750, the amount which remains unpaid on the plant. The municipal operation of the concern has not proved satisfactory.

The city of Ogden, Iowa, has engaged Dow & Hadfield, consulting engineers of Ames, Iowa, to prepare plans and specifications for a city lighting plant. Specifications will be drawn up and bids received on an electric plant of approximately 1,800 lights, a gas plant of 1,800 lights, and a combined gas and electric plant. Plans will be on file at the city recorder's office after February 26th. Bids will be received up to noon of March 15th.

Germany has 971 electric-lighting and power-generating stations supplying current to municipalities or districts. Of this number 50 have generating plants equivalent to 2,000 kilowatts or more. Nineteen of the 50 large stations generate both direct and alternating current, 16 stations produce alternating current only, and 15 are direct-current plants. The aggregate capacity of these 50 stations amounts to 271,479 kilowatts. The total capacity of all the electric-lighting and power stations is about 400,000 kilowatts. The largest plant is at Moabit (Berlin), which, including its sub-stations, has a capacity of 26,523 kilowatts. The plant at Oberspree (Berlin) has a capacity of 25,423 kilowatts.

The directors of the Deer Creek Water and Power Company, recently incorporated, met at Stewartstown, Pa., and elected officers. James H. Gable of York, Pa., is president, and Charles F. Ramsay of Stewartstown, secretary. The company will construct a dam and power plant on Deer Creek, one mile from Stewartstown, to furnish water, power and light to that town and vicinity. The work of constructing the plant will begin as soon as the weather permits outdoor work.

ELECTRIC RAILWAYS.

The gross earnings of the Louisville (Ky.) Railway Company for the last year, as shown by reports at the annual meeting, were $1,941,599.31. The operating expenses were $1,050,125.98.

Milton H. Smith, president of the Louisville and Nashville railroad, has agreed to lease the narrow-gauge road to the Louisville (Ky.) Railway Company, and the refitting of that line for electric cars will be carried out.

The Topeka (Kan.) Railway Company has executed a trust deed for $1,250,000 to the American Trust and Savings Bank of Chicago. The deed covers all property of the Topeka Railway Company and provides that $300,000 can be used in building steel bridges and re-equipping the power plant.

Fortunately the Pratt Street power house of the United Railways and Electric Company of Baltimore was not destroyed by the great fire. This power house consists of three sections. One section, the oldest, contains direct-current machinery, another section contains the boiler house, and the third the new plant.

Two important franchises are before the City Council of Clinton, Iowa. One provides for the construction of an interurban railway into Clinton, thus forming the nucleus for an interurban-railway system running out from there, while the other provides for the extension of the present street-railway system, and a modern construction for it.

Stephen A. Mitchell is surveying for the Kansas City and Lexington electric railway, being built by J. C. McGrew, a coal operator and mine owner at Lexington, Mo. The line will connect with the extension of the Metropolitan street railway at Fifteenth Street and run through Independence and Levasy, Mo. Mr. McGrew is building the line in order to secure cheaper freight rates into Kansas City.

W. J. Bell, former manager of the Baraboo (Wis.) Telephone Company, is endeavoring to interest business men in an electric line to extend from Baraboo to Grand Rapids—65 miles in length, directly north and south, and furnishing an outlet for all of Adams County, which at present has no railroad within its borders. At Baraboo, Kilbourn and Grand Rapids ample waterpower could be secured to operate the line.

The City Council of Kansas City, Mo., has extended the time given the Kansas City Interurban Railway Company for compliance with its franchise to construct and operate an electric railway from Kansas City through Dodson and Swoope Park. W. E. Winner is promoting the enterprise. The company has been condemning the right-of-way under the state railroad act. The franchise was first granted in 1902.

At a special meeting of the stockholders of the Sioux City, Homer and Southern electric railway, held at South Sioux City, Iowa, plans were discussed for the extension of the Homer line to Omaha. All of the stockholders expressed their anxiety to have the line extended to Omaha, and the understanding is that they will not have any difficulty in securing the right-of-way across the Winnebago and Omaha Indian reservations.

It is said that the Aurora, Elgin and Chicago electric railway is arranging with the Metropolitan Elevated Railroad Company whereby the interurban company's express trains are to be brought into the Metropolitan's Fifth Avenue terminal. An ordinance allowing the Metropolitan elevated to enter into an agreement with any interurban line to carry passengers and mail from Sixtieth Avenue to its downtown station has been introduced in the City Council. Provision is made for an express service every 15 minutes during rush hours and every 30 minutes at other times.

Speaking of the extensive system of public-works improvement upon which France is about to embark and the possibility of Americans securing contracts for a portion of the work, Consul J. C. Covert, at Lyons, says: "As to electric tramways, they are being built all over France, the contracts for them being invariably awarded to French companies. A bright American street-railway man would find many openings for such work in France, but I do not think it possible to secure any contracts of that kind for an American company unless it has a good man on the ground to help look up the lines for the roads and to take the initiative in building them."

SOCIETIES AND SCHOOLS.

The headquarters of the Boston convention of the National Electric Light Association, to be held on May 24th to 26th, will be at the Hotel Vendome.

The American Institute of Mining Engineers at its recent meeting in Atlantic City, N. J., decided to make a pleasure trip through the West Indies, the start to be made on March 8th. The officers elected were: President, James Gayley; secretary and editor, R. W. R. Raymond; treasurer, Frank Lyman, all of New York city.

A site for a new athletic field has been presented to the Armour Institute of Technology by J. Ogden Armour. Besides the importance to athletics, the gift is regarded as a valuable one by President Frank W. Gunsaulus as a site for other buildings in the future history of the school. Dr. Gunsaulus states that already new courses are being planned in anticipation of the enlarged capacity, among them being new courses in electricity. Some of the land will be reserved for the new machinery building, the construction of which seems inevitable.

The New York meeting of the American Institute of Electrical Engineers announced for Friday evening, February 26th, will be held after this issue of the Western Electrician has gone to press. Papers are to be read as follows: "European Practice in the Construction and Operation of High-tension Transmission Lines and Insulators," by Guido Semenza, chief electrical engineer of the Italian Edison Company of Milan, Italy; "Conductivity of the Atmosphere at High Voltages," by Harris J. Ryan, professor of electrical engineering, Sibley College, Cornell University, Ithaca, N. Y.

TELEGRAPH.

The Japanese army has a valuable aid in the bamboo forests of the orient. The poles used in its military-telegraph service are of bamboo, easily transported and easy to erect, and the telegraph keeps up with the marching columns and gives them constant communication with headquarters.

Bear Island, the largest island in Lake Michigan, will be connected with the mainland by a government cable this spring. The island lies near the foot of Lake Michigan, and since its settlement early in the last century has had no communication with the outside world except by boat during the summer. There are a number of commodious harbors, affording anchorage for boats, the largest being at St. James, a prosperous town. The cable will be laid from North Manitou Island to Beaver Island, with the land end at Glen Haven, Mich.

At a recent stockholders' meeting, in London, of the Direct United States Cable Company a report was submitted showing that the revenue for the six months ended with December 31st last, after deducting payments, amounted in round figures to £47,815, while the working and other expenses, including income tax, but exclusive of the cost of repairs, absorbed £21,816, leaving a balance of £25,999 net profit. President E. M. Underdown stated that the depth of water in which the last great repair was effected was 2,100 fathoms. It was satisfactory to know that no difficulty was experienced in dealing with the most complicated repairs.

SPACE TELEGRAPHY.

It is reported that the Japanese fleet in its passage to Port Arthur was able to intercept messages from the Russian space-telegraph stations located about 50 miles from Port Arthur. By this means the name of the warship Askold was read and further assurance of the fleet's whereabouts was afforded.

A working agreement has been effected between the Marconi Wireless Telegraph Company of America and the Western Union and Postal Telegraph companies, whereby every telegraph office in the United States and Canada becomes an authorized agency for the receipt and transmission of space-telegraph messages. This is an important step in the progress of space telegraphy.

A recent issue of the Glasgow (Scotland) Herald says: "An arrangement has recently been made with Reuter's News Agency for the regular transmission through the company's stations to vessels fitted with the Marconi system of press telegrams. Even at the present time the company is deriving a considerable profit from this business, although the range of transmission has been limited."

PUBLICATIONS.

The Phosphor-bronze Smelting Company of Philadelphia is sending out a small booklet containing price lists for 1904. The products of the company include roll and sheet phosphor-bronze, wire, wire rope, bars, plates, etc. The company now has a new rolling mill in successful operation.

Automobile-charging outfits as manufactured by the Westinghouse Electric and Manufacturing Company of Pittsburg are fully described in a late bulletin. One neat piece of apparatus is shown on the front page, and is a station-charging outfit with rheostats complete. Any number of cells from 10 to 40 may be charged simultaneously. Small charging panels are another specialty of the company

and are made of blue Vermont marble, some containing just an ammeter, voltmeter, switch and circuit-breaker; others are of a more elaborate nature, carrying as many as 12 switches, with corresponding rheostats. The company is also sending out a small booklet on auxiliary apparatus for railway equipments, such as automatic circuit-breakers, canopy switches, lightning arresters and the like.

The Electric Storage Battery Company of Philadelphia in a recent bulletin describes an installation of Chloride accumulators made for the San Francisco, Oakland and San Jose Railway Company in California. The bulletin contains pictures of the battery room, booster, and also some curves of operation. The average weekly load of this plant is about 700 amperes.

MISCELLANEOUS.

Recent advices from Mexico state that the Mexican government has issued an official decree increasing the duty on steel rails and other steel products to $10 a metric ton.

A merger of some of the principal copper properties in Utah and Nevada has been effected under the name of the Monarch and Smelter Corporation. The new company is capitalized at $30,000,000, and is organized under the laws of Maine. Arthur B. Lewis is the organizer of the present merger, which means the control of no less than 8,000,000 acres of mineral land. Senator Lewis says that the new company will be independent and has no connection with the Amalgamated Copper Company.

The British Westinghouse Electric and Manufacturing Company has a very complete system of training in its workshops. For a machinist the course includes four months' training in the blacksmith shop, nine months at the lathes, drilling and milling machines, nine months also at planing and boring machines, four months at assembling, four months at screwing machines, and 18 months at the bench and in other ways, the total being four years. Apprentices may take either a mechanical or an electrical course, and the company has at present nearly 150 school and college apprentices. At present some 6,000 workmen of various kinds are employed.

Finsen's Medical Light Institute in Copenhagen, Denmark, which was established by Professor Niels R. Finsen in 1896, has now been made a state institution. Up to May, 1903, 1,367 cases of malignant diseases had been treated, of which 1,000 were lupus vulgaris. Great interest has been aroused in the United States among the medical profession, which was strikingly evinced by the influx of American doctors into Copenhagen during last year. Seventy-five American doctors visited the institution during the year, from all sections of the United States, and many purchased Finsen lamps with a view of establishing institutes in this country. Of the first 800 lupus cases treated in Copenhagen, 407 were apparently cured, 193 almost cured, 80 decidedly improved, 40 were unsatisfactory and 71 disappeared from observation.

TRADE NEWS.

The recent disastrous fire in Baltimore destroyed the office of the district manager of the Bullock Electric Manufacturing Company. Temporary quarters have been located at 303 Cortlandt Street, in that city, where all inquiries should be addressed. This office is working full force and ready to take care of all business.

The many friends throughout the West of the Buckeye Electric Company of Cleveland will be interested to know that owing to ill health President M. K. Eyre, of the company, has been compelled to go South for an indefinite period, and L. P. Sawyer, formerly district manager for the Bryan-Marsh Company at Minneapolis, has been tendered and has accepted the position of manager of sales of the Buckeye Electric Company, with headquarters at Cleveland. Mr. Sawyer comes to his position well qualified to succeed in this new field. For 16 months his work as manager of the Bryan-Marsh Company's Minneapolis office has been a credit to both his company and himself. His intimate knowledge, too, of the scientific and technical side of lamp manufacture as well as of the lamp trade will now stand him in good stead. Mr. Sawyer was graduated from the University of Nebraska and has been connected with the Western Electric Company and the Sawyer-Man Company.

The Illinois Tunnel Company, which recently took over the assets of the Illinois Telephone and Telegraph Company, announces that bids for about 2,000 steel freight cars similar to those described in the Western Electrician of February 13th, and to be operated in the company's tunnels in Chicago, will be asked about March 15th. Many of the large buildings and wholesale houses are having connections cut from the tunnels to their basements and will soon be ready to receive and deliver goods to and from railroad terminals.

BUSINESS.

The Electric Appliance Company, Chicago, announces that it has added to its already large stock of electrical supplies a complete line of trolley ears and wheels, and that it is prepared to quote prices on railway overhead material.

The Central Electric Company, Chicago, reports gratifying business in American Circular Loom non-metallic flexible conduit. The company states that the trade generally throughout the country has been quick to take advantage of its prices and that it has received some large orders.

The J. Lang Electric Company of Chicago reports a satisfactory business in switchboards for the last year. The company is prepared to furnish designs and estimates for switchboards of any size and guarantees first-class apparatus. It is distributing small packets of mailing cards of a size permitting them to be placed in a card index. The cards bear a blank form to be filled out by those desiring to interview a representative of the company in regard to furnishing estimates.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) February 16, 1904.

752,036. Prepayment Apparatus. Melvin D. Compton, New York, N. Y. Application filed October 22, 1901.

In connection with a circuit maker and breaker, is a motor and a convolute-shaped cam, having a notch operatively connected with the motor. A pivotal coin lever is adapted to co-operate with the cam and has a tail which works in the coin slot. A movable backstop for the lever, mounted in proper relation to the lateral coin opening, ejects undersized coins.

752,037. Electric Train Service. Melvin D. Compton, New York, N. Y. Application filed December 2, 1901. Renewed September 12, 1903.

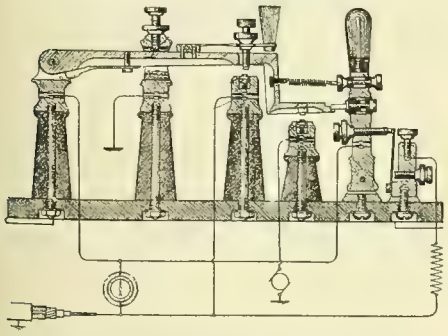
A generator circuit extends from end to end of the train and another circuit in parallel with the first contains a storage battery. The translating devices are situated on the battery side of an interruption in the latter circuit, and a motor-driven switch, subject to variations in potential of the generator circuit, operates to make and break the continuity of the battery circuit.

752,048. Electric Meter. Thomas Duncan, Lafayette, Ind. Application filed October 23, 1903.

The motor element includes armature and field portions. A friction compensating coil produces a field for the armature, and a switching device with a number of contact buttons connected with different portions of the coil co-operates with a switch arm adapted to engage the buttons and include more or less of the coil in circuit.

752,059. System for Operating Stock Boards. George S. Gallagher, New York, N. Y., assignor to himself, Rupert L. Joseph, and Frank E. Burrows, New York, N. Y. Application filed April 29, 1903.

Movable paper strips for quotations of different stocks are provided each with an electrical printing instrument. A circuit maker successively completes the electric circuit through the several printing instruments, a circuit selector controls the circuit maker, and an operating device controls the printing instrument.



NO. 752,158. KEY FOR CABLE TESTING

752,081. Car Signal. George M. Lane, Brooklyn, N. Y. Application filed May 14, 1903.

At intervals along the track catches are arranged which engage an arm carried by the locomotive. This arm operates an electric circuit and signal in the cab.

752,084. Railroad Signal. John K. Leedy, Roanoke, Va. Application filed November 10, 1902.

Several superposed arrows secured at an intermediate point to posts point respectively in opposite directions and carry signaling lamps. Current-conducting wires connect corresponding signals in series and extend between two separated terminal points or stations. A source of electrical energy at each station has multiple connection with all of the current conductors, and a number of independent switches are disposed at one station for closing the circuit through the signals carried by one set of arrows, corresponding switches being disposed at the opposite terminal for closing the circuits through the signals carried by the second set of arrows.

752,097. Automatic Starter for Electric Motors. William C. O'Brien, Baltimore, Md. Application filed May 4, 1903.

A resistance is arranged in the armature circuit of the motor, which carries a series of contact surfaces. A contact device movable over the surfaces increases and decreases the resistance in the armature circuit, and an electromagnetic controlling device moves the contact device to cut the resistance out of the armature circuit. An independent circuit includes the coils of the controlling device, with means for automatically interrupting the latter circuit when the resistance has been cut out of the armature circuit. (See cut.)

752,121. Trolley Finder. Elisha S. Stitt, Newton, Mass. Application filed October 17, 1902.

A guide fork is pivotally connected to the trolley pole to direct the wheel to the wire.

752,125. Panel Board. Hans O. Swoboda, East Orange, N. J. Application filed December 22, 1902.

Bus bars are secured to the panel board and a double-pivoted knife switch and contacts for engagement are secured on the panel board between the bus bars. Fuse connection is made between one switch-blade terminal and the adjacent bus bar and between one contact and the bus bar adjacent thereto. Distributing conductors connected to the other switch blade and to the other contact, respectively, remove the terminals of the distributing conductors from the bus bars.

752,127. Railway Switching and Signaling Apparatus. John D. Taylor, Buffalo, N. Y., assignor to the Taylor Signal Company, Buffalo, N. Y. Application filed January 12, 1901.

A motor is connected by a shifting device either to an operating circuit or an indication circuit. A magnet included in the indication circuit unlocks the detent which holds the interlocking mechanism.

752,139. Trolley Catcher. William C. Young and Johnston McMahon, Buffalo, N. Y. Application filed June 1, 1903.

A main spring for pulling the trolley downwardly is secured at its lower end to the lower end of a standard. A yoke is secured to the upper end of the main spring and receives the pull of the trolley. A retracting spring disengages a latch from a shoulder on the standard, operating independently of the pull of the trolley.

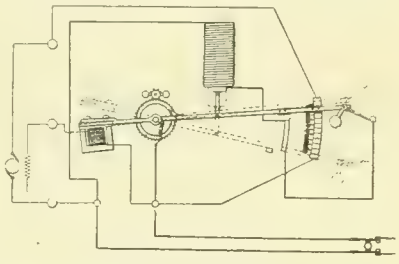
752,150. Electric Selective System. Julien A. Géhrung, St. Louis, Mo. Application filed February 8, 1902.

In the main line is a series of sending keys adapted to send varied or diverse electrical impulses of different polarities along the main line. A series of electromagnets having correspondingly graded electromotive forces co-operate with two groups of interdepending circuit closers, arranged parallel with opposing pairs, and operatively connected to single selective electromagnets.

(See cut on next page.)

752,158. Key for Cable Testing. William B. Hale, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed April 29, 1901.

A supplemental spring-mounted key is carried by a switch arm and controls an independent contact. Upon operating the supplemental key the switch arm is operated, and upon releasing the switch arm another contact is closed. One contact controls the connection of the source of current with the galvanometer and with the cable to be tested, while the contact of the supplemental key short-circuits the galvanometer. (See cut.)



NO. 752,097.—AUTOMATIC MOTOR STARTER

752,168. Dynamo-electric Machine. Hans Holzwarth, Hamilton, Ohio, assignor to the Hooven, Owens, Rentschler Company, Hamilton, Ohio. Application filed November 21, 1903.

Means for ventilating a specially constructed armature are described, which consist in providing the armature with a series of ventilating spaces, passing outwardly from the shaft, and each provided with an independent inner chamber. An axial conduit within the core connects with each of the chambers.

752,184. Hanger for Telephone Transmitters. Michael Setter, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed May 8, 1902.

The transmitter has a removable threaded mouthpiece and a flattened back portion. A ring-like portion is clamped in place by the mouthpiece, a flattened portion being also clamped in place upon the back portion of the transmitter.

752,192. Electric Switch. Charles C. Badeau, Swissvale, Pa. Application filed August 12, 1903.

An oil chamber in the switch contains two contacts arranged with means for shifting one of the contacts away from the other. An electromagnet forms the base of the oil chamber and an armature controls the movement of the contact.

752,236. Electric Generator. Hans Liebreich, Boston, Mass., assignor to the International Electric Company. Application filed June 29, 1903.

Means for passing the conductors through the magnetic field and for demagnetizing the field at a proper time to prevent the retarding effect of a continued cutting of the lines of force as the armature [illegible]

752,251. Automatic Telephone System. John K. Norstrom and John J. Brownrigg, Chicago, Ill., assignors to the Globe Automatic Telephone Company, Chicago, Ill. Application filed June 28, 1901.

Combined with the switches [illegible] is an electromagnet [illegible]

same electrical current that operates the telephone system, and normally lying in a shunt circuit. Electrical circuits operating as a test to determine whether the station called is busy, and a cut-out operated by the magnet whereby the station is put out of communication with the calling station if it is busy are other important features.

752,345. Electromagnet. James C. Keller and Otto F. Kadow, Cleveland, Ohio. Application filed May 23, 1903.

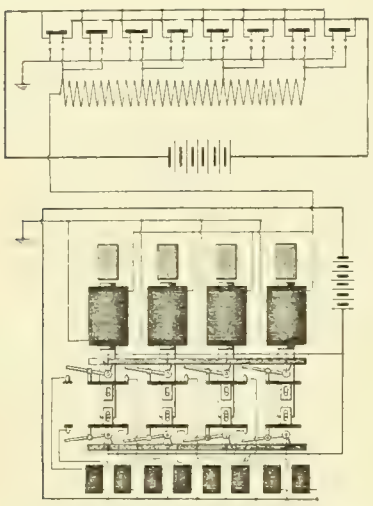
An electromagnet provided with a core consists of two members, one fixed and provided with a bracket and the other movable on a hinge. A rod is pivotally connected with the movable member and the bracket.

752,349. Battery-stem Guide. William H. Martin, Nevada City, and Alexander McCombie, Grass Valley, Cal. Application filed July 22, 1903.

A metallic block has upon opposite sides of its stem space downwardly converging guides and a cap with lateral flanges, the edges of which converge downwardly and are adapted to engage the guides.

752,357. Process of Electrically Heating Articles. Edgar F. Price, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed November 5, 1902.

The process consists in interposing between different portions of the electrodes or terminals of a source of electric current, direct-current paths comprising a resistance conductor and a separate layer of material which is normally a poor conductor of electricity, but is converted into a better conductor by heat. The articles to be heated are arranged in proximity both to the conductor and layer and an electric current passed directly through the resistance conductor, thereby initially heating the articles and layer of poorly conducting material.



NO. 752,150.—SIGNALING SYSTEM.

752,358. Process of Heating Articles by Electricity. Edgar F. Price, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed November 5, 1902.

Layers of the material to be heated are placed between high-resistance electric conductors. When heated the substance becomes a better conductor and carries part of the current, thereby coming to a still higher temperature.

752,374. Automatic Check Device for Trolley Cords. Seth J. Buckland, Springfield, Mass. Application filed April 22, 1903.

Mechanical features are described for an apparatus for automatically taking up the slack in the trolley cord.

752,384. Electrical Igniter for Explosive Engines. Willard E. Dow, Braintree, Mass. Application filed July 2, 1903.

The apparatus contains a single vibrator with several induction coils. An interrupter in each circuit causes the spark, the interrupters acting dissimultaneously.

752,391. Electric Motor. Christian Fleischmann, Bloomfield, N. J. Application filed June 24, 1903.

The motor armature is centrally mounted in a casing. A cylindrical field-coil carrier incloses the armature and is mounted at its ends upon frames rotatable in the casing. One of the frames is provided at its edge with rack teeth, and a worm is mounted upon the exterior of the casing in engagement with the rack teeth, so that the field may be shifted.

752,394. Means for Operating Synchronously Phonographs and Kinematographs. Léon Gaumont, Paris, France. Application filed December 17, 1901.

An electric motor which drives a kinematograph has a source of electricity, current being supplied to its field magnet in constant angular relation to that operating the phonograph, whereby synchronous relations are maintained between the movements of the phonograph and kinematograph. (See cut.)

752,405. Transformer. Charles B. McCurdy, Warren, Ohio, assignor to the Peerless Electric Company, Warren, Ohio, and Frederick C. Sutter and Robert V. Bingay, Pittsburg, Pa. Application filed April 24, 1902.

A primary winding consists of two coils, one coil on each leg of the core. A secondary winding upon the core consists of two coils, one upon each leg, one secondary coil being wound reverse or opposite to the other. Each secondary coil has a tap from its center, the taps being connected between the coils to form the neutral wire for a three-wire system.

752,408. Electrical Apparatus for Producing Sound Signals. Charles H. O'Brien, Augusta, Maine. Application filed November 1, 1902.

Details are described.

752,419. High-tension Therapeutic Electrode. Manuel Rodrigues, Brooklyn, N. Y. Application filed June 3, 1901. Renewed July 9, 1903.

High-tension static-discharge electrodes are used for medical purposes.

752,431. Automatic Signaling Apparatus for Incubators or Hothouses. Horace B. Ault, Newmarket, Tenn. Application filed July 20, 1903.

When the heat inside the incubator reaches a predetermined point, a thermostatic arrangement throws into circuit an alarm bell.

752,437. Overhead-trolley Guide. Charles W. Burkhead, Madisonville, Ohio. Application filed August 16, 1902.

Projecting members journaled on the trolley-wheel axle guide the wheel upon the wire.

752,456. Receptacle and Attachment Plug. Hubert Krantz, New York, N. Y. Application filed October 24, 1903.

The receptacle contains a main and a supplementary socket.

752,460. Firing Mechanism for Ships' Guns. Ludwig J. Mautner, Vienna, Austria-Hungary. Application filed June 4, 1903.

The device is mounted to turn on the horizontal axis of the gun. It contains a movable sphere, which, when the gun arrives at a certain angle with the horizon will roll along its track and make electrical contact, firing the gun. The angle is determined by previous adjustment of the apparatus.

752,501. Trolley Hanger. Montraville M. Wood, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 8, 1903.

An inverted-cup-shaped recess adapted to receive the head of an insulated stud carries the trolley hanger.

752,528. Protective Means for Electric Boosters. Maxwell W. Day, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 6, 1903.

Combined with a booster is a shunt motor for driving it, and a circuit-breaker in the main supplying both of them, having its tripping coil in the armature circuit of the motor.

752,531. Electric Switch. Warren K. Dodge, Manhattan, Kan. Application filed October 23, 1903.

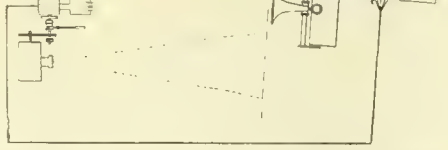
A rotary movable part has a number of circuit contacts. An inclosing case is supplied with stenciled markings through the walls, and an electric lamp within. A movable arm throws the lamp into circuit and a mask plate is attached to the rotary movable part of the switch and has cut-away portions to expose the stencil markings in the case whenever the corresponding contacts within the case are in circuit.

752,533. Wireless Signaling. Daniel Drawbaugh, Eberlys Mills, Pa. Application filed May 1, 1902. Renewed July 15, 1903.

Two metal plates with means for impressing on the plates intermittent currents of high potential are embodied in the invention. A source of current and means for modifying the latter current by and in accordance with sound waves, and for impressing the modified currents on the plates, are the other features.

752,534. Method of Transmitting Intelligence Through the Natural Mediums. Daniel Drawbaugh, Eberlys Mills, Pa. Original application filed March 1, 1902. Renewed July 15, 1903. Divided and this application filed June 28, 1902. Renewed July 15, 1903.

A method of transmitting intelligence through the earth consists in first impressing on the earth at two points currents of high potential, then impressing on the earth at the two points currents modified in accordance with the signal to be transmitted, and receiving the modified currents at a distant station.



NO. 752,394.—SYNCHRONOUS PHONOGRAPH AND KINEMATOGRAPH.

752,544. Electrical Device for Shocking Horses. James A. Giles, Elberton, Ga. Application filed September 24, 1902.

A magneto generator, within reach of the driver, supplies current to electrodes on the horse's harness. The object is to give a shock to the animal to incite it to greater speed or activity.

752,552. Automatic Circuit-breaker. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 28, 1898.

Main contacts and a number of shunting contacts closing circuits of different resistance are all carried on the same rod, those of lower resistance arranged to open before those of higher resistance. A chute incloses the shunted contacts, and arc-extinguishing means, such as a blow-out magnet, for the shunting contacts, are also supplied.

752,571. Machinery for Raising or Lowering Stage Scenery, etc., of Theaters. Edward Lytton, London, England. Application filed August 28, 1903.

An electric motor is used to raise and lower the curtain, a stop on the curtain operating a catch, which in turn automatically stops the curtain.

752,583. Lamp Reflector. Albert J. Pardridge, Chicago, Ill. Application filed April 11, 1903.

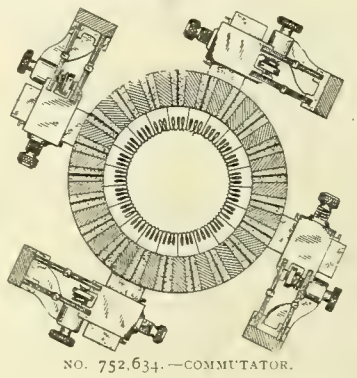
A conical reflector with central portion is provided with springs divided to form superimposed frustums of cones of relatively strong and weak parts placed to form frustums of cones of relatively different conicity, the cones forming a longitudinal extension of the reflector.

752,589. Electromagnetic Reversing Device. John Riddell, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 28, 1900.

A magnet armature is mechanically connected with the machine and two electromagnets in operative relations with respect to the armature are rotated simultaneously in opposite directions. A switch adapted to be operated by the machine at a selected phase of its movement opens the circuit of the coil of one magnet and closes the circuit of the coil of the other magnet. At another selected phase of its movement it opens the circuit of the latter coil and closes the circuit of the former coil.

752,590. Magnetic-clutch Application. John Riddell, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 27, 1901.

Two rotatable electromagnets and a rotatable armature between them are so arranged that the armature can engage with each of the magnets. A device prevents the armature from engaging with either magnet during certain periods of operation.



NO. 752,634.—COMMUTATOR.

752,613. Relay. Albert Carliss, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed May 25, 1901. Renewed December 23, 1903.

Details are described.

752,627. Controlling Means for Explosion Motors. Walter J. Lloyd, Birmingham, England, assignor of one-half to William Priest, Pirmingham, England. Application filed November 3, 1902.

A commutator is arranged to engage the controlling means of the exhaust valve and co-operates with a sparking-electrode contact.

752,634. Commutator for Dynamo-electric Machines. Frederick W. Young, East Orange, N. J., assignor to the Crocker-Wheeler Company, Ampere, N. J. Application filed May 22, 1903. Renewed January 9, 1904.

The commutator has composite commutator bars, each consisting of a metal contact bar, with a carbon contact bar adjoining the leaving edge and in direct contact with the metal contact bar. (See cut.)

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on February 22, 1904:

358,019. Electric-battery Jar. Charles G. Curtis and Francis B. Croker, New York, N. Y.
358,030. Galvanic Cell. William Frishmuth, Philadelphia, Pa.
358,031. Galvanic Cell. William Frishmuth, Philadelphia, Pa.
358,043. Transmitting Gear for Electric Motors. Walter H. Knight, New York, N. Y.
358,053. Electrical Pumping Apparatus. Moses A. Michaels, Allegheny, Albert Michaels, Pittsburg, Pa., assignors of one-fourth to John B. Sneathen, Pittsburg, Pa.
358,087. Galvanic Battery. William H. Tasker and Thomas J. Jones, London, assignors to the Primary Battery Co., Hanover Square, County of Middlesex, England.
358,092. Secondary Electric Battery. Jean Th. van Gestel, New York, N. Y.
358,109. Electric Push Button. Augustus G. Davis, Baltimore, Md.
358,111. Manufacture of Plates or Elements for Voltaic Batteries. Desmond G. Fitz-Gerald, Brixton, County of Surrey, Assignor to Primary Battery Co., Hanover Square, County of Middlesex, England.
358,120. Voltaic Battery. Thomas J. Jones, 12 Princes Street, Hanover Square, County of Middlesex, England.
358,131. Pump for Producing High Vacua. Elihu Thomson, Lynn, Mass.
358,133. Regulator for Dynamo Electric Machines. Francisco Vivoy Graells, Barcelona, Spain.
358,145. Electric Arc Lamp. Walter A. Crowdus and Henry M. Sutton, Dallas, Tex.
358,161. Electrical Gas Alarm. William McVay, Quincy, Ill.
358,250. Telephone Annunciator. John A. Barrett, Brooklyn, N. Y.
358,314. Electric Battery. Schuyler S. Wheeler and Charles G. Curtis, New York, N. Y.
358,309. Switchboard for Electric-light Systems. Geo. H. Warde, Brooklyn, N. Y.
358,317. Telephone Exchange System. George L. Wiley, Elizabeth, N. J.
358,340. Dynamo Electric Machine. Rudolph Eickemeyer, Yonkers, N. Y.
358,341. Electrical Accumulator or Storage Battery. Chaimsonovitz P. Elieson, London, Eng.
358,343. Armature for Electric Magnets. Charles A. Gaiser, Edwardsville, Ill.
358,346. Electric lighting System. James E. H. Gordon, 28 Coolingham Place, Kensington, County of Middlesex, England.
358,360. Electrical Mail Indicator. Virgil A. Krepps, New York, N. Y.
358,379. Telegraphy. Robert G. Brown, Brooklyn, N. Y.
358,386. Electric Battery. Francis B. Croker and Charles G. Curtis, New York, N. Y.
358,393. Fire Telegraph. John B. Guest, Brooklyn, N. Y.
358,415. Induction Coil. Marmaduke M. M. Slattery, Woburn, Mass.
358,417. Electrical Door Opener. Lucius P. Summers, Ormond, Fla.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, MARCH 5, 1904 No. 10

Some Features of the New Bellefontaine Exchange.

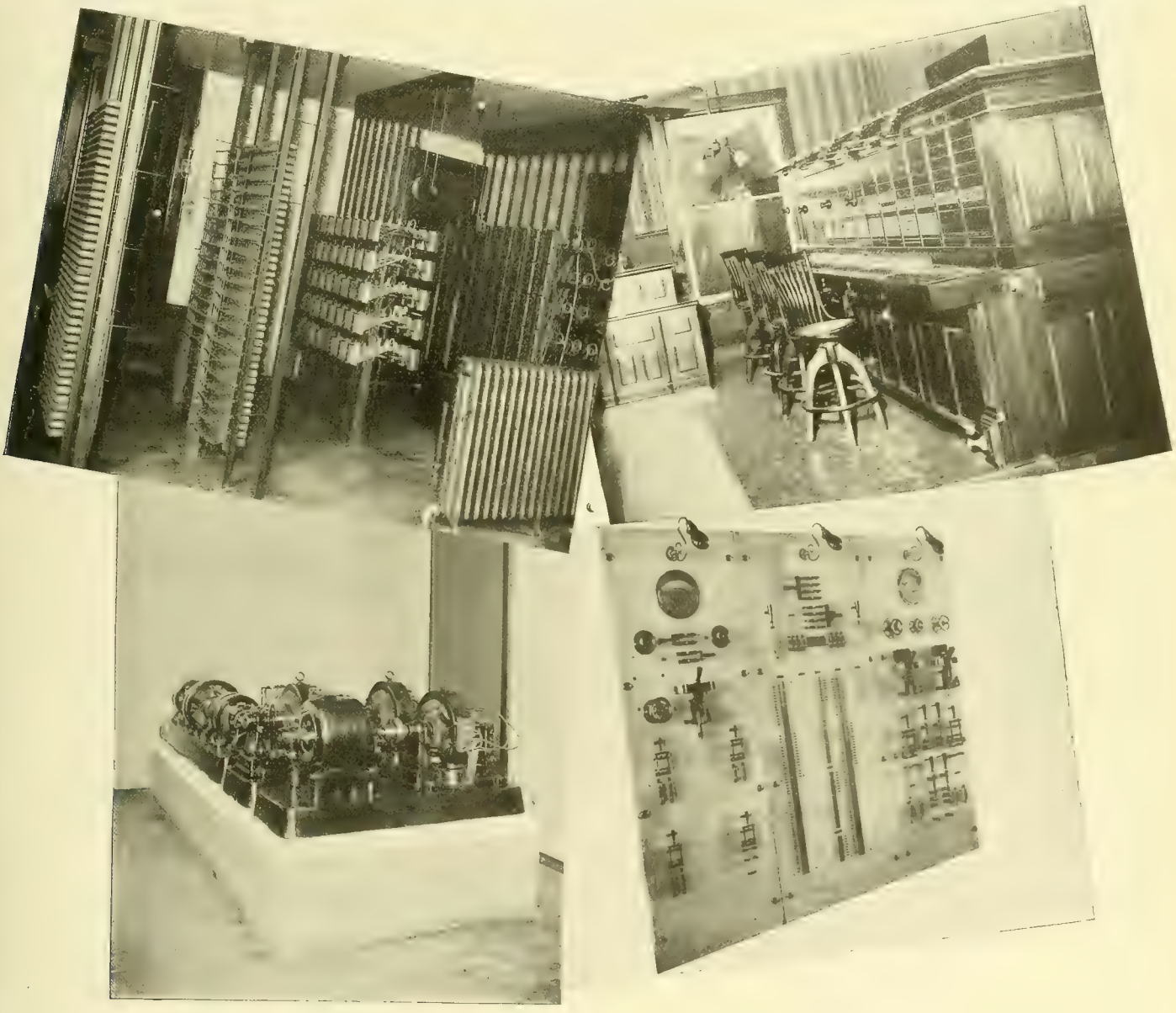
The new central-energy telephone plant which has lately been completed at Bellefontaine, Ohio, for the United Telephone Company possesses several features never before incorporated in an Independent telephone plant. When the plant was first opened for business the company had less than 100 telephones. This list rapidly grew until it became necessary to make several extensions to the plant. After a few years the company discarded the old equipment and purchased a new magneto express board, which has again been supplanted by the present equipment. When the company was first organized it did not foresee the wonderful development the Independent telephone movement would bring to the telephone field. Its rates were low. As the number of telephones increased from less than 100 to nearly 1,000, an increase of rates became necessary. This is one of the features taken into consideration in arranging for the new equipment.

Being a common-return magneto system, the old plant gave slow service and was not altogether secretive. The new system was equipped for metallic service throughout and arranged for a selective four-party-line service. This four-party-line service being superior to the individual-line service formerly given over the old system, the company had no difficulty in getting its subscribers to accept it at the same rates formerly paid for individual service, which was $12 a year for residences and $24 for business houses. A subscriber wanting a better class of service was given a two-party line at the rates of $15 and $27. If he wanted strictly individual service he was given an individual metallic line at $18 or $30, for residence and business, respectively. Solicitors experienced in telephone work and familiar with party-line systems had no difficulty in convincing the subscribers that they would receive a better and more secretive service for the same money with the privilege of better service for a slight advance in the rate. In this way the rates were raised with the subscribers hardly realizing that there was an advance, but in reality the company increased the earnings about $2,000 a year besides increasing the capacity of the outside wire plant nearly 50 per cent. This latter feature is important. The outside wire plant is one of the most expensive parts of a telephone plant, besides having a greater depreciation, owing to being exposed to the elements.

The old style of biased ringers operated by positive and negative pulsating currents had been tried by the Bell company and in a great many places discarded, owing to the great expense incurred in maintaining the system. The polarized bells or ringers were required to be biased by a spring which was subject to changes in temperature, and the slightest change in the tension of these springs affected the bell adjustment, and the bells would not ring when they should, or would ring when they should not (when some other subscriber on the line was called). This plan was not considered, owing to the expensive maintenance and inaccuracy in selecting. The system selected was the multifrequency system, known as the Dean system, in which there is no third wire or ground wire required. After selecting a party-line system the central-office equipment was secured. This was manufactured by the North Electric Company of Cleveland, Ohio.

One of the special features is shown by the cut on the next page, which represents a four-party selective indicating key. This key was used in each cord circuit, this being an important factor in giving good party-line service as well as making a saving of nearly 20 per cent. in operating.

Upon receiving a call the operator answers it in the ordinary way with an answering cord and listens by means of a listening key. After obtaining the number, say 536 L, she connects the subscribers as usual and depresses the L button. If the calling subscriber had called for 536 Y, she would

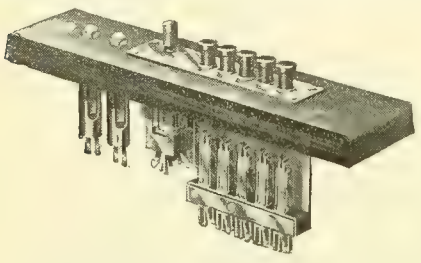


Relay Racks and Distributing Frame.
Power Plant.

Telephone Switchboard.
Power Switchboard.

SOME FEATURES OF THE NEW BELLEFONTAINE EXCHANGE.

have depressed the Y button. If he had called for 536 (an individual telephone), she would have pressed the button nearest the listening key, this button being wired for ringing the metallic or individual telephone. Upon ringing a subscriber the button used remains slightly depressed for the time being, so that the upper surface of the button remains slightly below the level of the other buttons. By a glance at the keyboard an operator knows by the supervisory lamps that a certain subscriber has not answered; she at once presses the button again, which is slightly depressed, and again rings the subscriber. This indicating feature is valuable in giving rapid and accurate service; otherwise, the operator, after answering two or three other calls and noting by the supervisory that a subscriber had not answered would be at a loss to know which one of the four parties on the line to ring. After the conversation is completed and the operator wishes to use this pair of cords for another subscriber, by pressing another button the former depressed button



FOUR-PARTY SELECTIVE INDICATING KEY IN BELLEFONTAINE EXCHANGE.

is released and the last button used is left, indicating which party she had just rung.

Another feature of economy is the number of lines to each operator. A careful test was made of the number of calls answered over the old exchange each day. This gave a basis upon which to determine the number of lines to be placed in each operator's position on the new board. The number of calls that should be handled per day per operator's position has been quite accurately determined by experience. This number varies according to the class of equipment—that is, whether there is a magnet or lamp-signal board used, whether there is a transfer or multiple board, or whether there is trunking. If party lines are used there cannot be so many lines per position; otherwise, it would make too many calls per position. Whether the keyboards are equipped with individual indicating keys or master keys makes considerable difference in the number of lines handled per day per position. All these questions should be considered in designing a new board. The cost of answering calls varies from 14 cents per subscriber per month to 83 cents per subscriber per month, or, more definitely, the cost of answering calls varies from 50 cents per 1,000 to $3.60 per 1,000. Among the Independent telephone plants it has been almost invariably found that where it costs the most to answer calls the service was the poorest. In Bellefontaine each operator is given 200 to 250 subscribers. The average number of calls per telephone per day is approximately five, which gives each operator's position approximately 1,200 calls. While this number of calls gives the operator somewhat below the average amount of work, it has very materially reduced the cost of operating. The service is more prompt than is ordinarily found in the average exchanges, the speed in answering being approximately three seconds. The total number of lines installed on the board is 800. With a party-line equipment the capacity is very much increased.

The first position of the main board was equipped to take care of farmers' lines and toll lines, the toll lines being switched to this position during the night and to the regular tollboard during the day. There was a two-position tollboard installed to take care of the toll business. The toll traffic in and out of Bellefontaine is quite extensive, owing to the fact that the city is the center for a number of smaller towns, which are connected with Bellefontaine by toll lines. It is also a switching point for the United States Telephone Company's long-distance lines. The tollboard is arranged for a distributing operator's position for receiving incoming calls. The position is also arranged for handling a portion of the outgoing business. Half of the cord circuits in each operator's position are equipped for toll-to-toll work, while the other half are equipped for handling the toll-to-local work.

Toll-to-toll cord circuits are equipped with three keys, each key having a double motion. One movement of the first key rings on the answering cord; the second movement places a repeating coil in the cord circuit. The second key is arranged so that the operator can speak to either toll party without the other party listening. This is found very desirable in toll work and saves the trouble of the operator using two pairs of cords, as is the usual practice of the toll operator. The third key fills the function of the ordinary key, that of listening to either subscriber and ringing on the calling cord. The toll-to-central-energy cord circuit is similar to the toll-to-toll cord circuit, except there is a master key added for selectively signaling party-line subscribers in the local exchange. The central-energy side of the toll-to-local cord circuit was equipped with lamp-supervisory signals, so that a local subscriber hanging his receiver on the hook signals the toll operator to disconnect. This is quite important when accurately timing toll messages. There is an extra key wired in each operator's induction-coil circuit on the tollboard, so that the operator's transmitter will not take up noise from the operating room when the operator is supervising the connection. At the same time there is an impedance coil cut in the receiver circuit. This coil adds sufficient resistance in series with the receiver to prevent the cutting down of the efficiency of the toll line to persons talking over that line.

The system of trunking between the main boards and toll board is quite ingenious. It is so designed that a person cannot call and give a false number and get service. This is sometimes done by dishonest persons to prevent having toll messages charged to them.

Besides the usual apparatus used by the chief operator for supervising the service there is a special tertiary-wound induction coil, which admits of the chief operator listening to an operator's conversation without the operator being able to detect that the chief operator is listening. There are also special-service trunks, which are so wired that any subscriber complaining about receiving poor service is closely supervised by the chief operator. Each time a subscriber makes a call it is duplicated on the chief operator's desk, and in this way she is able to determine whether the subscriber is given the proper attention by the operator. There is also another arrangement by means of which the chief operator knows of each call that is made on any particular line which may need supervision. If a man is being called and bothered and is not able to locate the offender his line is multipled on the chief operator's desk by a special circuit, so that each time he is called the chief operator has a notice of the fact, and she can then ascertain if the party calling is the offender. These features quite often prove very valuable, especially in large multiple exchanges.

The power plant embodies several new features which have not heretofore been used in telephone-power plants, one being the multicycle ringing machine. This machine is composed of a one-fourth-horsepower motor directly coupled to four special generators, which give a frequency of 2,000, 4,000, 6,000 and 8,000 respectively. The bells of the telephone are designed to correspond to the frequencies of these generators. Each one of the party-line telephones is designed to be operated by one of these frequencies. The system requires close regulation in the speed of the motor. To attain this uniform speed a special governor is attached to the shaft of the motor, which regulates the amount of current passing through the field magnates. In this way the speed of the machine is governed so that it does not vary more than one or two revolutions when the voltage operating the motor is varying from 100 to 120 volts. The machine was made by the Holtzer-Cabot Company, which also furnished the motor generators for charging the storage batteries. The motor generators are driven from 110-volt circuit, which is available either from the city lighting mains or from the company's own power plant.

Owing to the fact that the company owns its own building, which is a two-story brick affair—a portion of which is rented for offices—it found it economical to install its own power plant. This consists of a six-horsepower volume-governor gas engine belted to a four-kilowatt dynamo. This set supplies all current for lighting the building and operating the motor generators and ringing machines. By means of this equipment the company is able to reduce the cost of current for operating the exchange and lighting its building more than 50 per cent. The gas engine, built by Fairbanks, Morse & Co., is especially designed for small electric-light plants. The regulation is very close, owing to the fact that there is an explosion every revolution. The manufacturers of gas engines will not ordinarily guarantee the regulation on engines of less than 10 horsepower to be sufficiently close to operate electric-light plants. The engine in this plant has been used continually since it has been installed and is giving satisfactory results, it being the second engine of its type turned out by the factory. The engine was recommended by Mr. L. W. Stanton, consulting engineer of Cleveland, Ohio, who had full charge of drawing the plans and supervising the installation of the plant. It was through Mr. Stanton's influence that the party lines were added and the rates raised, and these changes have proved very satisfactory.

Increasing the Efficiency of Operation of a Magneto-call Exchange System.

By H. P. Clausen.

Managers of telephone exchanges in which the switchboard and telephone equipment consists of the old-style magneto-call and local-battery equipment frequently have before them the problem of making an economical change from the magneto-call system to something of a more satisfactory nature, particularly from the point of view of efficient operation.

With an old magneto equipment in an exchange and much-worn telephones, the problem is scarcely one to be considered in a different light than a complete renewal of the entire equipment, both inside and outside, but when the subscribers' equipments, or, perhaps, the switchboard, or both, are comparatively new and in good working condition, economical considerations will not permit of such a radical change as the rejection of a great deal of material and apparatus that might well give service for a few years longer.

It is the writer's intention to present a number of plans to meet the conditions, and which, he believes, may be adopted with profit. Therefore, the manager who may wish to improve his service has presented for his consideration several arrangements, any one of which may best meet his conditions.

In order to place the subject before the reader, I shall treat the systems tabulated below:

A. Local-battery magneto-call.

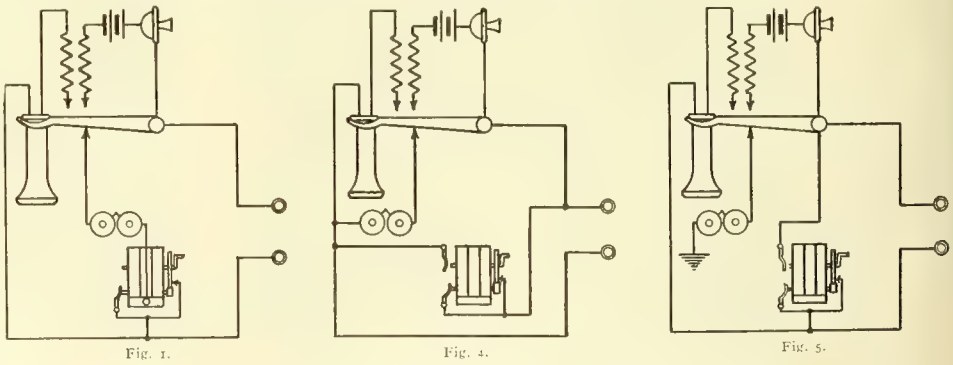


Fig. 1. Fig. 4. Fig. 5.

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B. Local-battery centralized-call.

C. Common-battery centralized-call.

The above three classes will terminate at the central office in the following:

D. Magneto-call drop shutter.

E. Magneto-call lamp signal.

F. Centralized-call drop shutter.

G. Centralized-call lamp signal.

Thus we have presented us three different systems of telephone circuits and four systems of call-announcing devices placed before the switchboard operator.

Now, for methods of clearing-out, we have the following:

H. Magneto clearing-out metallic-circuit drop.

I. Magneto clearing-out metallic-circuit lamp signal.

J. Centralized, automatic, clear-out, ground-disconnect drop.

K. Centralized, automatic, clear-out, ground-disconnect lamp.

L. Centralized, automatic, clear-out, metallic, lamp.

This gives us five plans for clearing out systems. By a "ground disconnect" we, of course, must understand that the disconnect signal is operated by a ground placed upon the telephone line at the subscriber's station, and when we say "metallic-circuit disconnect" it means that the circuit is not grounded at the subscriber's station when sending in a clearing signal.

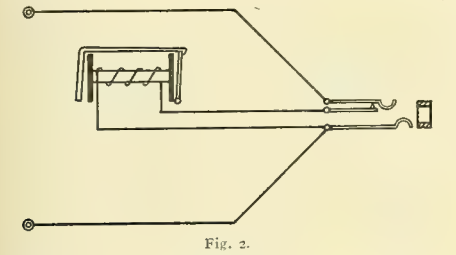

Fig. 2.

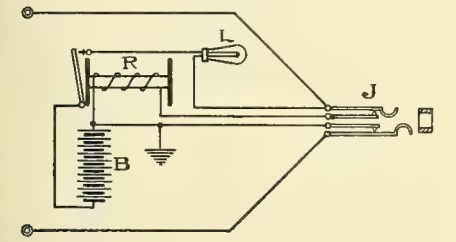

Fig. 3.

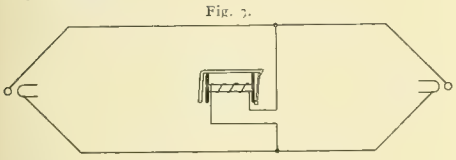

Fig. 7.

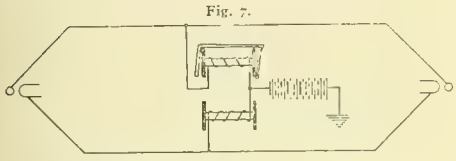

Fig. 8.

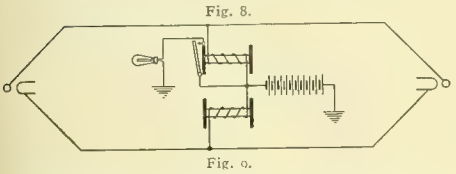

Fig. 9.

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Taking the above systems as they stand, we have first to consider what methods of signaling we can adopt for the different classes of telephone circuits. Thus, taking system A (local-battery magneto-call), we can operate such a telephone on the magneto-drop shutter (Fig. 2) or upon the magneto-call lamp signal (Fig. 3) and apply any one of the clearing-out systems described. When we take B (local-battery centralized-call), then we can operate line signals F (centralized-call drop shutter) and G (centralized-call lamp signal), but for the clearing-out system we cannot apply anything but the central, automatic, clearing, grounded drop and central, automatic, clearing metallic lamp, for in the B style telephone we have no magneto generator, therefore this drops out the D and E call signals and the H and I clearing-out systems.

Now when we come to the common-battery telephone circuits, there is no difference between the calling signals and the clearing-out signals, as we can still operate the central call-drop shutter and lamp signal as well as the ground-disconnect-drop lamp and metallic-disconnect lamp. These variations, when carefully analyzed, give us altogether 22 different systems of operation, but rather than to go into complicated details, we will examine the circuits that form a part of this article and leave the adaptation of the circuits to local conditions—to the manager, who must be the best judge as to what change in his telephone system and exchange apparatus can be made with the least trouble and expense.

Referring to Fig. 1, we have the diagrammatic circuit of a local-battery magneto-call telephone, with the generator connected in series with the ringer. As was explained before, this circuit may be used in connection with the magneto-drop and spring-jack circuit shown by Fig. 2, as also with the line circuits shown by Fig. 3. The circuits shown by Fig. 2 do not require any special explanation aside from the understanding that when the plug is placed into the jack the drop is cut out of circuit. In fact, in some cases, the jack is left connected across the line and the shutter is held in its no-call announcing position by mechanical means. This, however, does not affect the description.

Fig. 3 shows a line circuit in which the subscriber, by sending in his call, automatically draws up the armature of a relay and causes current to flow through that relay and also the line lamp by way of the jack springs, as shown in the diagram.

Thus, supposing a subscriber at the telephone in Fig. 1 drives the generator, the armature of the relay (R) in Fig. 3 vibrates, and the moment that the armature closes its front contact, current from the battery (B) passes through the lamp (L) and spring jack (J), keeping the lamp in its lighted position until the operator responds, in which case the spring jack opens the lamp circuit and causes the relay (R) to release its armature, thus restoring the lamp signal to its normal condition.

In addition to Fig. 1, I have shown Fig. 4. The operation of the line signals from this telephone circuit remains the same as was described in Fig. 1, but Fig. 4, of course, represents a bridging telephone. Fig. 5, however, shows the ringer normally grounded for the purpose of automatic disconnect signals, which will be referred to somewhat later on. Fig. 6 is also a magneto telephone circuit, but it contains a condenser for automatic-disconnect purposes.

Now let us consider the cord circuits which may be used in connection with the local-battery magneto-call telephone.

First, we have Fig. 7. This shows a plain magneto-call cord circuit with a clear-out bridged between the strands in a well-understood manner. For the purpose of simplification we have left out all ringing and listening keys, as the introduction of these parts is merely a matter of detail. This Fig. 7 cord circuit may be used in connection with the telephone circuits of Figs. 1, 4, 5 and 6, particularly Figs. 1 and 4, as Figs. 5 and 6 show the special circuits.

Now, when we take the Fig. 5 telephone circuit, we find that the ringer is normally grounded, and, referring to Fig. 8, we have a cord circuit in which there is a double coil connected across the cord with the center of the winding connected to a series of batteries which connect to ground at its opposite terminal in such a way that when the Fig. 8 cord circuit is placed, say, in the Fig. 3 line jack, the replacing of the receiver to the switch hook of a telephone station containing the circuits shown by Fig. 5 operates the clearing-out drop in the cord circuit of Fig. 8, through battery flowing through its winding. However, when we have the means for introducing an automatic-disconnect system, we may as well take advantage of the lamp signal, as this greatly increases the speed of operation.

Thus, referring to Fig. 9, we have the relay windings connected across the cord circuit with their centers grounded through batteries, as shown. The armature of the relay is connected to one side of the battery and a lamp is connected to a normally open contact. The free terminal of the lamp is connected to the battery in such a way that when the relay armature is drawn up the lamp will light. This operation takes place when we place the Fig. 9 cord circuit into the Fig. 3 line circuit and replace the receiver to the switch hook, as shown in Fig. 5. Of course, we may also secure the same automatic-disconnect operation by placing the Fig. 9 or Fig. 8 cord circuit into the Fig. 2 line circuit, but in each case the Fig. 5 telephone circuit must be used or some other means provided for grounding the telephone line at the subscriber's station.

Now let us consider a condition in which the subscriber's station cannot very well be provided with ground wires, and in which the central office line circuit cannot be changed from that shown by Fig. 2 or Fig. 3. This requirement calls for the necessity of providing a special cord circuit at the central office and the addition of a condenser in the subscriber's station equipment for connecting the ringer to the line; also in the provision of a special generator which is normally left open, so that the signal drop shown by Figs. 2 or 3 may be operated; also when the receiver is on the switch hook the circuit is only complete at the subscriber's station through the condenser connected in series with the ringer. With such a system a cord circuit, as shown by Fig. 10, can be adapted with slight modifications.

It will be observed that the tip and sleeve connections of the Fig. 10 cord circuit have the terminals of the battery connected to them through retardation coils (R′) and (R″), and that on the tip side we have two relays (C′) and (C″). There relays are provided with back-contact armatures which connect to the lamp signals and contain in their circuit means for opening the battery circuit while the plugs are removed from the line jack. For the purpose of illustrating this requirement, I have shown plug sockets which open up the lamp circuits. The operation of this circuit is as follows:

By picking up the plug, the spring resting against the shell of the plug closes a normally open contact and causes the lamp (L), Fig. 10, to burn, upon placing the plug into the line jack of Fig. 2 connecting to a telephone in which the condenser is connected in series with the ringer, the lamp continuously burns until the subscriber removes his receiver from the switch hook. This causes the relay (C′) to be energized, and by drawing up its armature extinguishes the lamp (L). It should be understood that the current operating this relay is not performing any useful funcion at the subscriber's station. It is rather a detriment to have it pass through the subscriber's receiver and induction coil, for the subscriber's telephone is provided with local batteries and must be equipped with magneto generator, as otherwise the Fig. 2 style drop could not be operated.

While I have shown a special form of cord circuit in Fig. 10, any common-battery cord circuit will, of course, result in the same operation and produce the same disadvantages.

In order to overcome this difficulty, the writer presents the plan shown by Fig. 11, which is a cord circuit equipped with a double-wound relay, or a single-wound relay, with an impedance coil connected to the opposite strand in such a way as to supply battery current to the metallic circuit and permit of the use of a front-contact relay in the cord circuit and do away with the necessity for providing means for normally cutting the lamp circuit open when the plugs are at rest.

Referring to Fig. 6, we have before us the telephone circuit required for use in connection with the Fig. 11 cord circuit. These two circuits are to be used in connection with either Fig. 2 or Fig. 3 line circuits. An examination of Fig. 6 will show that a condenser is connected in series with the telephone circuit and that the generator and ringer are connected direct across the line. So, under normal conditions, we have practically the telephone circuit shown by Fig. 1, with the addition of a condenser, as shown by Fig. 6. The operation of the system is to be as follows:

The subscriber drives a magneto generator and throws drop at central; operator picks up plug of Fig. 11 cord circuit, inserts it into Fig. 2 line jack, and if the subscriber has the receiver off the switch hook, no current flows through the subscriber's station apparatus. Therefore, the supervisory lamp at the central office does not burn, but when the switch-hook at the subscriber's station is drawn down, then there is a flow of current from battery (B), Fig. 11, through relay (R) over the line circuit and through the signal bell at the subscriber's station. The only way that the lamp (L) may be extinguished is by removing the plug from the line jack or removing the receiver from the switch hook at the subscriber's station.

This gives an excellent system of clearing out and simplifies the cord circuit very greatly and means practically no change at the subscriber's station, as it would only be necessary to add a condenser in the receiver circuit, and at the central office overcome the usual objections to cord circuits in which the

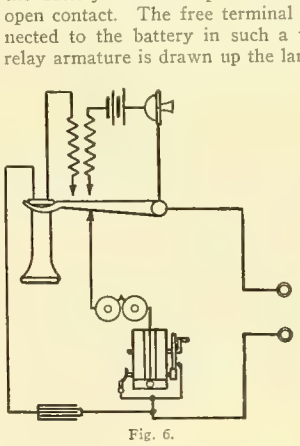

Fig. 6.

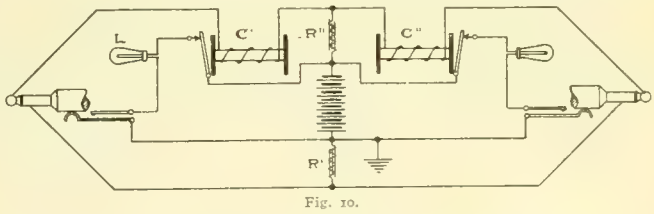

Fig. 10.

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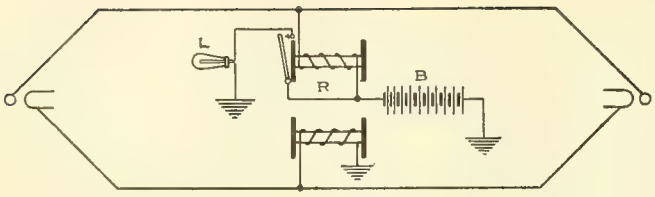

Fig. 11.

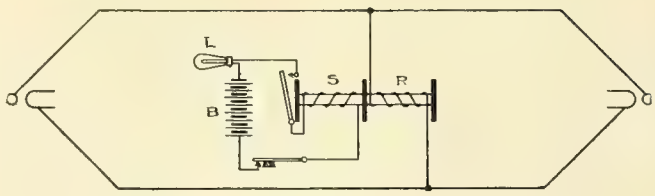

Fig. 12

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clearing-out signal-operating current passes through the subscriber's apparatus while the telephone is in use, whereas, in the plan suggested, the current only passes over the line wire while the telephone is in its unused condition. This produces a most economical plan of operation.

In considering magneto-call apparatus I shall make brief reference to the cord circuit shown by Fig. 12. This cord circuit may be operated in connection with any system of magneto-call switchboards, and only calls for the necessity of providing a means of cutting off the lamp circuit in the cord circuit.

Referring to Fig. 12, (R) is the regular winding of the relay, say, 500 ohms, and (S) is an auxiliary winding on the same core of the relay, but of a lower resistance. This relay is provided with a normally open-front contact, and when the clearing-out signal is sent into the office the winding (R) causes the armature of the relay to vibrate, and the moment that the armature strikes its open-front contact, current from the battery (B) passes through the lamp (L) and the relay winding (S). This causes the relay to lock up and keep the lamp lighted until the operator listens in on the cord circuit and opens up the lamp-supply circuit by means of an auxiliary contact on the switching key, or the supply circuit may also be opened up by the momentary operation of an auxiliary switch common to the entire operators' position and controlling the lamp-signal current-supply circuit. That is to say, one switch may be made to serve for restoring to normal any lighted lamps belonging to one or more cord circuits installed in the same position.

This system of clearing out is not to be recommended for regular local-exchange service, but may be, and often is, applied with good success to toll-switchboard cord circuits.

Giving our attention next to local-battery centralized-calling telephone circuits, we find that we may use line circuits, shown by Figs. 13 and 14. In fact, these two line circuits are applied generally for centralized-call or common-battery service. The best-known form of centralized-call telephone circuits is shown by Fig. 15, in which the ringer is grounded for the purpose of securing the clearing-out signal. In these systems the cord circuits shown by Figs. 8 and 9 should be used. Generally the circuit shown by Fig. 9, wherein the lamp circuit is used as a clearing-out, finds most favor. The telephone circuit shown by Fig. 16 may be used in connection with the cord circuit shown by Fig. 10, or any suitably modified cord circuit in which battery current is normally sent to line for supervisory purposes. Obviously, however, the telephone circuit of Fig. 15 is the preferable one when the ground disconnect can be applied, as with this circuit no current flows over the telephone line while the subscribers are talking, and the simplified cord circuits, Figs. 8 and 9, may be used.

In order to adapt the exchange equipment to a common-battery operation we have to consider the telephone circuits of Figs. 17 and 18. Fig. 17 shows a ground-disconnect system and Fig. 18 a metallic. The line circuits used in connection with the common-battery telephone remain as shown in Figs. 13 and 14, and the cord circuit may be that shown by Fig. 10. The only advantage in using Fig. 17 telephone circuit is that it is not necessary to provide a condenser at the telephone station. Taking Fig. 18, however, this gives metallic-circuit service, and the cord circuit shown by Fig. 10 or any modification thereof is generally used in connection with metallic-circuit common-battery systems.

In order to place the available telephone circuits in the simplest form I have shown Figs. 19, 20, 21, 22 and 23. Fig. 19 shows the regular local-battery system. Fig. 20 shows a single common-battery circuit, usually known as local secondary system. Fig. 21 indicates a common-battery system of telephone circuit without an induction coil, and Fig. 22 a common-battery telephone-circuit system with induction coil and condenser, but with a minimum amount of side tone. Fig. 23 shows what we generally consider the Western Electric Bell telephone circuit, possessing considerable side tone.

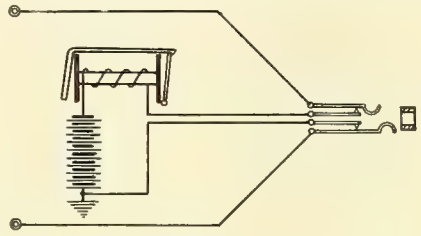

FIG. 13. IMPROVING MAGNETO-CALL EXCHANGE SYSTEM.

Some Practical Suggestions.

As mentioned before, it is difficult to offer conclusive suggestions as to what may be the best plan for a manager to adopt for introducing automatic-signaling provisions in a magneto-exchange equipment. As a general conclusion, however, it may be suggested that the subscriber's telephone equipment should receive the least attention in making the change. We may add a condenser in series with the receiver circuit with but little expense, and produce, as was described before, an excellent system of supervision by only a slight change in the cord circuits at the central office. However, if every telephone throughout the exchange already is provided with an earth or ground wire, then the addition of a contact to the switchhook may prove the least expensive plan.

It is the writer's opinion, however, that in considering all expenses in connection with changing a telephone we shall find that the labor item for installing the contacts in the switchhook more than equals the additional cost of the condenser to be placed into the telephone as compared to the cost of the contact. That is to say, we must purchase the contact for the switchhook in the one plan and the condenser in the other, but when we install the condenser this can be done in most cases in less than five minutes' time, as it only requires cutting open the receiver circuit in the telephone and inserting the condenser, but when we install the contacts this must always present considerable difficulty. It would appear, therefore, as though the insertion of the condenser in series with the telephone condenser is the most acceptable plan not only from an economical but from a practical standpoint as well, for wherever we can keep clear of a ground-disconnect system it is wise to do so, as is well understood by everyone ever having operated such a system in cities where the street-railway, electric-light and other currents are a constant source of annoyance.

As respects the central-office portion, the line circuits generally do not permit of a change from drop-signal to lamp-signal, as this plan would be too expensive and would mean the rejection of a large amount of apparatus on which there practically would be no salvage, but we may secure an automatic-signal system under certain conditions of switchboard construction, i. e., if we can conveniently get at one side of the drop circuits and have a double cut-out jack; then we may install an automatic-signal drop by inserting battery, as was described before, but when we have only a single cut-out in our spring jacks, then we must add some means for supplying battery to the line circuit for signaling purposes and taking the battery supply away from the line circuit when answering a call.

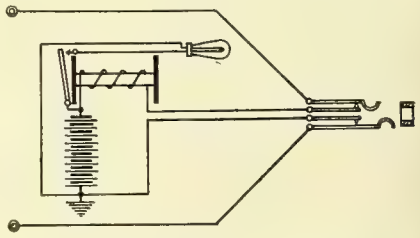

FIG. 14. IMPROVING MAGNETO-CALL EXCHANGE SYSTEM.

At its best the proposition for furnishing battery to a line circuit having only the single cut-out jack would be an expensive one and need not be touched upon further.

In the cord circuits, however, we have considerable latitude. In the regular magneto-cord circuit there is generally but little apparatus in the original installation, and we usually find enough room in the back of a switchboard for installing the few relays needed in almost any one of the supervisory systems described.

The writer believes, however, that as a rule the best plan is to keep away from common-battery apparatus, and when we use the cord circuits above described, particularly Figs. 8 and 9, we are not adding much complicated apparatus, and if we keep away from the ground telephone and install only the condenser in the subscriber's instrument we have but little to add to our central-office cord circuit in order to produce an excellent system of supervision.

True, the cord circuits presented show only a single supervisory system, but even a single supervisory system will mean a remarkable increase in the rapidity of operating a switchboard, but if a double supervisory system is wanted, it may, of

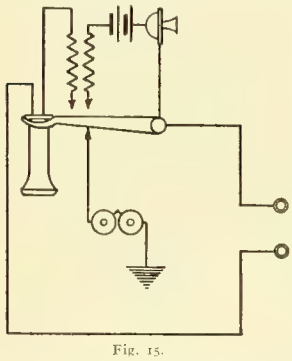

Fig. 15.

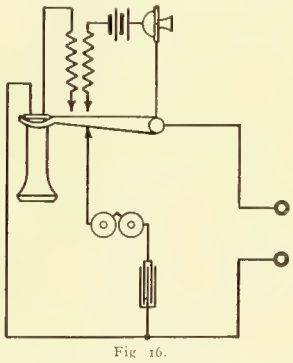

Fig 16.

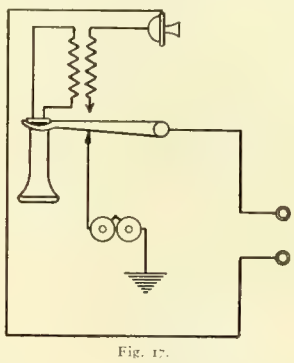

Fig. 17.

IMPROVING MAGNETO-CALL EXCHANGE SYSTEM.

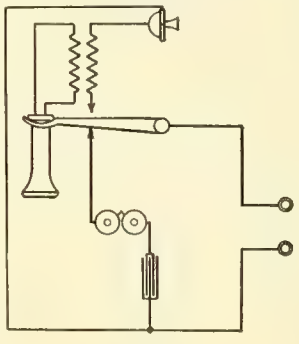

Fig. 18.

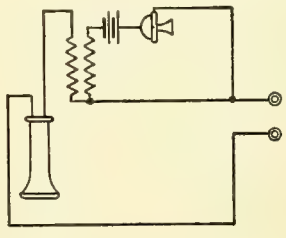

Fig. 19.

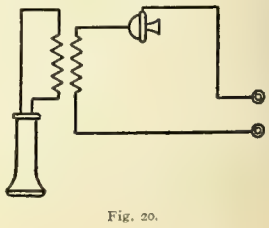

Fig. 20.

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course be obtained by simply adding a little more apparatus to the cord circuit, although this is again going off onto expensive construction and installation of additional apparatus, which should be avoided whenever possible, as a manager must always bear in mind that he does not expect to operate magneto apparatus any longer than absolutely necessary for getting reasonably long service out of it. Moreover, the relays installed in the cord circuits are not good salvage when the board is eventually changed to common battery.

This suggestion of common battery brings us to the point of the advisability of adopting common-battery transmission in a magneto exchange. As a first consideration we may safely state that there are but very few magneto-call exchange systems in existence, no matter how new, that will permit of their being made over into a common-battery system and give an absolutely satisfactory service.

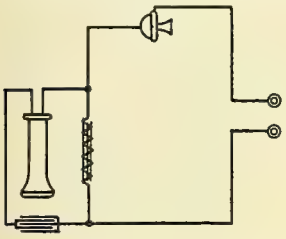


Fig. 21.

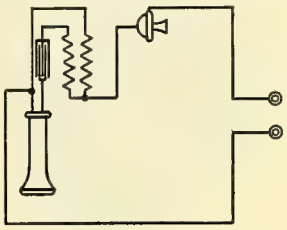


Fig. 22.

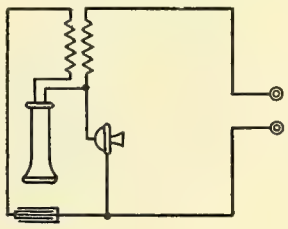


Fig. 23.

IMPROVING MAGNETO-CALL EXCHANGE SYSTEM.

There is no question that any magneto system may be made up into a common-battery system, but when we commence to figure upon the apparatus required we will probably find that as salvage at the subscriber's station we have the cabinet, the ringer and receiver and, very rarely, the transmitter. This means that we have got to add the condenser and induction coil, and when you commence to figure the cost of changing the telephones and the class of service that you are going to secure from the mixture of the new and old apparatus it is thought that a new equipment at the very startout, with no salvage on the old equipment, will prove the cheaper plan to follow.

At the central office, when the change is made from magneto to common battery, it is generally made with the idea of saving a great deal of switchboard apparatus, but as a rule few manufacturers would consider changing a magneto board to common battery and use, as salvage, anything more than the spring jacks, ringing and listening keys, the cabinet work, and, to a limited extent, the cable, but it will be found necessary to provide a great deal of apparatus which we do not generally find in a magneto exchange, and it is this additional apparatus which brings the installation price up to a figure but little under the price that would have been quoted for a new equipment. And not this alone. Few manufacturers would undertake to bid in a lump sum for making the change. Ordinarily they would want to make a charge for the time spent on the job, and when you come to paying for an installation gang for 30 or 60 days the feasibility of changing a magneto-call switchboard to common-battery loses its charm.

Electrical Exports for January.

Electrical exports from the United States for the month of January last amounted to a total value of $830,135, thus showing a decrease of $22,463 from the last preceding month, but an increase of $34,586 over January, 1903. Goods classified as electrical machinery again show a falling off as compared with the corresponding month of the preceding year, the deficit being $101,224. Electrical appliances, however, including telegraph and telephone instruments, show, as before, an increase, the advance over the figures for January, 1903, being $135,810, more than enough to offset the deficit in machinery. Comparative figures are as follows: Electrical machinery—January, 1903, $556,315; January, 1904, $455,091. Electrical appliances—January, 1903, $239,234; January, 1904, $375,044.

Classified according to destination, the exports of electrical machinery to some of the principal buyers in January were as follows: British North America, $103,923; United Kingdom, $94,586; Japan, $71,513; Mexico, $49,860; France $38,148; British Australasia $12,318; Argentina, $8,691; British Africa, $6,585; British East Indies, $6,582; Germany, $4,710; Colombia, $3,029; Philippine Islands, $2,657; Cuba, $1,780.

Comparing the above figures with those of January, 1903, the greatest contrast is shown in the case of the United Kingdom, which imported $243,102 worth of electrical machinery in January, 1903, and dropped to the unusual low figure of $94,586 in January last.

Ice Dangers to Power Plants at Niagara Falls.

By Orrin E. Dunlap.

The manner in which the ice has piled up adjoining the power house of the Niagara Falls Hydraulic Power and Manufacturing Company at Niagara Falls, N. Y., this winter has commanded much attention. It is recognized as a subject for engineering attention. It will be recalled that this power station is located at the water's edge in the Niagara gorge. The water that supplies the turbines installed in the station is carried in huge penstocks, but to the north of the station on the top of the high bank there are several mills that discharge water from their individual pits at points midway between the top of the high bank and the water's edge. This creates several little waterfalls, which are very pretty and attractive in the summer time, but in winter the wind catches the spray and blows it about.

The majority of the winds experienced at Niagara sweep down out of the southwest, and this winter the rear of several of the mills on the edge of the high bank have been so ice-coated that a force of men was engaged several days in removing the icy deposit. This was especially true of the pulp mill of the Pettebone Cataract Paper Company.

In front of the little waterfalls the ice mountain that formed this winter is of startling proportions, reaching, as it does, from the water's edge nearly to the top of the bank. Never in the history of the canal power development has there been so much ice at this point. The winter has been of unusual severity, and for two months or more the icy mound has had a daily increase in size. That there is danger in such accumulations of ice is demonstrated by the fact that a few weeks ago a huge icicle fell from the face of the cliff back of the power station and plunged upon the roof, doing considerable damage. The roofless portion of the structure is clearly seen in the illustration.

Of course there is much speculation as to just how the present mass of ice will pass away. There are some very large pieces hanging to the cliff, and should these fall and slide toward the power house they might do great damage. It seems highly probable that all of the present little waterfalls at this point will in time cease to exist, because the water that forms them may be captured and made to perform double service in the operation of turbines in stations at the water's edge. When this occurs ice formations like that now existing will be unknown.

The severity of the winter has kept the power companies busy in avoiding an ice blockade at the entrance to their canals. There are vast fields of ice on the upper river in front of the inlet canals, and men have been kept at work blasting it here and there to keep the channels open. The success attained was highly satisfactory. When the ice breaks up in Lake Erie there will in all likelihood be a tremendous flow of it down the river. When this takes place it will require further watchfulness.

ICE DANGERS TO POWER PLANTS AT NIAGARA FALLS.

Reversal of a Series Motor.

A Chicago reader of the Western Electrician asks the following question: "In order to reverse a series motor it is necessary to reverse the current through the armature. By leaving this current the same, and reversing just the field, will the motor reverse?"

It will. To reverse the direction of rotation of a series motor, either the armature or field current may be reversed, but not both. In either case the relation of the flux between the pole-pieces to the field set up by the current flowing in the armature is changed and the motor reverses. If both field and armature currents were reversed at once this relation would remain unchanged and the motor would continue to rotate in the same direction.

Indianapolis Lets Lighting Contract.

The Indianapolis Board of Public Works has awarded the contract to light the city for 10 years to the Indianapolis Light and Power Company, the lowest of three bidders. The other bidders were George E. Fisher of Detroit and E. G. Bruckman of New York. The successful company bid $75 a year for each light on both direct and alternating-current enclosed-arc lamps and $74 on direct-current open-arc lamps. The competitors bid $78.50 and $87.86, respectively. Under the old contract the city paid $85 a year on a moonlight schedule. City Engineer Jeup says that the new contract is based on one of the lowest rates in existence in any city in the country.

W. S. Clark of Philadelphia has been successful in the Pennsylvania courts in a suit which he brought to recover damages for being unlawfully ejected from a street car because the conductor arbitrarily decided that a half dollar tendered for fare was a counterfeit. Mr. Clark was awarded $175 damages. A curious feature of the case is that the coin not only turned out to be genuine, but to be of the rare issue of 1832, and therefore worth about $5.

Independent Telephone Development in Indiana.

The two large Independent telephone properties centering at Indianapolis—the New Telephone Company (which is the local company) and the New Long-distance Telephone Company (which is the long-distance adjunct of the local company, and connects it with all the principal cities of Indiana)—are wholly independent of each other, but are practically owned by the same people. The growth of these two companies has been remarkable. The demand for their service is so great that it is almost impossible to keep up with it. Large extensions have been planned, by both companies, to enable them to take care of the business that is being offered them, and this new work will be commenced as soon as spring opens.

The New Long-distance Telephone Company has gone quite largely into the composite-circuit business, and is now doing nearly all of the Associated Press telegraphing in Indiana. The company has brought this particular line of business to such a state of efficiency that it is impossible, for instance, for a man who is telephoning between Indianapolis and Terre Haute to realize that one of the wires of the metallic circuit over which he is talking is, at the same instant, being used for the purposes of telegraphy by the Associated Press, and that, as hundreds of words are spoken over the circuit, other hundreds are going at the same moment by telegraph.

A prominent gentleman from the East visited the office of Mr. S. P. Sheerin, president of the Long-distance company, some time ago, and Mr. Sheerin embraced the opportunity to show him what the long-distance lines could do. He sent in a general call for Terre Haute, Fort Wayne, Marion, Muncie, Lafayette, Louisville, Ky., St. Louis, Mo., and several other cities. When the test was completed the gentleman said: "That is excellent; I have never found better telephone service. But, Mr. Sheerin, one thing you have forgotten. You told me that you had some lines over which you sent telegrams at the same time that they were in use for telephone purposes. I would like to try some of these."

"Well," said Mr. Sheerin, "you have already talked over five of them, but if you want to try more, I will give you the opportunity." The gentleman declared that he was entirely satisfied, but that he could not have believed that a thing of that sort could be so satisfactorily done, without having had such a complete demonstration of it.

"How do you account for the phenomenal success of your companies?" a correspondent of the Western Electrician recently asked Mr. Sheerin.

"There are many reasons for it. Undoubtedly we meet, in a very large degree, the wants of the people. The service given by both companies is admitted on all sides to be most admirable. The rates are uniform and all subscribers are treated alike. The stockholders of both companies are home people. There is not five per cent. of the stock of the local company held outside of the city of Indianapolis. A large majority of it is held by responsible men who can afford to hold it. They feel keenly the obligations of civic pride. They mildly believe that they have the best telephone plant in the United States. They are firmly convinced that they have, by several hundred per cent., the best telephone service that was ever given in Indianapolis, or likely ever to be given. More than 90 per cent. of the bonds of both companies are also held in Indianapolis.

"The stocks of both organizations are paying quarterly dividends—that of the local company at the rate of six per cent. per annum, and that of the long-distance company at the rate of four per cent. per annum. Both companies are earning more, but the management is conservative, and prefers to invest a certain sum of surplus in new construction each year."

"What about the number of Independent telephones in the state of Indiana as compared with the Central Union?" was asked Mr. Sheerin.

"I should say, safely, four to one. There are, in Indiana, by actual count, 110,000 Independent telephones. The Central Union does not claim more than 25,000, and I doubt very much if it has that many. In the 32 counties of the state reached by our own long-distance lines there are 62,000 Independent telephones, as compared with 12,000 Central Union telephones. There is an Independent exchange in the county seat of everyone of these 32 counties, as well as in most of the smaller towns in them. There are 14 of these counties in which the Central Union has no county-seat exchange at all, and we outnumber them, on an average of three to one, in the remainder of the counties.

"In addition to the 62,000 telephones on our own lines, we reach, over the lines of connecting companies, 36,000 telephones, and there are 12,000 Independent telephones with which we have no connection, as yet, but the greater part of which we will reach during the coming year.

"Perhaps 25,000 of the 110,000 Independent telephones in the state are in the houses of farmers. This is very interesting, in view of the fact that, before the Independent movement began, there was not one telephone in the house of a farmer in the entire state of Indiana. The telephone has done more for the farmer than any other agency. It affords him opportunities for social intercourse; brings him the weather forecasts and market reports; enables him to summon aid, when needed, and saves him many miles of travel.

"The Independent telephone movement has also greatly benefited the merchant in the small town, as well as the wholesale dealers in Indianapolis. Before the advent of the Independent telephone it was necessary for the merchant to carry a large stock of goods, including many articles for which there was only an occasional call. His orders were divided among the traveling men representing the large wholesale houses of Indianapolis, Cincinnati, Chicago and St. Louis, and very often the goods were slow in reaching him after they were ordered.

"Now he finds that he can conduct his business on a much smaller capital. He patronizes the Indianapolis dealers almost exclusively, and, when he finds his stock running low, he sends in an order by telephone—first finding out where he can obtain the best prices—and the goods are delivered on very short notice. In this way he always has a fresh stock of staple goods, and if he has a call for any special thing he can get it within a few hours."

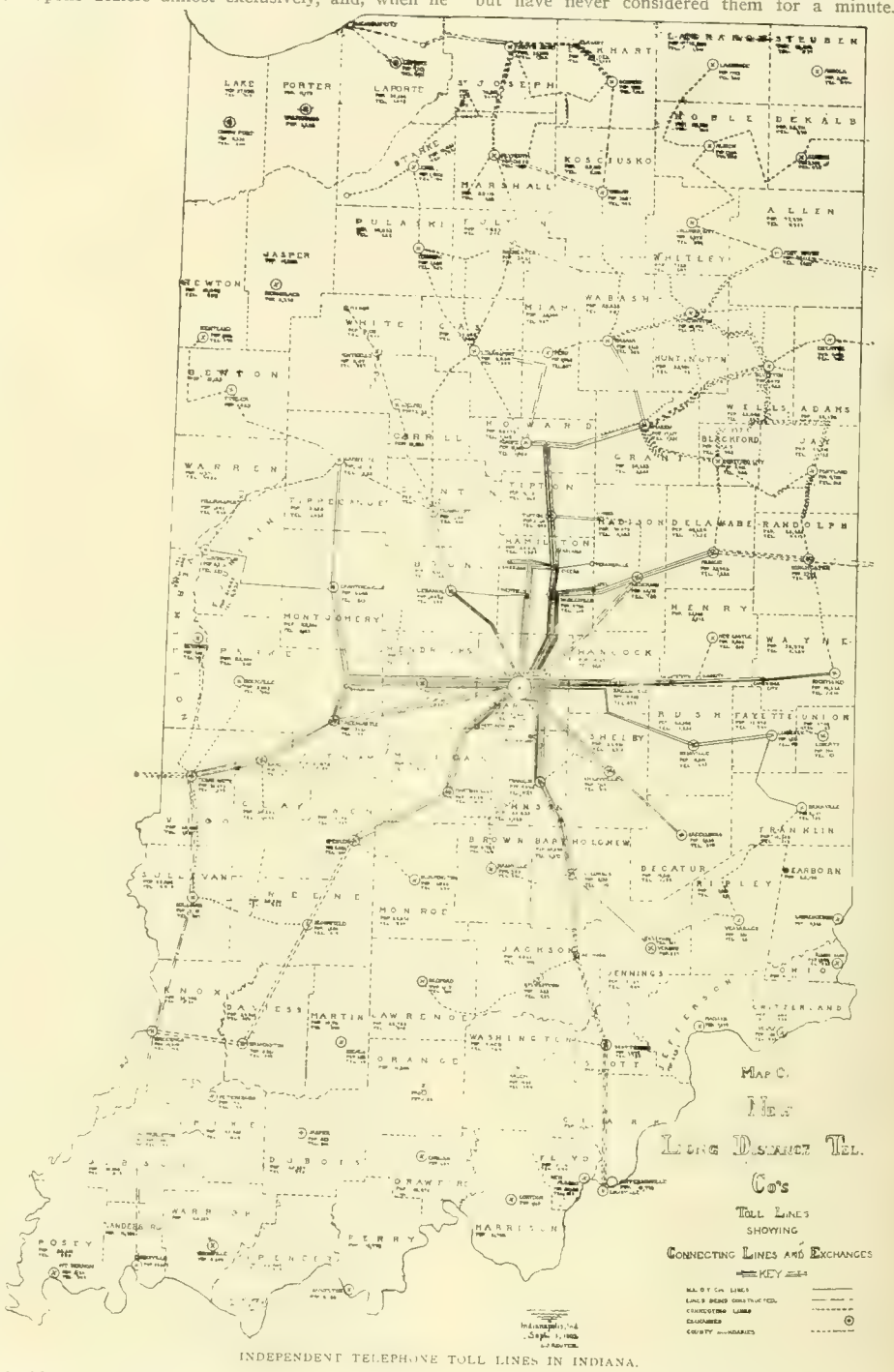
"I have heard some favorable comment as to the character of your officers and employes. Have you any special reason to assign for that?"

Mr. Sheerin: "To begin with, we use our best judgment in the employment of people for all positions. We employ them with the intention of keeping them. We very much prefer promoting our own people, who have been with us a long while, to employing strangers for responsible positions. We follow this rule with both men and women. We require a fairly high personal standard. We are ourselves part of the general public, and we keep in as close touch with the people as possible. All our young men, and young women, too, holding responsible positions, have been trained in the business by ourselves.

"Every now and then I hear a report, on the street, that there is a likelihood of your companies selling out to the Central Union?"

Mr. Sheerin: "There never was a greater absurdity than this. When our 'friends, the enemy,' have nothing else to do, they trot out this age-worn story and put it into service. There is absolutely not one word of truth in it, and never was. If you will stop to think about it, it is a ridiculous thing on its face. The control of these two companies is in the hands of men who would not sell to the Central Union under any circumstances. They are profitable investments, and the work is very congenial to the gentlemen who fill the executive offices. We have had numerous applications to sell, but have never considered them for a minute. I give all my time to the two companies, and so does Mr. H. B. Sale, secretary and treasurer of both companies. Mr. Louis Hollweg, one of the wealthiest men in Indianapolis, who is vice-president of the local company and one of its largest stockholders and is also largely interested in the other, also gives liberally of his time and advice in the management. Mr. Hollweg is a magnificent example of not only how a man may grow old gracefully, but how he can multiply years usefully. Whenever he feels his capacity for work waning a little he informs his associates, suddenly, that he has decided to take a trip to Europe, and the next day he is off. After an absence of six weeks he returns, with a reserve store of energy sufficient to run him comfortably for the next six months. Mr. A. F. Ramsey of Crawfordsville, vice-president of the New Long-distance Telephone Company, and Mr. Hugh Dougherty of Bluffton, one of its largest stockholders, also give all the time required of them whenever called upon."

Mr. Sheerin referred the correspondent to Mr.



INDEPENDENT TELEPHONE TOLL LINES IN INDIANA.

H. B. Sale, secretary and treasurer, for information as to improvements, enlargements, present conditions and intended improvements. Mr. Sale said:

"We are very much obliged to the Western Electrician for giving us an opportunity to tell the people something about ourselves. We began our plan for 2,500 subscribers. The Bell people had, at that time, fewer than 2,000, and we thought that it would take us some time to get 2,500. Before we were ready to open we had to prepare for 3,000. Inside of a year we had 3,500. The increase has gone on rapidly, until now we have 7,977 subscribers in the city of Indianapolis and 1,000 more among the farmers and in the small towns of Marion County.

"In addition to our main exchange we have two large branch exchanges—one for the South Side, on Prospect Street, and one for the North Side, on Twenty-second Street. The company owns the real estate and buildings in each case. We also have three smaller branch exchanges, located at Broad Ripple, North Indianapolis and Irvington, respectively.

"We have now on file more than 2,000 applications for telephones in the city of Indianapolis. These will be taken care of by the work laid out to be done this spring, embracing an exchange in the eastern part of the city, with a present capacity of 1,000 and an ultimate capacity of 5,000, and increased cable facilities in all the exchanges.

"We have 52 private-branch exchanges installed, and these are in the largest and altogether most important establishments in the city. For more than two years there has not been a Bell telephone of any kind in the Union Stockyards of Indianapolis. This has not come about by any request of ours, but simply because our stockyards people find our service more efficient.

"The New Long-distance Telephone Company has planned to spend $100,000 this year upon extensions. A very large part of this will be for new circuits upon pole lines already up. Our toll business, out of Indianapolis, over the lines of the New Long-distance Telephone Company last year averaged 17,860 messages a month, to say nothing about the incoming business."

The accompanying map of the New long-distance lines and their Independent connections shows something of the magnitude of the Independent telephone development during the last nine years. It is predicted that within the next 10 years there will be half a million telephones in Indiana. It is estimated that there is upward of $6,500,000 invested in the Independent telephone business in Indiana, and the improvements and extensions marked out for the present year will add materially to the above figures. New companies are incorporating at the rate of from three to five per week.

S. P. Sheerin, President.

Louis Hollweg, Director.

H. B. Sale, Secretary and Treasurer.

OFFICERS OF THE NEW LONG-DISTANCE TELEPHONE COMPANY, INDIANAPOLIS.

Interurban Electric Railways in Indiana.

A review of electric-railway construction in this country indicates that Indiana before the close of the present year may take the lead over Ohio, which led last year. A careful recapitulation shows that there are 21 roads in operation in Indiana, having a total of 851 miles. Of this mileage 551 miles center in Indianapolis. There is under construction in the state at present a total of 484 miles. Lines that are projected for construction just as soon as favorable weather opens up aggregate over 2,200 miles. A conservative estimate is made that at least half of the lines projected will be constructed this year, which, with the lines now under construction and in operation, will increase the total mileage to 2,500 miles or more. There is a total of 55 companies now operating, building and preparing for construction. The heaviest part of the construction planned for the year will be in Northern and Southern Indiana. At least two and possibly three new lines will be brought into Indianapolis.

The Hillsboro Electric Railway Company of Hillsboro, Ill., has been granted a license to operate an electric-street railway and construct an electric-light point in Hillsboro. The incorporators are Isaac Hill, T. M. Jett and L. V. Hill.

Boston "Tech" Banquet in Chicago.

Lighted by the ghastly rays of mercury-vapor lamps, the University Club banquet hall in Chicago was the scene of one of those interesting dinners given by the sons of old "Tech" which are said always to show something new or startling for the participants.

The banquet was given on February 27th by the Northwestern Association Massachusetts Institute of Technology. The members and guests, to the number of 117, were greeted, upon entering the banquet hall, by a weird scene produced by six mercury-vapor lamps, which were the only source of light in the room. When seated the company presented a startling appearance. The red roses upon the table became blue, the champagne green, while the glasses took on a violet hue.

After sufficient time had elapsed for the enjoyment of the scene the lights were turned off and a curtain drawn aside in the front of the hall, revealing a large electric sign decorated by evergreens and bearing the words, "Northwestern Association Massachusetts Institute of Technology" in small incandescent lamps.

Dinner was then served, enlivened by songs from the glee club and jokes, which respected no more the dignified class of '76 than they did the class of '03. After dinner the president of the association, Solomon Sturges, made a short address, and then introduced Professor W. E. Goldsborough, the principal speaker of the evening, who had come from St. Louis especially for the occasion. As head of the Department of Electricity at the St. Louis Exposition, Professor Goldsborough outlined briefly the scope of the work to be done in his department. He said that people of today are not only looking continually for something new, but for something that is just on the verge of being born. They look for these new things to be accomplished more along the lines of electrical achievement than in any other direction.

The problem before the managers of the exposition, therefore, is to present something new to the people. Among the electrical features at the fair will be seen an electrical water-purification plant, taking the "thick," "rich" water now pumped into the St. Louis water mains and turning out a pure, clear product. Another electrical process will manufacture nitrogenous compounds from the atmosphere for fertilizing purposes. Three new alternating-current traction systems will be exploited, while space telegraphy and telephony will be conducted with the most powerful apparatus. In connection with the latter exhibit will be what will be known as the "noiseless court," a large, empty room, 100 by 200 feet. Persons walking in this court will be enabled to hear conversation, through the little telephone receivers with which they will be provided, without the intervention of any wiring. This is brought about by producing a powerful electromagnetic field in the room, through outside sources and by variations of the inductive effect of this field to reproduce in the receivers the words which originally affect the variations in the field. In regard to the lighting effects at the St. Louis Exposition, Professor Goldsborough said that it is the aim of the management to make these even more effective than those at the Pan-American Exposition. The lighting scheme, as planned, embodies the lighting of the whole "picture" of the exposition in three colors, yellow, green and purple, the wiring being so arranged that the different colors may be thrown on separately or in combination. Just what the effect will be is as yet somewhat a matter of conjecture, but it is hoped that it will be one of surpassing beauty.

Succeeding Professor Goldsborough, Professor Burton, dean of Massachusetts Institute of Technology, spoke upon various subjects of interest to the old "grads," but principally upon the rumored affiliation of the Institute with Harvard, which has been so much discussed of late. According to Dean Burton, no offer has yet been made by Harvard to the Institute, regardless of what has been stated by the press upon both sides of the question. However, it seems certain that such an offer will be made. By affiliation the Institute will lose its identity, but a fund of $5,000,000 will be placed at the disposal of the scientific department of Harvard University. The members of the Northwestern Association, almost without exception, are indisposed toward such a move.

Other speakers during the evening were John Freeman, T. W. Robinson, F. K. Copeland and Louis A. Ferguson. The officers of the Northwestern Association, which are elected each year by the old officers, were announced, being: President, F. W. Clark, '80; vice-president, C. M. Wilkes, '81; secretary and treasurer, Conrad H. Young, '96; executive committee, with the above, George L. Lavery, '76; R. B. Price, '94, and M. J. Sturm, '96.

Cheap Telephone Service for Toronto.

The Stark Telephone, Light and Power Company has applied to the city of Toronto, Ont., for the privilege of establishing a telephone, light and power service within the city limits. The company promises to give a telephone service at $6 a year and one cent per outgoing call for telephones in private houses, with a limit of $15 a year. The rate for business telephones is to be $6 a year and one cent per call, with a limit of $35 a year. The company also promises reduced rates for light and power. It has already secured over 4,000 telephone subscribers in Toronto, and will proceed at once to install its system. This is the company recently formed to employ the Stark system of giving telephone, light and power service over the same wires.

MAIN EXCHANGE BUILDING OF NEW TELEPHONE COMPANY, INDIANAPOLIS.

The Fremont Power and Canal Company of Fremont, Neb., will develop a 35,000-horsepower plant on the Platte River, from which it will furnish electric power for Omaha, Lincoln, Council Bluffs, Fremont and Columbus.

RECENT DEVELOPMENTS IN AUTOMATIC TELEPHONY.

Norstrom-Brownrigg Automatic Telephone System.

An automatic telephone system which possesses the feature of simplicity, if an automatic system can be called simple, has been patented by two Chicago men, John K. Norstrom and John J. Brownrigg, and assigned to the Globe Automatic Telephone Company of Chicago.

Electrical impulses sent out over the line in a predetermined order serve to operate the automatic apparatus at the central exchange, as is the case with all the present methods of automatic telephoning. Beginning with the subscribers' apparatus,

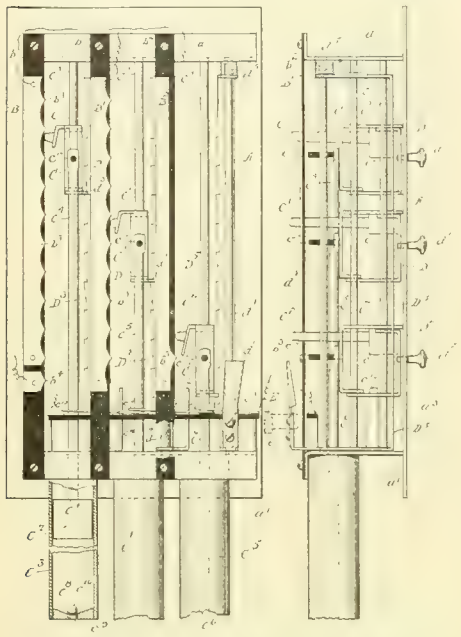


FIG. 1. NORSTROM-BROWNRIGG AUTOMATIC TELEPHONE SYSTEM.—SELECTOR MECHANISM IN SUBSCRIBER'S SET.

where the call originates, a drawing of the apparatus which produces the impulses is shown in Fig. 1, the drawing representing a side and front view. In the side view are shown three knobs (d), (d') and (d^2), which move up and down through slots in a front plate located on the outside of the telephone casing. These knobs move the carriages (C), (C') and (C^2) up and down along their guides. These carriages carry wiping contactors, which successively make contact with the projections on the metallic plates (B) and (B'), which make and break the calling circuit. Each contact carriage is carried on a piston which works in a cylinder, shown at the bottom of the diagram. The cylinder is provided with an exhaust valve which allows the air to escape slowly and retards the downward movement of the contact carriage. The right-hand carriage, as seen, only makes contact with one point (b^3), and it is normally held above this point by a catch upon the receiver hook.

In calling, the process is to raise each of the knobs to the numbers on the plate indicated by the digits of the number called. The numbers are arranged on the plate beside the slots from 0 to 9 in each row. The knobs are held in their raised positions by the catches (D^3), (D^4) and (D^5). When they have been placed to indicate the required number the receiver is taken from its hook and this releases the carriage of the contactor farthest to the right. It descends not too rapidly on account of the piston at the base. When it reaches the lower end of its path it operates to release a catch holding the next carriage to the left, which in turn descends and releases the next carriage. In this manner the required impulses are sent out over the line.

At the central station the apparatus consists of step-by-step mechanism operated by the impulses sent out from the subscribers' stations. This latter mechanism has an upward and a horizontal or cross movement which is brought about by the energization of electromagnets by the current impulses. Fig. 2 shows the connection of one of the station switches with the subscribers' circuit. Fig. 3 is a diagram showing the connection of three of the switches at the central station.

The method of calling up a subscriber and the operation and circuit formed in doing so may be shown from the diagrammatic illustration in Fig. 2. The first operation to be performed by the person calling up is to raise the buttons of his signaling device to the numbers representing the number of the telephone to be called—as, for instance, suppose the number to be called is 59: The two right-hand buttons represent units and tens or a total of 99, the right-hand or units button is therefore raised to 9; the next button, representing tens, is raised to 5, and the left-hand button, which is associated with strip (B^2) (Fig. 1) is raised past the single contact (b^3). Then upon removing the receiver from the hook the buttons and wipers will fall, as before explained. As the first wiper to fall, which is the wiper associated with the left-hand button and strip (B^2), touches the contact (b^3) the following circuit (see Fig. 2) is formed: Beginning at battery (1) to binding post (2) through wires (3) (4) to front frame plate (A), serving as base of signaling device, through contacts (5) (6) to hook (E), wire (7), binding post (8), magnet (K), wire (9) to common-battery strip (10). This will have operated the magnet (K) and moved the carriage (J) up one notch to allow the cross movement to operate. The cross movement is set in motion by the falling wiper (c'), which makes and breaks the following circuit: Beginning as before (1), (2), (3), (4), (A), through contact strip (B'), then connectors and binding posts (11) (12) (13) (14) (15), through switch (H), which is in electrical connection with the framework of the apparatus and which is herein called "the mass," thence to the contact carriage, thence to contact finger (J'), point (16), magnet (M), back to battery. This current will operate as many times as the wiper (c') contacts with the points on the strip (B') and through the magnet (M) will move the wiper (I) to a corresponding position beneath the row of the terminals (h'). The falling of the last wiper (c) in the signaling device repeats the first circuit described as many

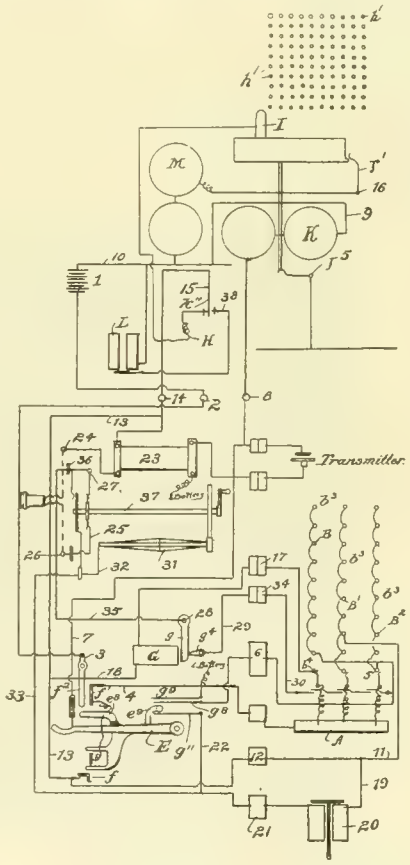


FIG. 2. NORSTROM-BROWNRIGG AUTOMATIC TELEPHONE SYSTEM.—DIAGRAM OF CONNECTIONS.

times as it passes over the contact points on the strip (B), thereby again operating the magnet (K) and moving the wiper (I) up to a corresponding terminal (h'); but as the wiper (c) passes over the point (b^4) the following circuit is formed: Beginning, as before, at battery (1) and following path (2), (3), (4), (A), (b^4), (17), magnet (G), (18), (13), (14), (15), (H), (I), through wire (h'), that it may be in contact with, to the switch of telephone called and having the corresponding number and in such switch through its base (which for convenience will be supposed to be numbered the same) and through connections of that telephone (H) and (J^5), (15), (14), (13), (12), (19), (20), (21), (22), (E), (7), (8), (K), (9) back to common-battery strip (10). The coil (20) of the bell of the telephone called has sufficient resistance to prevent the magnet (G) in the calling telephone from attracting its armature; but should the telephone called have its receiver down or be, in other words, "busy," the current will take the following circuit: (1), (2), (3), (4), (A), (b^4), (17), (G), (18), (13), (14), (15), base (H), (h'), (J^5) of the called switch and through connections of the latter, (H), (15), (14), (23), (24), (26), (25) [the receiver being connected from (24) to (26)], (27), (28), (29), (30), (6), (E), (7), (8), (K), (9), (10). This being a circuit of lower resistance, magnet (G) will be energized, breaking the ringing or talking circuits. The ringing and talking circuits having been broken by the magnet (G) remain broken by reason of engagement of catch (g^2) with armature (g) until the receiver is replaced on the switch-hook, when arm (e^9) depresses the catch (g^2) and releases (g). By this means the automatic switch of the subscriber called is not disturbed. The two tele-

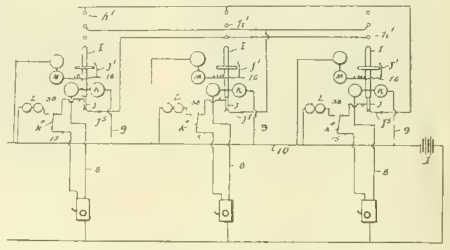


FIG. 3. NORSTROM-BROWNRIGG AUTOMATIC TELEPHONE SYSTEM.—CONNECTION OF SWITCHING APPARATUS AT EXCHANGE.

phones being in connection, the ringing circuit begins with armature (31) through connections (32), (33), (21), (20), (19), (12), (13), (14), (15), (H), (I) (h') to (J^5) of called switch and in that switch through (H), (15), (14), (13), (12), (19), (20), (21), (22), (E), (7), (8), (K) (9), (10), back through original switch (9), (K), (8), (7), (E), (6), (30), (34), (29), (28), (35), (36) to (37), which represents the mass of the generator and is in electrical connection with the armature (31). The party called having been rung up, the talking circuit is formed as follows: Beginning at binding post (14), (15), (H), (I), (h') to (J^5) of called switch, and in that switch through (H), (15), (14) (called party has removed receiver), (23), (24), receiver, (26), (25), (27), (36), (35), (28) (29) (34), (30), (6), (E), (7), (8), (K), (9), (10) to (9) of original switch, then through (K), (8), (7), (E), (6), (30), (34), (29), (28), (35), (36), (27), (25), (26), receiver, (24), (23) to (14) point of beginning. When the parties are through with the conversation it becomes necessary to release the telephones and bring their mechanism to a normal position. The release circuits are (1), (2), (3), (E), (7), (8), (K), (9), (10). This circuit is formed by placing the receiver on the hook. As the hook falls contact is made with the plate (E') and through which with the contacts (f'). This is diagrammatically shown at (3), Fig. 2. Simultaneously the attraction of (K) closes another circuit as follows: (1), (2), (3), (E), (f), (13), (14), (15), (K^{11}), (K^{12}), (38), (L), (10), (L) being the magnet on the back of the switch, releases the detent and allows the carriage to fall to its normal position. When the switch-hook contact passes below (f) after replacement of receiver, the magnet (K) is deenergized and the detent being released the carriage falls to normal position.

Faller Semi-automatic System.

The Faller semi-automatic telephone system was devised to meet the requirements of operating-telephone companies using multiple-manual switchboards which they cannot afford to discard. The following data in relation to this new and interesting development were furnished by the Faller Automatic Telephone Exchange Company of New York, which is the manufacturer.

The service is accurate, quick, private, and no interference is possible. An answer is always given in a few seconds, whether the line is busy or not busy. It is not subject to the mistakes which are made in transmitting numbers vocally. It is unnecessary for the subscriber to stand at the telephone holding the receiver to his ear while the connection is being made. If the line is busy and he has called a number with which he is not familiar, he does not require to refer to the directory again, as the number stands before him on the sender until he wishes to call another subscriber. The operator does not even know what number is called, and operators therefore do not use transmitters or receivers, as even the "busy test" is given by visual signal.

The ordinary commercial telephone is employed

without any modification either in construction or wiring. Each subscriber's instrument is provided with a mechanical signal transmitter called a "sender," which may be placed beside the telephone instrument, and by means of it the number is signaled to the exchange. The "sender" consists of a box five by five inches, containing a clockwork arrangement. On the face of the "sender" a number of rings appear side by side, which revolve on a center, each ring having the numerals from 0 to 9, four rings giving numbers from 0 to 9,999, and five rings giving numbers from 0 to 99,999.

On the side of the box is a knob, and when the subscriber wishes to call a number he quickly sets the numerical rings, so that the desired number is displayed across the sender, and then gives the knob a turn. This is the only operation he performs. The act of turning the knob gives him instant access to the exchange.

When the connection is established (which is in about four seconds), the caller's bell rings once, indicating that he may take down the receiver and converse, or two rings will indicate that the line is busy. In the latter case he can repeat his call by giving the knob another turn, as he can, if he wish, leave the required number already set.

This knob, upon being turned, winds the spring of the clockwork: it then returns to its first position, where it is locked, thus preventing further interference until the call has been sent and properly received at the central exchange. When the "sender" starts, the series of impulses are sent over both legs of the metallic circuit simultaneously. The "sender" also contains a magnet whose armature normally retains the clockwork until the magnet is energized by current from the exchange.

At the exchange the jacks, lamps, plugs and cams used at present in a section of a manual multiple exchange are the same as used in the semi-automatic system and do not need description. The elimination of multiples makes a difference in the appearance of the board.

In the multiple board there is a multiple panel and an answering panel. In the semi-automatic system the multiple panel is out; it does not exist, and instead of the thousands of jacks which occupied this panel on the multiple board there are only 200 jacks, which serve for trunking to each section of 200 lines. All calls are trunked, even though they originate and terminate in the same section. These jacks are arranged in the ordinary manner, and on top of the jack strips a single lamp is placed, carrying the trunk lamps, the office of which will be described later. The number of jacks in the answering panel remains the same, namely, 200 per section (or more if it is not a busy section), the only difference being that to each answering jack there are two lamps—one red and one white.

The key shelf has the ordinary complement of keys, and in addition to the regular pair of plugs a trunk plug. There are two supervisory lamps and a trunk pilot lamp for each cord circuit. The percentage of cord circuits may be any that is required, and is 10 per cent. in the regular equipment.

To give an example of the change in the appearance of the board, it may be mentioned that a section of a 4,000-line multiple board transformed into semi-automatic contains only 20 rows of 10 jacks each and 20 rows of trunk jacks, or 400 jacks in all, as against the 4,000 jacks in each section of a multiple board of that size. The trunk jacks, in a vertical line, are individually interconnected with the corresponding trunk jacks in alternate sections, and terminates each in one of the plugs of a group. Trunk lamps above each vertical row are common to all trunks terminating in the same plug group

These connections are the only connections carried between the sections, making it possible to subdivide the system at will, which of course would be impossible with the multiple system without sacrificing its advantages entirely.

The act of the subscriber in turning the knob instantly causes a white-line lamp to light at the exchange; the operator plugs the corresponding jacks and throws a key. A trunk lamp then lights, the operator tests for "busy," and then plugs an idle trunk jack, and throws the key the other way, which transfers the call by the particular trunk plugged to the section where the called subscriber is located, which may be in another exchange, or in another section of the same exchange, or in the section in which the call originated. In the former cases, which will be most frequent, the operator in the other exchange or section sees a pilot-lamp light up, throws a key belonging to the light, whereupon another (a red-line lamp) lights over the answering jack. The operator then rings, when the whole connection is complete. Where the calling and the called subscriber are in the same section one operator makes the whole connection.

Since there is only one line jack provided per subscriber, it is of course not necessary in this system to provide a busy test for the subscribers' lines, since the operator will at once see that the line is already plugged, if a busy subscriber is called, and will in this case simply ring back on the line twice, indicating "busy" to the calling subscriber.

For the trunk jacks, which have several terminals, a visual busy test in the shape of a single lamp is provided in each section, and the operator tests trunk jacks for "busy" just as in present manual practice she tests a multiple jack. In the semi-automatic board the result, if busy, is that the trunk busy lamp immediately lights. The operator then uses the next clear jack in the same vertical row.

Double supervision is provided by the two regular supervisory lamps on the shelf, and these lamps are, as in present practice, directly controlled by the receiver hooks, each lighting as soon as the subscribers hang up their receivers. When the operator who did the ringing takes down the connection at her section the trunk pilot at the originating section begins to "wink," indicating to that operator that she should take down the connection.

In practice, the average time consumed from the time the subscriber turns his knob until he is signaled "Go ahead" or "Busy," is only between four and five seconds. The operation is simpler, quicker and more mechanical than in the multiple system, consequently the strain on the operator is not nearly as great. She can maintain her best efficiency throughout working hours, and it is evident that a large number of the operators, now necessary, will be dispensed with.

In answer to questions which have been asked regarding certain details the manufacturer makes the following statements:

The number of wires required per telephone is two wires and a ground. Talking is over metallic circuits, signaling is over the ground.

The power-distributing and protector equipment required is the same as is now used for the present central energy multiple systems, except that no intermediate distributing board is required, there being no multiples.

As to the magnets in the talking circuit, the talking circuit does not differ at all from that of the present central-energy practice.

Four-party selective ringing service can be given. Selective-ringing keys need only be provided in party-line sections, and any ordinary commercial telephone can be used without any modification either in construction or wiring.

The area to be served may all be handled from one large exchange, or may be subdivided, so as to be handled by any desirable number of exchanges, interconnected by trunks. A system so divided will give identically the same service as one large exchange. Trunks between exchanges require only two wires.

A "trouble" call is provided at the sender, so that if the sender is disabled through abuse or other reasons the subscriber can still instantaneously connect himself with the "trouble" or information department.

The semi-automatic system will work in perfect harmony with full automatic and measured service; nickel-in-the-slot, or any other kind of special service can easily be given.

At Salt Lake City recently 14,919 feet of 200-pair telephone cable was laid in seven hours and 40 minutes by a force of nine men, establishing a "world's record," it is asserted. Francis B. Hall was the engineer in charge. The best previous record was made in St. Louis in 1898, when nine men and a foreman stretched 7,556 feet of 120-pair cable in the short space of 8½ hours.

Lorimer Automatic Machine Telephone System.

By F. Dagger.

As a result of several years of careful study, hard work and the expenditure of a large sum of money, an automatic telephone system has been devised, known as the Lorimer machine telephone, the invention of two brothers bearing that name, which will enable the work of a telephone exchange to be carried out with rapidity, regularity and efficiency. The accompanying pictures of different parts of the system show the details of the apparatus.

Two 100-line sections of a 10,000-line exchange completely wired and ready for service are shown in Fig. 1. Each section is built upon a steel frame, which carries a series of arms, upon which the working parts are erected. On the front ends of each section, the terminals of the subscribers' lines are clearly shown, these being carried from the distributing frame in cables. At the foot of the first section is the motor and driving gear. The driving mechanism consists of a shaft between the two sections (concealed by the framework) and on each section is a horizontal shaft, connected with six vertical shafts, one for the sectional division and one for each of the five percentage or connecting divisions. These shafts are revolving continuously in a working exchange at a speed of 50 revolutions a minute, one-eighth horsepower a section being all the power required. By means of the revolving shafting, in combination with electrically operated clutches, which start and stop the cylinder switches, the moving contacts are stepped to their required positions and released when a conversation is finished.

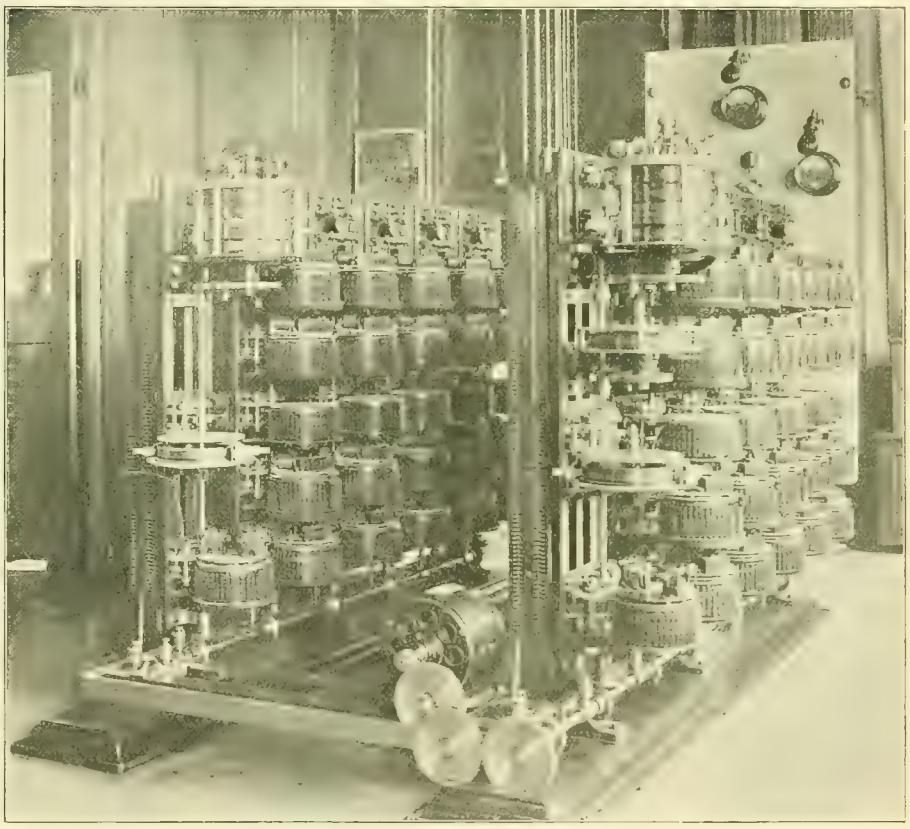


FIG. 1. LORIMER AUTOMATIC MACHINE TELEPHONE SYSTEM.—TWO 100-LINE SECTIONS READY FOR SERVICE.

The first row of mechanisms, arranged vertically, comprises the sectional or controlling division, the function of which is to receive the calling impulses from the subscriber's line and select the first idle division, which completes the connection with the number called. In other words, the sectional division performs a similar duty to that of a manual operator inserting the answering plug in the calling subscriber's local jack, with this difference: That it can take one call in every three seconds throughout the 24 hours without intermission. It never tires or gets confused, and, being a machine, it cannot err; all points which apply with equal force to the whole exchange.

The remaining part of each section comprises five percentage or connecting divisions, each consisting of five vertical rows of cylinder switches—a rotary switch, which controls the circuits for the rest of the division; a primary connector, carrying contacts representing line 1 and 2 of the circuits of each subscriber on its own section, which, by means of rotating brush contacts, completes the circuit with an interconnector; an interconnector, carrying contacts representing trunk circuits to every section of the exchange, which, by means of rotating contacts, selects a secondary connector of a division in the section on which is the line of the called subscriber; a secondary connector, carrying contacts representing the lines of its own section, which, by means of the rotating contact brush, forms the cir-

cuit from the interconnector to the called subscriber's lines, thereby completing the connection of the called with the calling subscriber; and a signal-transmitter controller, which, as its name implies, controls the signal transmitter of the calling subscriber by forming a circuit for the starting and release impulses at the calling subscriber's station. Fig. 2 is an illustration of a percentage division.

Fig. 3 shows a subscriber's telephone set, which, in addition to the usual transmitter, receiver and ringer, comprises a signal transmitter, which consists of a clockwork-driven device, controlled by an electromagnet which steps forward a revolving contact brush over four sets of contact pins, representing numerals 0 to 9 of thousands, hundreds, tens and units, in addition to a normal, preliminary and talking pin. On the face of the telephone set is an indicator plate, with four vertical slots, representing thousands, hundreds, tens and units, in each of which is a pointer carrying a brush contact arranged to slide up or down in front of the numerals 0 to 9. In this way the pointers can be arranged to indicate any number from 0 to 9,999, inclusive. At the back of the indicator plate are four rows of stationary contacts, corresponding to the numerals on the plate, and arranged so that the brushes of the pointers make contact therewith. These contacts are wired to the four sets of pins over which the revolving contact brush passes as it is stepped forward by the impulses from the signal-transmitter controller at the exchange. The indicator plate is in circuit with the common-return wire of the system, and, the brushes of the pointers being also in metallic contact with the plate, the number of impulses caused in the opening and closing of the circuit by the revolving brush passing over the four

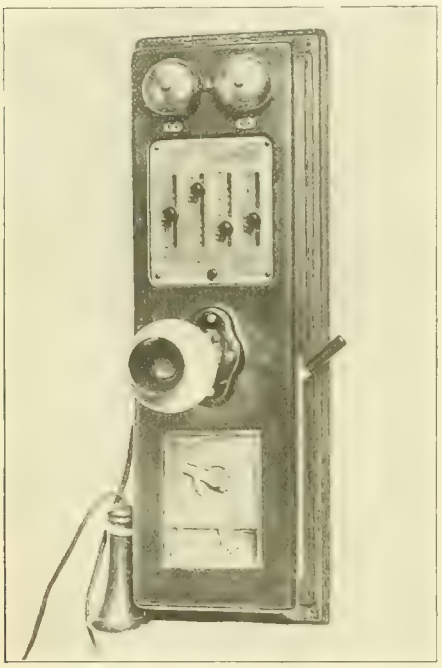


FIG. 3. LORIMER AUTOMATIC MACHINE TELEPHONE SYSTEM.—SUBSCRIBER'S TELEPHONE SET.

sets of pins is regulated by the positions of the pointers on the indicator plate in combination with the contacts at the back.

The revolving-brush contact rests normally on the normal pin, to which line wire No. 2 of the subscriber's circuit is connected, leaving the line circuit through the brush contact, the normal pin, and the ringer when the receiver is on the switch hook; thus, in answering a call, it is only necessary to remove the receiver, which brings the line into the speaking circuit, and replace it when finished, as in the manual system. To make a call, the pointers are first moved to indicate the number required; then the lever on the right is pulled down, which, moving the revolving-brush contact on to the preliminary pin, connects No. 1 wire with the common return and completes the circuit with the sectional division of the exchange. As soon as the sectional division has selected an idle percentage or connecting division, the lever commences to rise, and in so doing passes the revolving brush over the contact pins. When the lever reaches a stationary position with the brush on the "talking" pin, the receiver is removed, placed to the ear, and the ringing button shown on the indicator plate is pressed. If the alternations of the ringing current are heard, it indicates that the connection is made and the "called" subscriber's bell is ringing. If no alternations are audible, the line is busy, the receiver is replaced, which act under all conditions restores the subscriber's and central-office mechanisms to their normal position. Once a call is sent in by pulling down the lever, the switch hook is locked, and the connection cannot be interfered with until it is completed, when the passing of the revolving brush from the "preliminary" to the "talking" pin releases the switch hook.

One very important point to be noted here is the fact that should all the percentage divisions be taken up by prior calls, the call is stored at the exchange until a connecting division becomes idle, when the lever, which in the interval has remained in the position placed by the subscriber, rises and indicates that the connection is made.

The decimal indicator (Fig. 4) acts as a monitor for each section. It consists of a commutator, comprising three rings of 100 segments, one ring representing No. 1 wire of the subscriber's circuits, a second ring of 100 segments connected with the guard or busy-test wires, which are also represented on each percentage division, and a "units" ring, which indicates the units value of the number calling.

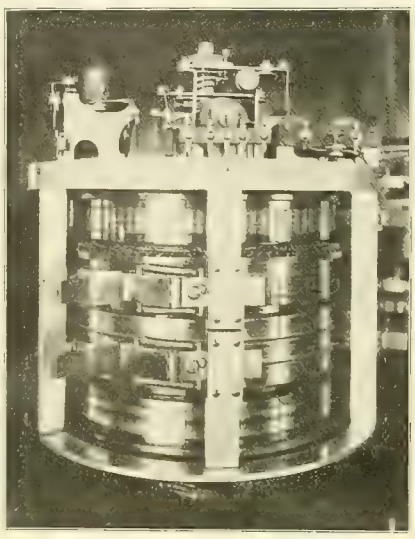


FIG. 4. LORIMER AUTOMATIC MACHINE TELEPHONE SYSTEM. DECIMAL INDICATOR.

There is also a ring of 10 segments connected with the decimal register controller (shown under the decimal indicator), and a signal register on top of the rotary switch, which indicates the tens value of the number calling. Two battery-feed rings are added, from which two brushes take the current for operating the section. A concentric ring, carrying contact brushes, revolves around the commutator at the rate of 20 revolutions a minute, a brush passing over each of the 100 segments once every three seconds. As stated before, the act of pulling down the lever by a subscriber connects No. 1 wire with the common return; this also completes the battery circuit through these wires and the windings of an electromagnet, which, in combination with a clutch, brings the concentric frame to a stop with the brush resting on the segment of the line ring to which the calling subscriber's line is connected. The other brushes are resting on the segments of their respective rings, thereby forming circuits, which, in combination with the decimal register controller and the division starter (shown under the decimal register controller), select an idle percentage division. The concentric ring once more resumes its

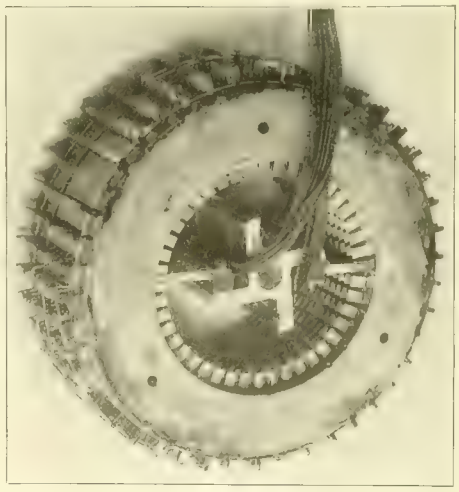


FIG. 5. LORIMER AUTOMATIC MACHINE TELEPHONE SYSTEM.—CYLINDER SWITCH SHOWING STATIONARY AND ROTARY BRUSHES.

motion and the percentage division completes the connection in the manner before stated.

In addition to the parts mentioned, the sectional division of an exchange includes a "consecution controller," the function of which is to prevent two or more calls being sent into a section simultaneously and to insure the handling of all calls in consecutive order. It may also be stated that the sectional division tests all the lines of its section for crossed or grounded wires once in three seconds, or each time the brushes pass over the line segments. The presence of such troubles is instantly announced by the ringing of a gong, when the attendant in charge can at once pick out the faulty line and isolate it until remedied.

Referring now to Fig. 5, the picture shows a cylinder switch of a percentage division, showing the stationary and rotary-brush contacts. As will be seen in Fig. 1, these switches compose 90 per cent. of the exchange mechanisms; therefore the solidity, simplicity and economy of their design is an important factor in the construction of the exchange. The cylinders are uniform in their design and only differ from each other, when in position, by the manner in which they are wired to form the necessary circuits. Each one consists of a cylinder of insulating material having an external diameter of 6¾ inches, the space within which the contact brushes rotate being 4¼ inches. Embedded in the insulating material are 528 strips of german-silver, the outer ends forming the tips on which the wires are soldered, and the inner ends the knife contacts which are wiped by the double contacts of the rotary brushes. These cylinders, with the springs embedded therein, are manufactured in one operation by a specially designed mold and frame, at a cost below that of a single row of multiple jacks in a manual switchboard. When it is remembered that a 2,000-line multiple switchboard has 1,000 rows of jacks, 2,000 subscribers' drops or lamps and 200 pairs of cords and plugs, with clearing-out drops or lamps, in addition to the operators' equipments; whereas a Lorimer machine telephone of a similar capacity would require only 520 cylinder switches, some idea may be gained of the marvelous simplicity of this invention.

A rotary brush for the cylinder switch is shown by Fig. 6. This consists of an aluminum spider carrying a number of brushes mounted radially in a clamp of insulating material. Each brush is composed of two german-silver springs, arranged to make hard wiping connections on the two surfaces of the knife contacts in the cylinder switch when the spider is revolved. One objection that has hitherto been made to automatic telephone operators has been that the pressure of the springs on the contacts is too light to insure good circuits, but with this system of contacts the pressure is not only heavy but uniform. The switches are dustproof, since the knife contacts are of a wiping nature, and this objection is entirely removed. The cylinder and brushes illustrated have

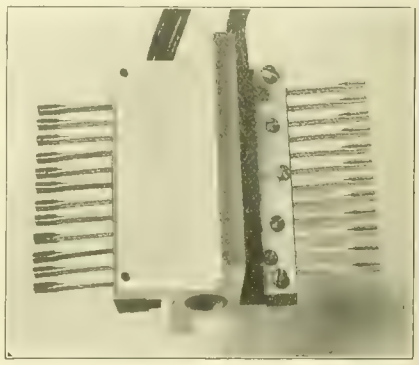


FIG. 6. LORIMER AUTOMATIC MACHINE TELEPHONE SYSTEM.—ROTARY BRUSH FOR CYLINDER SWITCH.

been subjected to a test comprising a series of rapid revolutions equal to the completion of 23,000,000 calls, or 150 years actual use, and they are now in a serviceable condition.

Through the center of the rotary spider is fitted a spindle gear which is operated by the vertical shafting of the divisions in combination with a controlling electric clutch whenever a call is sent in. It may here be stated that with the exception of the concentric ring on the decimal indicator and the shafting, all the mechanisms are normally in a stationary position, motion to the other parts being only imparted when a call is being sent through, and then only one division is affected.

A back view of a section completely wired is seen in Fig. 7. One advantage of this system is that each section is sent out from the factory with every circuit wired and tested. There are no heavy installation expenses for wiring after it reaches its destination. The only wiring necessary in the exchange is the connecting-up of the subscribers' leads and the cabling of trunks between sections. Every section is a complete working unit of 100 lines, and the telephone manager can increase the capacity of his exchange by one section at a time as his increase of business necessitates the extension. He does not have to spend a large amount of unremunerative capital in providing for future requirements, and, above all, he never has to face the position of having to "scrap" his central equipment because his subscribers' list has outgrown the capacity of his switchboard. The simple, substantial and uniform character of the mechanisms which form this exchange are such that the cost of maintenance is much less than that of any manual central-office equipment.

The system is "central-energy," being operated at a potential of 30 volts. The cost of current is no greater than that for operating a manual exchange. One attendant is allowed for the supervision of an exchange of 2,000 lines.

There are many points in which the Lorimer machine telephone differs from other automatic sys-

tems, but those which place this invention in the front of all others may be summarized as follows:

1. It eliminates the most fatal element in the growth of telephone systems by enabling the exchange to be built up from the first section of 100 lines to as many thousand at the same cost per hundred as that of the first section. This will enable the telephone manager to increase the capacity of his exchange concurrently with the growth of his subscribers' list without necessitating any advance in rates, no matter what the proportions the system may eventually reach.

2. The connecting capacity of each section is similar to that of a manual switchboard, comprising a number of connecting divisions corresponding to the pairs of connecting cords on a manual section, each of which is in like manner common to the use of every subscriber. This eliminates the provision of individual selectors and connectors for each subscriber and affects an economy of 90 per cent. of the mechanism necessary in other automatic systems.

3. The multiple system of wiring is eliminated. The subscribers' lines terminate on the sections to which they belong, the connections between the sections being made over trunk circuits, which are common to the use of the whole exchange.

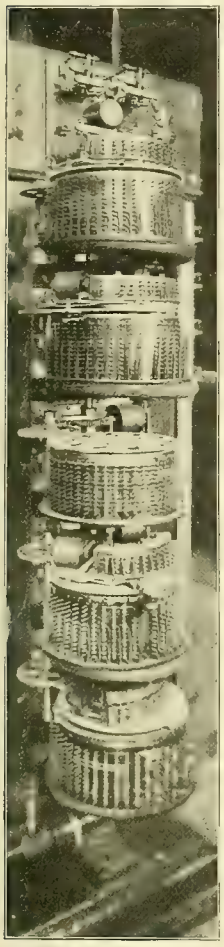


Fig. 2. One of the Percentage Divisions.

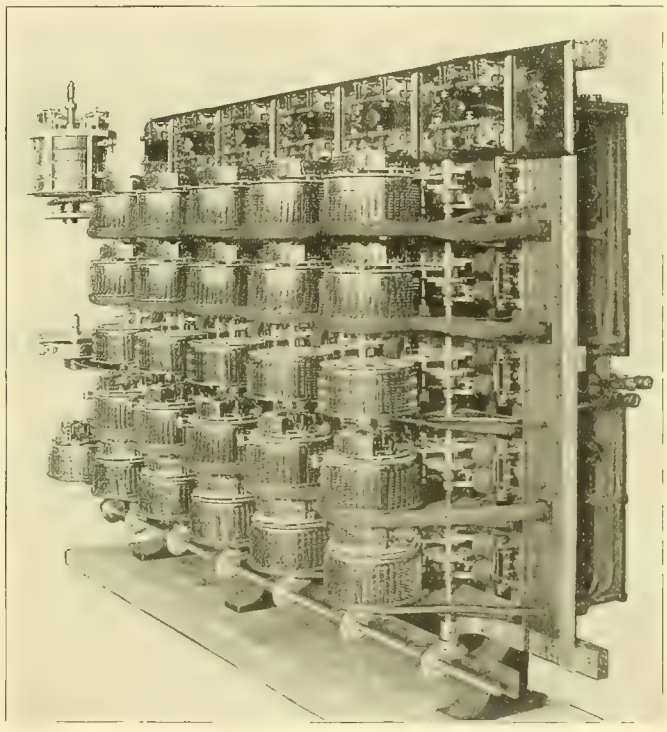


Fig. 3. Back View of One Section

LORIMER AUTOMATIC MACHINE TELEPHONE SYSTEM.

With the exception of Canada, where the rights have been sold to the Canadian Machine Telephone Company, the patents for the United States, European and other civilized countries are owned by the American Machine Telephone Company of Piqua, Ohio. The president and general manager of the company is N. D. Neill; vice-president, C. J. Thintner; secretary-treasurer and electrical engineer, G. W. Lorimer.

The factory of the company is at Piqua, where an exchange may be seen in operation.

Manual versus Automatic Telephone Operation.

At the recent telephone meeting in Chicago the comparative merits of automatic and manual exchanges were discussed. A general idea of the meeting was given in the Western Electrician at the time, but as the subject is an important and timely one, further reference to it will be of interest.

The paper which aroused the discussion was written by Franz J. Dommerque, and was entitled "The Commercial Aspect of an Automatic Telephone Exchange." Mr. Dommerque's conclusions were unfavorable to the automatic system. The following extracts from the paper will show the trend of the argument:

"Every telephone manufacturer has long ago found out that a satisfactory local-battery transmitter can be designed and manufactured at less cost than a common-battery transmitter because almost any transmitter, however crude, will talk with local battery, while the design of a really good common-battery transmitter is an art; therefore the use of common-battery transmitters may be prohibitive in some automatic systems because the rest of the machinery and the circuits do not permit of the margin between rough-and-ready local-battery transmitters and the scientific common-battery transmitters."

"The principal requirement to render an automatic system commercial is the provision of a good talking circuit, with the minimum number of contacts and coils, and common battery as the source of current for transmitters and signaling devices."

"In the present available automatic systems the subscriber has to do his own operating, and therefore carries the responsibility for good operating to a great extent himself. If he is a good operator he may give good service, but as a rule the operator at the manual board is the better operator."

"The possibility of manual apparatus failing to give reliable service is very remote. Any automatic apparatus must necessarily be more complicated than manual apparatus and the chances for trouble greater. When an operator gets sick her place is immediately filled by another operator; when an automatic switchboard gets sick there is trouble."

"In the days when grounded signaling was in vogue with manual systems, the advent of electric railroads forced the telephone company either to run a common return back to the exchange or connect the subscribers to ground in bunches so as to equalize the difference of ground potential in different localities. Automatic systems with grounded circuits will have the same experience and the remedy will cost at least $1.50 a subscriber."

"Automatic switches contain a great number of contacts in the talking circuit, and even if these contacts are all platinum, they are not desirable, as they are expensive and liable to get out of alignment and become weak."

Mr. Dommerque gave estimates of cost of operation on an exchange equipped for 5,000 subscribers. The first cost of manual board and subscriber's instrument he put at $25 a subscriber, or $125,000. The corresponding first cost of the automatic (referring to the system most widely in use) he estimated at $38.50 a line, or $192,500. This exceeds the manual first cost by $67,500. Twelve and one-half per cent. interest and depreciation on this sum amounts to $8,437. Insurance adds $675, grounded signaling, if used, $600 (as interest on $7,500) and local-battery expense $7,500; total added maintenance expense $17,212. To offset this Mr. Dommerque could only figure out a net saving of $11,580 a year in operators' wages. Summing up, he contended that $17,212 less $11,580, or $5,632 a year, represented the financial saving of the manual system.

"Automatic systems * * * limit the number of subscribers that can be given service to the ones that can afford to pay for single-line service. Wherever an automatic system without party-line service has to compete with an manual system in the same city the automatic system is seriously handicapped because of the party-line question."

"Another important factor in modern manual service is the pay station. Pay stations not only are a great convenience to the public but a good revenue producer for the telephone company. So far the companies giving automatic service have not been able to arrange for pay-station service."

In the discussion A. H. Dyson of Chicago, for the automatic system now most widely in use, combated Mr. Dommerque's statement and conclusions. He has yet to find a manual system where the transmission surpasses the automatic system with which he is most familiar. The automatic can be adapted to common-battery transmission. In a 5,000-line exchange the annual expenses would be $15,000 in favor of the automatic, rather than the other way, as Mr. Dommerque figured. Depreciation of the automatic should be figured at 3½ per cent. per annum.

L. W. Stanton of Cleveland said the cost of operating varies from 16 to 87 cents a telephone a month. When traffic is properly handled, the manual board can give very good service. The automatic is coming sooner or later, but several improvements must be made. A combination of automatic selection and manual operation might be useful.

Mr. Dyson: Why stop half way? If you are going in for automatic operation, have the exchange completely automatic. There is no limit to the automatic system. It may be arranged for two stations or two million stations. There are 14 contacts in automatic talking circuit in a 10,000-number exchange. In a 100,000-number exchange system there would be 18 contacts in the talking circuit. In general, the larger the exchange the greater the saving in favor of the automatic.

H. P. Clausen said he believed there were 11 springs in the automatic telephone as against two in the best common-battery instruments. These springs were bound to give trouble. There are four series magnets and eight bridging magnets in the automatic talking circuit. No large automatic exchange has been in service long enough to show what the system can do. This speaker was strongly in favor of the manual system.

Mr. Dyson remarked that the automatic could do anything that the manual could, and better, with the exception of selective party-line service.

A. D. T. Libby said the manual was faster than the automatic. C. O. Harris agreed with this statement. He defied any machine to equal the record of manual operators for speed. The automatic has not the flexibility of the manual, he said; the machine takes care of certain conditions, not of all conditions. Private branch exchanges were pointed to as an example of manual superiority in the matter of flexibility.

Professor Morgan Brooks of Urbana said the small automatic exchange at the University of Illinois had given less trouble than had been expected. The automatic had the advantage of continuous operation, day and night, no matter how small the exchange, and of confidential communication.

Michigan Independent Telephone Association.

The Michigan Independent Telephone Association held its annual convention in Grand Rapids on February 24th and 25th. About 100 delegates were present at the opening meeting, held in the Citizens' Telephone Building. The formal programme opened with an address of welcome by Mayor Palmer, followed by papers on timely subjects by the following-named members: Dr. G. S. Root of Hart, R. F. Johnson of Saginaw, W. C. Hunt of Adrian and R. B. McPherson of Lowell. In the evening the delegates were banqueted at the Pantlind, and W. J. Melchers of Alma read an interesting paper.

At the second day's session a committee was appointed to select a clearing-house committee and draw up a code of rules for the conduct of a state clearing house. It is probable that each of the 10 toll-line companies in the state will be represented upon this committee. The purpose is to employ a clearing-house manager with such assistants as he may need, with an office centrally located. It will be the mission of this institution to adjust all differences between the companies interchanging business, and to apportion the rates for such business as is done. The expenses of the clearing house will be defrayed by the respective companies according to the amount of business which they do.

Another resolution was adopted requesting all Independent manufacturers to refrain from selling telephone apparatus to companies which may be started for the purpose of competing with legitimate Independent companies.

Papers were read at this session by N. F. Wing of Jackson, C. E. Tart of Grand Rapids, H. A. Douglas of Jackson, J. B. Ware of Grand Rapids, and Charles F. Speed. Each of the papers was followed by a general discussion.

The delegates then took up the election of officers, with the following result: President, E. B. Fisher, Grand Rapids; vice-president, R. B. McPherson, Howell; secretary, C. F. Brown, Alma; treasurer, R. F. Johnson, Saginaw. These, with William Robinson, Muskegon; W. O. Hunt, Adrian; J. Robinson, Benton Harbor; A. E. Palmer, Kalkaska, and W. E. Wing, Grass Lake, constitute the executive committee.

If the plan is considered feasible, a state directory containing the names of all subscribers to the Inpendent telephone system in Michigan, will be issued in the interest especially of the long-distance service.

For the third time the City Council of Lincoln, Neb., is considering an ordinance to submit at the April election, a proposition to bond the city for a municipal electric-light plant. Bonds have been voted twice before, but owing to defects in the ordinance were declared illegal.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

American Institute of Electrical Engineers (next meeting of the Chicago branch), rooms of Western Society of Engineers, Monadnock Building, March 8th.

Iowa Telephone Association (annual convention), Savery House, Des Moines, March 8th, 9th and 10th.

American Electrochemical Society (annual business meeting), Washington, D. C., April 7th, 8th and 9th.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

A RATHER plaintive note is struck in the recent annual report of the Municipal Light Board of Hudson, Mass. "We regret that we have been obliged to wait until the factories closed before lighting the streets," say the members of the board, "but we could not do differently." No further explanation is offered, but apparently the current from the plant was supplied to the factories during the daytime and was not available for street lighting until after the workshops shut down at night. At this distance it appears strange that a plant installed by taxpayers' money for the primary purpose of lighting the streets of the community should be diverted from its purpose to serve the needs of private industry. The best argument for municipally operated lighting plants is that well-lighted streets are in a measure policed and that the municipality may well protect itself in this manner with its own plant. In Hudson, however, the needs of the factories seem to take precedence over what the people must have thought were their rights when they established the plant.

AUTOMATIC telephone systems have their disadvantages, no doubt, but nevertheless they are increasingly "in evidence," to employ a loose but convenient phrase. One hears more rather than less of exchange systems in which mechanisms replace human intelligence to a considerable extent. Not only is the number of automatic exchanges in use gradually increasing, but the inventors are turning out varied systems with significant activity and zeal. The movement is not confined to the Independents in the telephone field, but also embraces the Bell people, who possess many automatic patents and are commonly reported to be carrying on an exhaustive series of experiments with a comparatively small automatic exchange in an eastern state. There are working automatic exchanges in Chicago, Grand Rapids, Mich., Dayton, Ohio, Fall River, Mass., and other cities. The service given, in Chicago at least, seems to be satisfactory to those who use the telephones. But the mere fact that one is able to make connection and talk clearly through a new automatic exchange does not indicate that the problem has been solved. There are many other things to be considered, involving financial questions, the everyday working efficiency of the apparatus and its adaptability to the various demands that are made on the modern telephone exchange. Today over 99 per cent. of telephone conversations are made through manually operated boards; the automatics have still to stand the test of time. But the fact remains that a growing number of telephone men are asking whether a change is impending. Where so many inventors and engineers are at work and where so much money is invested, the disinterested observer feels that somthing important must be at stake. It will not do to say that the automatic exchange was tried and discredited a dozen years ago; the idea persists; systems have been greatly improved; and the principle is now fairly on trial, apparently, to be accepted or rejected by the record of hard actual experience. What system or systems, if any, will survive only the future can tell. That there is no lack of types from which to choose, this and preceding issues of the Western Electrician show.

FROM the viewpoint of hard common sense the affiliation of the Chicago Electrical Association with the Western Society of Engineers is an advantageous arrangement for all concerned. And yet there will be not a few to regret the passing of the only distinctively local electrical society in Chicago. To be sure, the Chicago branch of the American Institute of Electrical Engineers remains and there will be an electrical section of the strong Western Society, but in both cases these bodies are merely parts, of more or less importance, of a whole. In the one case the society is all electrical, but with headquarters in New York; in the other the administration is distinctively Chicagoan, but not distinctively electrical. The Chicago Electrical Association was entirely electrical and entirely representative of Chicago, but it has passed away. New York maintains a purely local electrical society, but Chicago now has none.

But these are largely sentimental objections; there are several practical benefits to commend the merger to the members of the old association. The Western Society of Engineers is a strong and influential body, with now about 800 members. It is noted for the large proportion of active members; on July 1, 1903, 83 per cent. of the total membership was composed of active members, who must be professional engineers. On its rolls are the names of a large proportion of the prominent engineers of the West, and among its presidents it has numbered such men as William Sooy Smith, Benezette Williams, E. L. Corthell, L. E. Cooley, Isham Randolph, Alfred Noble, Onward Bates and Octave Chanute. It is 35 years old and has centrally located rooms, with a good library and assortment of periodicals and a well-equipped, though small, assembly hall. It is, in fact, a union engineering society, and very likely Chicago will have, too, before long, a union engineering building. It offered practical advantages and associations which the younger and smaller electrical association could not afford to ignore. On the other hand, the society is strengthened, broadened and invigorated by the absorption of the alert and enterprising young electrical men.

The Chicago Electrical Association had an honorable existence of 13 years. Before it many technical papers of high character and real value were presented, as readers of the Western Electrician are well aware. It published in 1897 a collection of standard electrical diagrams of much usefulness that attracted wide attention. It leaves a record of which none of its members need be ashamed.

A CURIOUS and interesting question of neutrality in wartime has come up in relation to the request made by Japan through the Commercial Pacific Cable Company, as reported in the daily press, for permission to land a cable on the island of Guam to connect Japan with that island, and consequently with the American Pacific cable connecting Manila and San Francisco.

Japan is connected with the mainland of Asia by four submarine telegraph cables. Two lead north from Nagasaki to Vladivostok, and are now, of course, unavailable owing to the war between Russia and Japan. The other two extend west across the Yellow Sea from Nagasaki to Shanghai, in China. As this body of water is comparatively shallow, the Japanese apprehend the possibility that the Russians may be able to cut the cables now in use, thus isolating their country from the rest of the world in a telegraphic sense. As an alternative route—one likely to come into use sooner or later in any event—they propose to lay a cable in the deep waters of the Pacific southerly from some landing place on the southern coast of the island of Nippon, say Yokohama, to Guam. Such a cable would be about 1,600 miles long and would be an important link in the world's network.

It is reported that the United States government has the application under consideration and is disposed to give a favorable response. Russia holds, it is said, that permission for the landing of such a cable at Guam while Japan is at war with Russia would be a violation of neutrality on the part of the United States. On the other hand, recognizing the laying of the proposed cable as an important commercial advance, the State Department may give its permission, with the stipulation that the cable shall not be used to further the belligerent ends of either of the warring nations.

The laying of the Japan-Guam cable would be an enterprise of considerable magnitude, and it does not appear to be clear whether Japan proposes to undertake the work and defray the expense itself or whether it has made an arrangement with the American company. It is interesting to recall that the Western Electrician anticipated, in an editorial printed just before the breaking out of the war, the present situation. In the issue of February 6th we said: "The last link of the American Pacific cable connecting Manila in the Philippines with the mainland of Asia remains to be laid. A war in the Far East might further delay the laying of this cable, or, under conceivable circumstances, might accelerate it." The "conceivable circumstances" have arisen rather sooner than expected. There is a cable in existence, of course, between Manila and Hongkong, but it belongs to a British company. An American line to the Asiatic coast will undoubtedly be laid in time. But in the meantime a branch to Japan, forming also an alternative route to Asia, would be advantageous. The commercial interests of the United States would be benefited by the laying of such a cable, and apparently the war situation has given a stimulus to the project.

HIGH-TENSION TRANSMISSION PROBLEMS.

At the meeting of the American Institute of Electrical Engineers held in New York city on Friday evening, February 26th, two papers were read and discussed. One, by Professor Harris J. Ryan of Cornell, was upon "The Conductivity of the Atmosphere at High Voltages;" the other, by Guido Semenza of Milan, Italy (read by Mr. Lieb), was entitled "European Practice in the Construction and Operation of High-pressure Transmission Lines and Insulators." A synopsis of Mr. Ryan's paper and an abstract of the paper of Mr. Semenza and the discussion which succeeded it are here given. It is probable that in a future issue of the Western Electrician further refrence to Professor Ryan's important paper will be given.

The Conductivity of the Atmosphere at High Voltages (synopsis).

BY HARRIS J. RYAN.

The paper gives an analysis of the factors that are responsible for the nature of the atmospheric loss occurring on high-voltage lines, as reported by Mr. Charles F. Scott in his paper that was published in the American Institute of Electrical Engineers Tranactions [Vol. 15, p. 531], 1898, based upon results obtained by himself and Mr. Ralph D. Mershon. The analysis shows that the equation

$$E_{max} = 2055 \log_{10}\left(\frac{s}{r}\right) D' (r + d) \times 10^{10} \qquad (10)$$

expresses the relation between the voltage, conductor sizes, and separation at which the sudden rise occurs in the curve of "loss between wires" at ordinary barometric pressures and temperatures wherein

E_{max} = the maximum value of the voltage wave applied to the line.
r = the radius of the line conductor in inches.
s = the separation of the line conductors from center to center in inches.
d = the distance from the conductor surface at which the strain due to the electrostatic field causes initial atmospheric rupture.
D' = the strength of the electrostatic field of force (dielectric flux-density) that will electrically rupture the atmosphere at the distance d from the surface of the conductor having a radius r measured in coulombs per square inch.

To this is added an account of the experiments that were made to determine the above values of d and D' in relation to r and the effects due to barometric pressure and temperature changes and to the presence of moisture.

The values found for d and D' in relation to r at a barometric pressure of 29.5 inches of mercury and a temperature of 70° F. are given in the following table:

B. & S. G.	2r.	d.	D'
20	0.03106	0.0050	350×10^{10}
15	0.05706	0.0100	300×10^{10}
10	0.10189	0.0180	275×10^{10}
8	0.12840	0.0220	258×10^{10}
6	0.16202	0.0350	200×10^{10}
4	0.20431	0.0700	171×10^{10}
2	0.25763	0.0700	170×10^{10}
Measurements upon conductors of larger sizes to the limit of a diameter of 0.625 inch.	0.625	0.0700	170×10^{10}

The experiments demonstrated that the voltage at which the atmospheric line loss is inaugurated varies as the atmospheric density, i. e., directly as the barometric pressure and inversely as the absolute temperature. On substitution of corresponding values obtained by experiment equation (10) takes the following practical form:

$$E_{max} = \frac{17.94b}{459 + t} \times 2055 \log_{10}\left(\frac{s}{r}\right) D' (r + d) \times 10^{10}$$

wherein (12)

b = the barometric pressure in inches of mercury.
t = the temperature in degrees Fahrenheit.

Since the values of d and D' are constant for diameters of conductors larger than 0.250 inch, it follows that equation (12) for corresponding conductors reduces to

$$E_{max} = \frac{17.94b}{459 + t} \times 350{,}000 \log_{10}\left(\frac{s}{r}\right) (r + .07) \qquad (13)$$

The results obtained by calculation employing equations (12) and (13) are compared with the measurements made by Mershon on the Telluride high-altitude line in 1898 and those obtained by Professor Harold B. Smith upon the Worcester Polytechnic Institute laboratory line in 1901 and 1902 at ordinary altitudes.

Efforts were made to determine the effects of the presence of moisture upon the point at which the atmosphere about high-voltage lines becomes conductive, i. e., upon the point at which the sudden rise in the loss-curve occurs. However, no definite effect of this sort could be found, and this is practically in accord with Mershon's conclusions after his observations made upon the Telluride line under variable weather conditions. If there is such an effect, it must be small.

The following table of values has been calculated by means of equations (12) and (13). It shows the corresponding diameters of line conductors that must be employed to avoid loss between wires for a series of line voltages wherein the barometric pressure is 29.5 inches of mercury, the temperature 70° F., and the distance between the conductors, 48 inches.

Maximum Volts at which Atmospheric Conduction Loss Occurs.	Corresponding Effective Volts (Sine Wave).	Operating Pressure, 90 Per Cent. of Corresponding Effective Volts.	Diameter of Conductors in Inches.
78,500	55,000	50,000	0.058
118,000	83,300	75,000	0.106
157,000	111,100	100,000	0.192
235,500	166,600	150,000	0.430
314,000	222,200	200,000	0.710
392,000	277,700	250,000	0.990

The real voltage limit today in transmission is due to the insulator, where the line has to be exposed to the weather. In the future the insulator difficulty will be solved in one way or another and higher voltages will be used. Possibly in large undertakings the line may be protected from the elements by means of a continuous covering. It is evident that when such high voltages are employed atmospheric conduction, or "the brush" (as one experienced high-voltage engineer termed it in conversation with the writer), must be avoided. High-voltage brush discharge was studied and reported upon in the American Institute of Electrical Engineers Transactions [Vol. 10, p. 85] by Dr. Steinmetz. He applied to it the term corona. The present paper shows that the brush discharge or corona occurs always when a definite strain exists in the atmosphere next to the high-voltage conductors, and that to avoid such corona with its destructiveness and waste of power, it is necessary on transmission lines and auxiliaries to proportion things so as to keep the dielectric strain of the atmosphere below a definite point, above which the corona will inevitably develop.

In the above table a factor of safety of 1.11, or a margin of 10 per cent., has been allowed in estimating the safe voltage at which to operate so as to avoid losses due to brush discharge. This is a laboratory conclusion only. In application the following points must be kept in mind:

1. Without special care there will be doubt in advance as to the exact value that the voltage wave will not exceed. Almost invariably the line-charging current will cause important line-voltage wave distortion, so that the maximum of the wave will exceed the effective value of the voltage by a factor much greater than the square root of two. The corona formation depends primarily upon the maximum, and not upon the effective, value of the wave; this has been found by Scott, Mershon and others, as well as in the present experiments.

2. One must remember that unless the insulators are properly proportioned, after the cross-arms and pins have been exposed to the weather for some time and have become conductive, the presence of the insulators made of material that has a considerably greater permeability to dielectric flux (greater specific inductive capacity) than the atmosphere, will cause corona to a greater or lesser degree to form over the conductors in their neighborhood, even if the line has been proportioned so as to avoid corona or atmospheric conduction over the remaining portion of the conductors. The presence of corona upon the conductors in the neighborhood of the insulators will likely be accompanied by corona over the pins inside the insulators, resulting in their ultimate injury if made of wood from this cause alone, even if the surface-leakage current is so limited as not to injure the pin.

In view of the above, it is evident that practical experience, and not the laboratory, must eventually determine the factor of safety that should be allowed under given circumstances in lieu of the 1.11 factor or the 10 per cent. margin allowed in the above table.

The paper closes with the suggestion that, when viewed in the dark, the corona formed upon wires of given diameters and distances apart provides a method for gauging high voltages that is free from the short-circuit and surging disturbances occasioned by the use of the spark-discharge method. Either two parallel conductors or a conductor mounted at the center of a cylinder may be employed for this purpose.

European Practice in the Construction and Operation of High-pressure Transmission Lines and Insulators.

BY GUIDO SEMENZA.

The first question which requires consideration when a line is to be built and the voltage of the current has been fixed, is, Which is the most advantageous wire section to be adopted? In a line you may allow any loss of energy, say, between two and 20 per cent., but what will be the most advantageous value, considering both the cost of construction and economy of operation? In some instances the line loss is limited by the regulation required at the end of the line; or in cases of small powers and high pressures, by the minimum section of the wire required to give the necessary mechanical strength; in other cases, the problem is generally purely one of economy. In the old practice, the most economical wire cross-section was determined without the aid of any calculation, in quite an empirical way, based on the consideration of gross expenses, weight of wire, etc. However, a close examination of the subject shows this to be an important factor of economy.

In Europe, generally speaking, important lines are carried across the country and not alongside roads; this is done for obvious reasons. The cross-country method allows the building of a straight line, thus avoiding angles to a considerable extent; then, again, the line is shorter. Of course, crossing cultivated land, as is generally the case in Europe, the cost of building the line is increased on account of the expropriations; but in the greatest number of cases, the extra cost of purchase of land or of right-of-way, is more than compensated by the shorter line. It must not be forgotten that the weight of copper increases in the ratio of the square of the length of the line, the loss remaining the same. It is often argued that following the high roads, the patroling of the line is much easier, but in many cases the right-of-way along the line across the fields is included in the purchase, and the system proves very efficient. At all events, well-constructed and straight lines far from the roads, do not show the necessity of very close patroling, although it is prudent to exercise it.

A most important question now arises, Whether metal poles are better than wooden poles? The principal reason for the adoption of wooden poles is the small cost of installation. For small lines this may be true. Another reason is the assumption that wooden poles increase the insulation of the line; and this also is true, but only when the insulators are very bad. A close investigation, however, will lessen the advantages claimed for wooden poles.

I shall now enumerate the principal advantages and disadvantages of iron poles. Advantages.—Wooden poles will last from two to 10 years, according to the nature of the ground. The durability of iron poles cannot be definitely stated as yet, but they will surely last 40 years, reducing the depreciation to a small amount.

Spans with iron poles may reach from 300 to 400 feet, and in exceptional cases, to 600 feet and more. This compensates for the higher cost of single supports, as, in lieu of three or four wooden poles one iron pole can be adopted, reducing the number of insulators, and consequently of weak points, and thus rendering possible the crossing of difficult passages.

The experience with existing lines constructed with iron poles, shows that the expense of keeping the line in proper repair and good working condition is very much reduced. With wooden poles the strain exerted by the wires will slightly displace the poles or rotate the cross-arms. Dry or wet weather will loosen the connections between cross-arms and poles and between pins and poles. In some cases wooden poles will twist in time.

All the above facts affect the insulators, pins and bindings, so that a certain amount of work is constantly required to keep them in good order. In line construction with iron poles, all these causes of deterioration are avoided and lines which have been in use from five to six years are in as perfect condition as they were when first constructed. The poles only require repairing every four or five years.

Disadvantages.—There is a somewhat greater capital investment. To illustrate this point, I submit the following figures, showing the difference between a line constructed with wooden poles and a line constructed with iron poles, based upon European prices and for a three-wire line for high-tension transmission:

Wooden Poles.

50 poles at $6.00	$300
3×53=159 insulators with brackets, at $1.00	159
For right-of-land occupation $2.00 per pole	100
	$583

Iron Poles.

16 poles at $24.00	$384
Concrete foundation at $9.00	144
2×16=48 insulators with brackets, at $1.00	48
For right-of-land occupation, at $2.00 per pole	32
	$608

Better insulators are required. As a matter of fact, the breaking of an insulator means a complete grounding; but, as we shall see, the insulators which can now be obtained reduce the frequency of this disturbance very much. On the other hand, it is not always true that wooden poles act as insulators, as, for instance, in wet weather one cannot depend upon the surface insulation of wood. Therefore, from an economical point of view, iron poles require a larger capital investment; but the maintenance and depreciation are reduced to a minimum. These considerations tend to make the adoption of iron poles for important transmission lines more and more general.

Iron poles are calculated by the ordinary rules of mechanics. The forces acting on the poles are: The weight of the pole itself, the wind (both on poles and wires), and the strains transmitted by the wires. With equal spans on each side of the pole and no angles, the only forces acting on it are the weight of the wires and the wind. When spans are not equal there is a longitudinal strain which varies with the temperature. If an angle occurs, there is a component of the strain exerted by the wires which acts in a transverse direction. In the

case of a vertical angle there will be a vertical component.

We must then begin with the calculation of the strains exerted by the wires. In doing so the effect of wind and snow must be taken into account, allowing a tension which does not exceed the limit of strain admitted for copper in coldest weather and with an overload of snow and ice. The maximum sag is also calculated in order to determine the height of the pole, as the wire must never come too near the ground. Taking into consideration all the above facts and effects, the poles are calculated in the same way as any iron structure.

Wooden cross-arms are sometimes employed with iron poles, in which case any system of pins may be used; but in general, supports constructed entirely of iron are preferable. In this case either iron or steel pins are used on brackets composed of angle iron.

A special cement is employed to fasten the insulators to these brackets, or, in the case of small lines, tarred rope is employed. This differs entirely with American practice, and no attempt is ever made here to use threaded insulators, as it is difficult to obtain good insulators with thread of the exact gauge. The best cement that can be employed for this purpose is composed of 10 parts of litharge and one of glycerine, well mixed.

When the span exceeds a certain length, care must be taken that the wires do not come in contact through their oscillation due to the wind. It is obvious that in order to avoid such a contingency, it is necessary that two or more wires should never be placed on the same level, and the adoption of cross-arms as practiced in America is not to be followed. In any case, it is easy to calculate the deflection of the wires from their vertical position, due to the force of the strongest wind prevailing in the country and midway of the span, thus finding the distance between the insulators to prevent the wires coming in contact.

One may ask if it is worth while to make such a careful calculation. That is easy to answer—in order to reach a high economy in the use of iron poles, it is necessary to put in them only the quantity of iron that is absolutely necessary; and this cannot be done without a close calculation of every element of the line. The author had the opportunity of calculating the poles of a line built without much precaution, and found that each pole weighed about 200 pounds more than was necessary. As the number of poles was 600, the extra weight represented a total of about 60 tons of metal in excess of what was actually necessary.

The problem of high-pressure insulation is very carefully studied by European electricians. It is well known that glass insulators are not used in Europe, and the reason for this, I believe, is that good porcelain can readily be obtained here. Glass is considered to have a better dielectric strength, but not as good surface insulation; moreover, glass is weaker against meteorological agencies, the superiority of porcelain being due to the materials composing the glazing. It must be said at once that European engineers do not consider American porcelain as good as European porcelain. It is possible that they may be mistaken, but a few tests made by the author on American insulators showed a higher dielectric resistance for the European porcelain, which in appearance, finish and homogenity of material is much better. Perhaps the difference in these particulars may have had much to do with forming his opinion.

In designing an insulator the following points are to be considered: Dielectric resistance, resistance against surface arcing, mechanical strength, facility of cleaning, ease of construction. It is well known how the resistance against puncture can be increased, by making the insulators of several pieces, introduced one piece inside the other. In general, the different pieces are cemented together with a kind of glazing in the process of manufacture and put on the market as single pieces. The author does not follow this practice, but prefers having them furnished by the factory in separate pieces for the following reason: When the thickness of the porcelain reaches a certain limit the ordinary testing will not puncture a sound insulator. In testing an insulator made up of two or more pieces, one layer of porcelain may be cracked but is protected by the other layers. When the tests are performed on the single composing parts this cannot happen, and one is sure to have the insulators made up of sound parts. Moreover, each composing part can be better inspected and the character of glazing observed.

The ability of an insulator to resist surface arcing is due to its dimensions and shape, the latter to be considered under a double aspect: 1. The protective action against moisture and rain. 2. The property of giving origin to electrostatic phenomena. An insulator with a very large petticoat on the top and only a second petticoat round the pin will not afford a very good protection against rain and moisture, as during a storm the inner petticoat will get quite wet. It is therefore good practice to have one or two intermediate petticoats, which will also insure the dryness of some part of the surface in all kinds of weather.

With reference to the influence of electrostatic phenomena on surface arcing it is only possible to venture some assumptions, although it appears that they have a certain basis of fact. It is well known to those who have studied tests on insulators that the surface arcing does not always occur at once, but seems to be preceded by a number of static discharges between the petticoats. These discharges, of a bluish color, are very marked with insulators having petticoats close together, in which arcing seems also to occur with large air spaces. It is not improbable that these blue discharges may produce an ionization of the air and moisture, which facilitates the striking of the arc.

DISCUSSION (IN ABSTRACT).

J. W. Lieb, Jr.: I would say that this paper is indicative of the character of analysis that European engineers give to mechanical problems when they are presented. It is, perhaps, true that the European engineer is not as active in undertaking pioneer work in new fields, particularly where large investment and commerical development are necessary, but I think it is also true that when these applications are once made by them that the constructions are subjected to very careful analytical treatment. I remember when one of the first electric railways was introduced in Italy, in the 90's, on the Sprague system, from Florence to the heights of Fiesole adjacent. In making a report on this construction an Italian engineer gave a most excellent analysis of some of the problems in connection with matters as applied to railway work, an analysis which has only been equaled in its thoroughness by some of the work that has been done in very recent years. It is unfortunate, I would say in this connection, that the work that is done by a good many of the Italian workers in the field of experimental physics and analytical investigation is apt to be lost to the world through insufficient publication. I think there are a number of cases where this has been the fact, notably the pioneer work that was done by Professor Pacinotti, which was buried for quite a few years before it was resurrected from the archives of a purely physical production. This was also the case with other investigators, but some of the more recent investigators, notably Marconi, have been more fortunate in having their work brought forward. Including the remarkable work of Professor Galileo Ferraris, there is a vast amount of careful research in physical work going on, done under most unfavorable circumstances, with limited means, and all through Italy will be found students who are laboring under the greatest difficulty in trying to construct primitive apparatus to conduct research work, and, as I said before, it is unfortunate that some of this work has not the advantage of being given that publicity which its value merits.

W. N. Smith: I think we must all regret the fact that the author of this paper is not here to tell us a little more about how the plant works. He has wound up his paper by saying that the results are satisfactory and the lines are economical and safe in operation. The methods which are so well outlined here are so radically different in structural details from nearly all the principal examples of first-class work in this country that it seems a pity we cannot get a little closer to these European fellows and have an opportunity to hear them tell just what happens or does not happen, as compared with the results we are accustomed to get from our work in this country. Their method of construction of the high-tension lines is quite different from ours as usually practiced. It would be interesting to know, for instance, how effective their methods of construction are, these vertical sets of wires one above the other, in the matter of preventing possible short-circuits; for instance, from small boys throwing wires over them. Perhaps small boys do not do those things in Europe; perhaps the police regulations are more effective, or the paternal government frowns on it to an extent that makes it impossible. That is a condition which does not obtain in this country, and a thorough threshing out of some of these different questions would be very useful to us as showing whether their methods are really better than ours or not. That is simply one of the things which occurs to me in looking over this paper, which I consider an unusually fine contribution to the cause of electric-power transmission. As I say, I cannot but regret that some of those gentlemen who are accustomed to build lines in this manner under European conditions are not a little nearer to us so that we could find out exactly how to compare the results of their work with the results of our own.

Mr. Lieb: I can perhaps answer one or two questions. I am sure Mr. Semenza regrets not being present at this discussion, and he emphasizes that in his letter to me. I remember when this transmission line was first spoken of and this transmission plant was first being considered. I was the chief engineer of the Italian Edison Company at that time, and one of the things that gave the gentlemen who were expecting to put their money into the concern a cause for apprehension was the liability of just such occurrences as the gentleman refers to, not so much from the small boy, because he is a difficulty practically absent from European work. One does not usually see a small boy around, and he is not generally engaged in making himself a nuisance, but to what extent the line might be subjected to disturbance by people shooting at insulators, and that kind of thing, which was feared, I am not able to say.

President Arnold: I can say there is just such a line as this almost completed, and perhaps in operation, in Mexico, and, as you know, they shoot pretty freely in Mexico. The line is about 100 miles long, built with steel towers, regular windmill towers, using seven poles to the mile, and supposed to be the most modern line now built. The gentleman who built it showed me photographs of it two weeks ago, and that indicates that at least one man in this country has awakened to the fact that Europeans know how to build transmission lines, and possibly we will learn considerable from the other side in that respect in the near future. I will say that the New York Central Railroad, with whose work I happen to have something to do, has considered this transmission question recently as to whether they would put the lines overhead or underground for the transmission of power for the operation of trains. They have come to the conclusion it is safer and more reliable in operation to have them overhead on steel poles than to put them in conduits. This decision is substantiated by the information we secured from the different transmission lines in this country. Every competent engineer whom we consulted said to go ahead and put them overhead if it is possible, because if there is any trouble you can get at it and repair it promptly, while if there is any trouble underground in conduits you cannot locate it and do not know what the damage is. There will be certain parts of the work which will be in conduits underground, but where we can go overhead we will do it. We will use steel poles of some such form as is outlined in this paper.

W. E. Dix: I would mention a recent example of a 400-foot river span where they had some trouble with two or three of the triangularly arranged wires touching on account of severe winter conditions. They used phono-electric wire, stretched at high tension, in order to have the sag as little as possible so as to prevent any barns, etc., which should happen to go over the dam in case of flood, striking the span; but notwithstanding the precautions they had taken the wires were brought together. Now, had the arrangement suggested by this Italian engineer been followed I think perhaps it would have eliminated the trouble from that particular cause. I would say further, in discussing the paper, that I think our American insulator manufacturers are now adopting the suggestions that have been brought out by the writer, namely, to reduce the number of petticoats, increasing the surface, and also increasing the space between the petticoats, thus reducing arcing and leaking from the shortened path.

C. F. Scott: It seems to me that there is a difference between the engineering inside the station and outside the station. The engineering inside the station, the development of electrical apparatus, has been in general in the hands of a few manufacturing companies, with a corps of expert engineers who have given their attention to these points, and they have developed the interior machinery, and this development has constantly increased until very high degrees of perfection have been reached. In general, it is thought that anybody can run a line outside of the station, and the engineering elements are left to the wiremen. The outside construction and system has been haphazard. It has been in the hands of this company and that company, and has been treated by local companies with little or no consideration. Some of these companies have done their work very well, but in the external construction the plant lacks the standardization, lacks the uniformity, and lacks the higher grade of considerations which have been given to other departments.

Texas Telephone Statistics.

The comptroller of public accounts of the state of Texas has taken steps looking to the enforcement of the law requiring all telephone companies operating in that state to pay an annual tax on each telephone instrument in use. It is conservatively estimated that there are fully 250 telephone companies operating in Texas. Of this number only 29 have so far complied with the law requiring the payment of taxes on the telephones, which they had in operation on January 1, 1904. The list is as follows:

Texas Telephone Company of Bonham, 382 telephones; tax paid, $95.50.
Seymour Telephone Company of Seymour, 230; $57.50.
Brownwood Telephone Company of Brownwood, 295; $73.75.
Palestine Telephone Company of Palestine, 708; $177.
Huntsville Telephone Company of Huntsville, 152; $38.
Waverly Telephone Company of Huntsville, 40; $10.
Fayette County Telephone Company of La Grange, 190; $47.50.
San Angelo Telephone Company of San Angelo, 420; $105.
A. R. Riddle Telephone Company of Weatherford, 230; $57.50.
Central Texas Telephone Company of Ballinger, 198; $49.50.
Navasota Telephone Company of Navasota, 190; $47.50.
Texas Telephone Company of Wichita Falls, 320; $80.
Decatur Telephone Company of Decatur, 79; $19.75.
Gonzales Telephone Company of Gonzales, 292; $73.
Cistern Telephone Company of Cistern, 3; 75 cents.
Bryan Telephone Company of Bryan, 349; $87.25.
Archer City Telephone Company of Archer City, 10; $2.50.
Tyler Telephone Company of Tyler, 508; $127.
Globe Telephone Company of Tyler, 64; $16.
Barksdale Telephone Company of Barksdale, 6; $1.50.
Beeville and Refugio Telephone Company of Beeville, 44; $11.
Beaumont Telephone Company of Beaumont, 886; $221.50.
Charco Telephone Company of Charco, 4; $1.
McKinney Telephone Company of McKinney, 292; $73.
Boyd Telephone Company of Boyd, 56; $14.
Albany Telephone Company of Albany, 206; $51.50.
Southwestern Telegraph and Telephone Company of Dallas, 38,258; $9,569.50. The telephones reported by this company include those in operation by its local exchanges in all the principal cities of the state.
Weesatche Telephone Company of Weesatche, 10; $2.50.
Baird Telephone Exchange of Baird, 180; $45.

The total number of telephones reported is 44,622, and the total amount of tax paid $11,155.50.

Chicago Street-railway Situation.

The local transportation committee of the City Council has made its report on the franchise-extension ordinance of the Chicago City Railway Company by offering an ordinance extending the company's expired franchise to January 1, 1905, thus to allow more time in which properly to adjust matters. Pending the consideration of the temporary extension the council extended the company's permit to operate its lines until March 15th. The ordinance provides specifically that the extension is granted to cover the period of the negotiations between the city and the traction company for a new franchise, and is revocable at the will of the city. The compensation is fixed at $100 yearly for each car operated, which is double the charge at present. The ordinance also includes provisions for improving the service, and permits the installation of an overhead trolley in Wabash Avenue, north of Eighteenth Street and around the Randolph Street loop, as a measure for relieving the cable by taking from it the Indiana Avenue cars and preventing the congestion at Eighteenth Street.

At a meeting of the transportation committee it was stated by a representative of the Chicago City company that if the city would grant extension of one year the company would, within 30 days, install the trolley in Wabash Avenue, put on all the extra cars needed, and begin work at once on its proposed $4,000,000 power plant at Halsted and Thirty-ninth Streets.

The situation on the whole is in a very unsettled condition, and it is argued by some familiar with traction matters that no satisfactory adjustment can be reached with either company until the courts have reached a final disposition of the 99-year act and decided once and for all just what its value to the companies is. According to present plans, the hearing on the claims of the Chicago Union Traction Company, under the provisions of the 99-year act will be before Judges Grosscup and Jenkins as the Western Electrician goes to press, and for the first time, after years of discussion, the validity of the 99-year claims will be argued before a tribunal for final settlement.

Judge Grosscup has set aside three days for the hearing, in which some of the most noted legal counsel in the country will appear. It is expected that the decision will be handed down within two months, leaving time to get the case before the Supreme Court at the October term. The final decision may therefore be expected in a year.

Convention of the H. W. Johns-Manville Company.

A convention of branch managers, department manager and salesmen of the H. W. Johns-Manville Company of New York was held on February 15th to 20th. Representatives to the number of about 35 from all parts of the country met in Hartford, Conn., as the guests of the Johns-Pratt Company, where sessions were held on February 15th, 16th and 17th, after which the delegates went to New York city, where three more days were spent in bringing all branches into closer touch with one another and in a general discussion of the varied lines manufactured by this company.

The session in Hartford was opened with an address by E. B. Hatch, president of the Johns-Pratt Company, followed by Joseph Sachs and J. W. Perry. General topics, such as insulation, fuses, steam packing and commercial matters, were discussed. Considerable time was given up to inspecting factories and many social features were enjoyed.

In New York the delegates were taken to the large Brooklyn factory of the company, where all departments were inspected. A part of each day was given up to the reading of papers by practical men. These were as follows: "General Steam Packing," by R. L. Hoff; "Practical Demonstration of the Use of Packing," by Mr. Robinson; "Advertising," by Henry W. Hart; "Contract Work," by Messrs. Walsh, D. T. Dickson and T. G. Younglove; "Keystone Hair Insulator," by Messrs. d'Homergue and Lee; "Manville Dry Powder Fire Extinguishers," by Messrs. Dade and Blakney; "Asbestos Roofing," by Messrs. Brooks, H. E. Manville and D. T. Dickson; "Credits and Collections," by G. W. Gladwin. Papers on commercial matters were also read by Messrs. Thompson, R. D. Jacobs, T. T. Lyman and J. B. Johnson. All the papers developed interesting and instructive information.

Preparations for Space Telegraphy at St. Louis Exposition.

Ground was broken for the World's Fair station of the American DeForest Wireless Telegraph Company recently, and every effort will be made to have the plant in working order by the first of May. Mr. Abraham White of New York, president of the company, Dr. Lee DeForest, scientific director, and inventor of the system, Mr. L. Z. Harrison, western manager; Mr. H. E. Overstreet, erecting engineer, and Professor W. E. Goldsborough, chief of the Department of Electricity of the exposition, were present. Mr. White is shown in Fig. 1 lifting the first shovelful of earth.

Fig. 1. Breaking Ground for the Tower near Press Building.

Fig. 2. Structural Iron for Tower

PREPARATIONS FOR SPACE TELEGRAPHY AT ST. LOUIS EXPOSITION.

This company has from the first made elaborate plans for its World's Fair exhibit, which, it is said, will be the largest and most powerful space-telegraph station in the world. There will be, in fact, three separate and complete stations for the transmission and reception of messages—that in connection with the steel observation tower now being erected near the Press Building; the mainmast on Art Hill, near the Japanese Building, and the exhibit in the Palace of Electricity. The first and last mentioned will be equipped with the standard type of apparatus of low capacity, and from these messages for Chicago, Cleveland, Buffalo, Kansas City and Omaha will be relayed to the Hill station, where they will be repeated with the most powerful transmitter ever constructed. The transmitting and receiving mechanism has received the personal attention of Dr. DeForest, who is confident of his ability to maintain communication with those cities of the Middle West where the company has stations. For the short-distance transmission—50 to 100 miles—Dr. DeForest has found a sending transformer of two or three kilowatts capacity sufficient, but the World's Fair station will be equipped with a 90-kilowatt apparatus, which is being especially built for this purpose. The sending key and all auxiliary apparatus are being built in duplicate, and after special designs, and many improvements on the present type will appear. The 200-foot mast will be of novel design, consisting of a triangular structure resting on a concrete bearing. At the top of the mast a 40-foot boom will support the aerial wires or antennæ, which will be gathered together at the base, where the power house and station will be located. Current will be taken from the Exposition Power Plant, located in Machinery Hall.

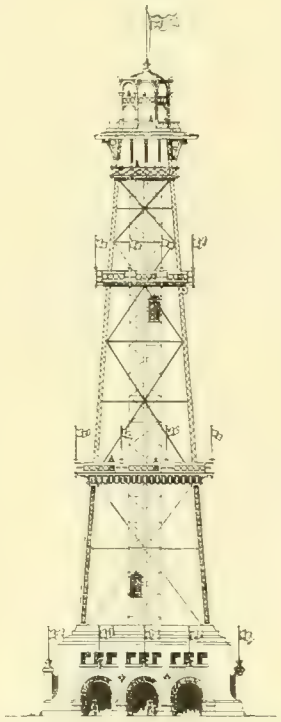


FIG. 3. OBSERVATION TOWER AT ST. LOUIS EXPOSITION TO BE USED FOR SPACE TELEGRAPHY.

The steel tower, shown in Fig. 3, was purchased from the Tower View Hotel of Niagara Falls, and is now being re-erected with a concrete base 20 feet high. Fig. 2 shows some of the structural iron for the tower. High-speed elevators will convey visitors to the platform, 300 feet above the ground, from which a view of St. Louis and surrounding country can be obtained. From its top the Ozark Mountains can also be seen. A 60-foot mast surmounts the tower, supporting the antennæ.

The most interesting portion of the DeForest company's exhibit will be found in the Palace of Electricity, where a miniature of the Seattle (Wash.) station will be found. The three towers will each be 60 feet high, and from them the antennæ will be strung in exactly the same manner as at the Seattle installation. Smaller antennæ will also be hung from each of the three masts, to be used for demonstration purposes. A collection of space-telegraph apparatus dating back to the first experiments of Dr. DeForest and his co-workers will be of interest in tracing the development of the responder and its accessories. An auxiliary exhibit will contain receiving and sending apparatus, and will be located in a remote part of the building, the whole constituting a most elaborate demonstrative equipment. Visitors may send messages between the stations in the Palace of Electricity, or, for a small sum, they will be relayed from the Hill station to any of the DeForest stations in the Middle West, so that the company will have ample opportunity to demonstrate its ability to transmit messages without interruption from outside causes. Mr. L. Z. Harrison, western manager of the DeForest company, will also have his offices in St. Louis equipped with a complete set for sending and receiving.

Hat Rapids, a few miles from Rhinelander, Wis., is to be developed at once for the furnishing of electric power and light for the use of towns and factories in that vicinity. The work will be done by the Rhinelander Power Company, recently incorporated, with a capital of $85,000. The officers of the company are: President, A. W. Shelton; vice-president, E. A. Forbes; secretary, C. A. Wixson; treasurer, Charles Chafel. It is estimated that 1,500 horsepower can be developed.

Variable-speed Motors for Single Voltage.

Application of the electric motor to the propulsion of a great variety of machines has developed the fact that special designs are necessary to fulfill the requirements of the classes of work to be accomplished. One class of machines to which it is rather difficult to apply motor drive embraces those which require a great variation in speed, with the heaviest torque or pulling power, at the slowest speed, and a less torque at a higher speed, the actual horsepower being the same at all speeds. Lathes, boring mills, milling machines, drills, with many others, belong to this class, and to secure the greatest output from them it is necessary to run the

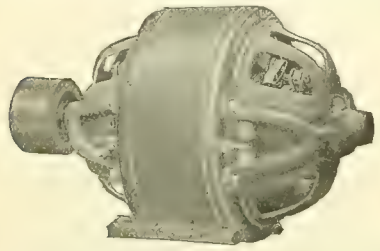


FIG. 1. VARIABLE-SPEED MOTOR FOR SINGLE VOLTAGE.

work at the greatest cutting speed and take the heaviest cuts the tool will stand, whatever may be the nature of the work. To accomplish this, the horsepower of the motor must not fall off when run at the low speeds required for large diameters. It is for this class of service that a type of variable-speed equipment designed by the Commercial Electric Company of Indianapolis, Ind., is especially adapted. The general construction of these machines is similar to that embodied in the company's general lines of constant-speed machinery which have been on the market for the last decade.

The Commercial variable-speed motors accomplish the variation in speed by means of a double-commutator machine (Fig. 1) having two different windings, but each winding is of the same size conductor or of the same ampere capacity. A speed controller is furnished for making the necessary combination of these armature windings and for varying the field strength to secure intermediate steps between the armature combinations. These controllers are simple, compact and reversible, and the changes from minimum to maximum speed are easily and quickly effected. Included in the controller is the rotary starting and reversing switch, by means of which the motor is started, stopped and reversed, while the speed control is set at any desired point. The speed controller and starting switch are combined into one piece of apparatus and enclosed in a neat compact case which can be placed at any desired point on a driven tool, or which can be mounted on a stand (see Fig. 2) conveniently located by the side of the tool.

The advantages claimed for this system are: A

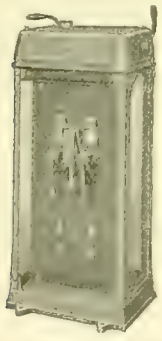


Fig. 2. Controller and Stand

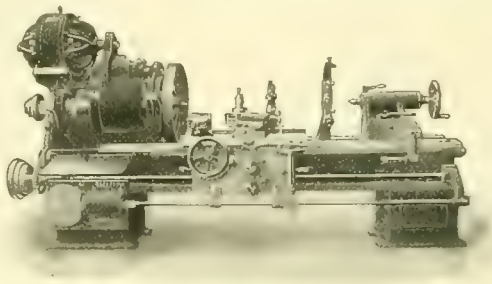


Fig. 3. Motor Mounted on Lathe.

VARIABLE-SPEED MOTOR FOR SINGLE VOLTAGE.

range in speed of four to one in 12 uniformly graded steps without overlapping is secured. The greatest torque or pulling power occurs at the slowest speed, so that pieces of large diameter may be turned with as heavy cuts as smaller pieces. A constant maximum horsepower is secured at all speeds, and the capacity does not fall off at low speeds when the greatest effort is usually required. A practically constant speed is obtained at all loads when the controller is set at a given point, and the machine does not slow down when a deep cut is struck and speed up when the tool runs out into air. A practically constant efficiency is maintained at all speeds and a high efficiency at all loads and no power is wasted in heating resistance coils, ordinarily used to control the speed. The system can be installed on any standard two-wire or three-wire, direct-current system, running from the same wires as constant-speed motors or lights already installed. It does not require a special generating plant, motor-generator set or a special system of wiring. Therefore a single machine, or any number, can be installed without the consideration of an extra expense for special generators and wiring.

A picture of one of these motor equipments mounted for driving a lathe is shown in Fig. 3.

Practical Construction of Country Telephone Lines.

By Reginald F. Fennell.

The telephone lines known generally as "farmers' lines," built by farmers and those living in the country, have done much to make telephone service in the rural districts popular and promote as well as facilitate business.

When the farmers and those living in the country districts first became aware of the necessity for telephone service and to some extent what they were losing by being without it, both from social and business points of view, they took such steps as were considered necessary to connect themselves with their neighbors as well as nearby towns.

It appears that in many instances the class of construction was not given the consideration it warranted in order to obtain permanent and first-class telephone service. Many of the rural or country lines are now connected with exchanges in nearby cities and towns, and by means of the toll lines connected with such exchanges, long-distance connections can be had by the farmer and those connected with these rural lines. For such connections it is of paramount importance that the lines herein referred to be constructed in a first-class manner so that good service can be given not only locally but when they are connected with cities or towns outside of their immediate locality, especially now that connections with more distant places are being made oftener.

It is undoubtedly to the best interests of the Independent exchange operator to see that these country lines when in course of construction are built on a standard basis, and the manager should lend as much assistance as possible with this end in view.

It has been the experience of the past that when a subscriber to a telephone line or exchange has once become educated to the use of the telephone the service is considered more or less of a necessity and looked at somewhat in the way in which light or heat as a requisite item to the household, store or office is considered. This being the case, the more permanent the construction of the lines the more satisfaction those interested derive from it, both from a financial point of view, it having a much longer life, and that of operating, it being capable of furnishing better service. Further, it costs less to maintain a well-constructed line than one of poor construction.

The class of service is a factor to be taken into consideration in the rural-line service, now that those living in the country as well as in the cities value more the use of the telephone and consequently appreciate first-class service.

Many of the farmers' or country lines have hitherto been constructed with grounded circuits, resulting in the line being quite noisy, particularly in the summer and during storms. This noise is practically eliminated by using a metallic circuit and transposing the wires at regular intervals, resulting in much better service and clearer conversations. There is also the great advantage in metallic-circuit service, now that connections are becoming more universal with more distant points, that these lines can be connected with exchanges and long-distance lines and satisfactory service given.

With a grounded circuit, particularly if it is a long one, it is impossible to connect with more distant points and obtain good results, notwithstanding that the connecting lines may be of first-class construction. This is a point which it is important for exchange managers to watch, and, as suggested, it warrants co-operation with those intending to build lines of this description, especially as the class of construction used may materially influence the business that can be done over them from an exchange and its connections with which they may connect.

The kind and size of poles used, as also, of course, other material, have a considerable bearing on both the service and permanency of the lines. The following is a list of some of the material and dimensions that might be used to construct a substantial line of this description:

Poles.—These should be of the best quality live green wood, free from wet or dry rot, reasonably straight and well proportioned from butt to top, with bark peeled off and the knots trimmed close, and of the following dimensions according to the kind of pole used:

	Length in Feet.	Circumference at Top in Inches.	Circumference Six Feet from Butt in Inches.
Michigan cedar...	25	20	30
	30	22	36
	35	22	38
	40	22	43
Canadian cedar...	25	20	30
	30	22	38
	35	22	40
	40	22	43
Chestnut	25	24	34
	30	24	37
	35	24	40
	40	24	43
Juniper	25	21	31
	30	22	37
	35	22	40
	40	22	44
Black cypress....	25	28	41
	30	28	42
	35	28	46
	40	28	47

Guy Stubs and Anchor Logs.—The guy stubs should be fully as large as the poles and the anchor logs at least 28 inches in circumference and from five to seven feet long.

Cross-arms.—These should be made of thoroughly seasoned, straight-grained, long-leafed, heart yellow pine and free from such knots as would weaken them. They should be painted and 10 feet long by 3¼ by 4¼ inches, bored for 10 1¼-inch pins, one five-eighths-inch machine bolt and two three-eighths-inch carriage bolts.

Pins.—The pins should be made of the best quality split locust, sound, straight-grained and free from all knots or sap wood, 1¼ inches in diameter by nine inches long over all.

Insulators.—The standard pony glass insulators should be used, except where transpositions are made.

Cross-arm Braces.—These should be galvanized and 30 inches long by one-quarter inch thick and 1¼ inches wide, with one seven-thirty-seconds-inch hole at one end and one thirteen-thirty-seconds-inch hole at the other end.

Fetter Drive Screws.—These should be galvanized and four inches long by one-half inch in diameter.

Carriage Bolts.—These should be galvanized and 4¼ inches long by three-eighths inch in diameter.

Square and Round Washers.—These washers should be galvanized. The square washers should be 2¼ inches square and three-sixteenths inch thick, with three-quarter-inch hole in the center. The round washers should be 1½ inches in diameter, one-eighth inch thick, with one-half-inch hole in the center.

Cross-arm Bolts.—These should be galvanized and five-eighths inch in diameter and from 12 to 20 inches long and with a four-inch thread.

Guy Rods.—These should be galvanized and eight feet long by five-eighths inch in diameter.

Thimbles.—These should be galvanized and three inches long over all.

Guy Clamps.—These should be galvanized and of the standard three-bolt type and capable of holding five-sixteenths-inch strand.

Guy Strand.—The guy strand should be double galvanized and made up of seven No. 12 B. W. G. wires, making a five-sixteenths-inch strand.

Wire.—If iron wire is used it should be No. 12 B. W. G., B. B. iron wire, having a weight per mile of 165 pounds. If copper wire is used it should be at least No. 10 or No. 12 B. W. G. hard drawn.

Should one metallic circuit only be used, brackets can be substituted for the cross-arms, pins, braces, machine bolts, carriage bolts and washers, and very good results obtained. If brackets are used they should be attached, one on each side of the pole about 18 inches apart, with one 40 and one 20-penny cut nail. When brackets are used and consequently only one metallic circuit, No. 6 or No. 8 steel wire may safely be substituted for guy strand and clamps.

If the line is a comparatively short one, iron wire can be used with very satisfactory results.

In order to secure a good and permanent line, great care should be exercised in laying it out to see that the poles are in a perfectly straight line and placed not more than 130 feet apart. To obtain the best results it is of considerable importance that the poles be set in a straight line, otherwise when the wires are strung they will be pulled out of alignment and a ragged line be the result. When necessary to make a curve or corner the poles should be placed closer together and well guyed so that they will not pull out of position. Better results will be obtained if the heaviest poles are placed on the corners and where the line curves, as they are capable of bearing a greater strain.

The top of the pole should be roofed with two

sides and one gain cut 10 inches from the apex of the pole roof 4¼ inches wide and one-half inch deep, with one five-eighths-inch hole bored through the center of the gain for the cross-arm or machine bolt. If necessary to have more than five circuits, a second gain should be cut 24 inches below the first gain.

The pole should be set in the ground 4½ feet deep on straight lines and five feet on curves, and the hole sufficiently large to admit the pole with ease, and be completely filled in and well packed down so that the pole will be held firmly in position. It should be so placed that it will be perpendicular.

Anchor logs should be placed in the ground five feet at least. Guy stubs should be set seven feet deep at least.

A good right-of-way should be trimmed so that the wires will clear all branches of trees or other obstructions by at least between two and three feet.

Cross-arms should be placed on alternate sides of the poles except at curves and road crossings, when they should be placed facing the curve or crossing. They should be attached to the pole by means of a galvanized five-eighths-inch machine bolt 12 to 20 inches long, according to the size of the pole. One square washer should be placed under the head and one under the nut of the bolt.

In guying, the guy should be wrapped twice around the pole and fastened by means of a clamp set about seven inches from the pole. A thimble should be used to protect the guy wire where it passes through the eye of the guy rod, and the clamp at the end nearest the guy rod should be placed about five inches from the end of the rod. When necessary to place a guy wire across a road a stub long enough to elevate the strand sufficiently high should be used and the stub anchored to the ground.

The cross-arm should also be braced to the pole by means of two 30-inch braces attached to the cross-arm by 4½-inch carriage bolts and the braces secured to the pole by one four-inch fetter drive screw. A round washer should be placed under the head of each of the carriage bolts.

Both copper and iron wire should be strung on the side of the insulator away from the pole, except on curves, when they should be attached to the insulater in such a manner that the strain will be against the insulator, and not against the tie wire, and according to the following table:

Temperature in Degrees Fahrenheit.	Span of 75 ft. Sag in Inches.	Span of 100 ft. Sag in Inches.	Span of 115 ft. Sag in Inches.	Span of 130 ft. Sag in Inches.	Span of 150 ft. Sag in Inches.	Span of 200 ft. Sag in Inches.
10.....	1½	2⅝	3½	4⅜	5¾	10¼
30.....	1¾	3	4	5⅛	6¾	12
60.....	2½	4¼	5½	7	9	15⅜
80.....	3⅛	5⅝	7	8⅝	11¼	18¾

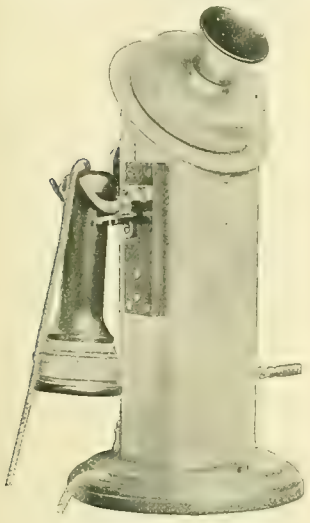
Practice has shown that in localities where the variation of temperature is great that, with an allowance of a 10-inch dip in the center of the span for wire strung in the summer and an eight-inch dip for wire strung in the winter, satisfactory results are obtained.

Chicago Meetings of the Institute.

The next meeting of the Chicago branch of the American Institute of Electrical Engineers will be held on March 8th at 8 p. m., at the rooms of the Western Society of Engineers in the Monadnock Building. The subject for the evening's discussion will be "Modern Traction Systems, with Particular Reference to Single-phase Motors," based on the recent papers of Steinmetz and Slichter. It is expected that P. M. Lincoln of Pittsburg, B. A. Behrend of Cincinnati, Professor D. C. Jackson of Madison, Wis., and a number of Chicago experts will take part in the discussion. The following meeting of the Chicago branch will be held at the same place on March 29th. The subject of this meeting will be "High-tension Transmission."

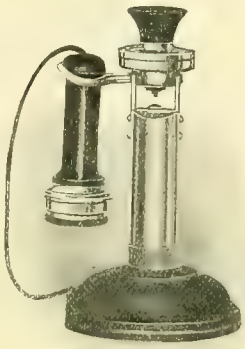
Development of the Desk Telephone.

Desk telephones, as they are now manufactured with their ornamental and at the same time compact design, present little of the crude and ungainly appearance that they did even a few years ago. It is interesting to compare the later types with those of earlier make and note the gradual development from the original designs to those which today are found in the best appointed offices. The accompanying illustrations represent this development in the desk sets as manufactured by the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y.



Original Type Desk Set, 1895, with Magneto Type of Transmitter.

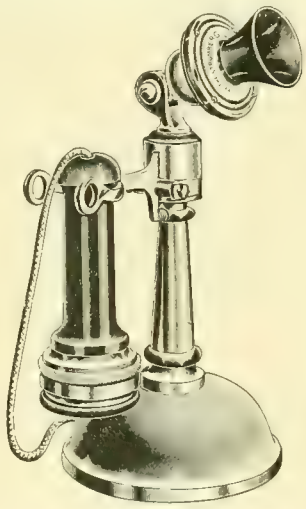
Second Type, 1895, Having a Tip-down Transmitter.



Desk Set with Ringer Removed, 1896.

DEVELOPMENT OF THE DESK TELEPHONE.

The first type of desk stand manufactured by the company was the one made in 1895. This instrument was equipped with a magneto type of transmitter and



STANDARD TYPE DESK SET OF 1901.

did not use any battery for talking. The set was provided with hand generator and ringer, both of which were mounted in the set itself. The upright portion of the set was covered with metal, nickel-plated, and was about four to six inches square. The ringer was mounted in the upper part of the instrument, one of the gongs being shown just above the receiver. The generator was mounted in the lower part of the set, the crank for it being shown on the right in the cut. At the time this instrument was made trials were made over long-distance lines, and it was possible to carry on a conversation from Chicago to New York with this type of instrument.

Next came the desk stand, produced in the latter part of 1895, the principal change in this set being in the transmitter. This was the first desk set produced by the company, having granular carbon for carbon electrodes, and the transmitter was supported on a rod, provided with a lever so as to tip the transmitter forward for conversation. This was done in order to shake up the granules and prevent packing. At this time it was not possible to obtain carbon that was much better than coke. Telephone manufacturers did not have the science down to a very fine art for manufacturing carbon themselves, and those from whom it could be obtained knew very little about the requirements. When the transmitter was tipped forward, it also served to close contacts, putting the instrument into circuit. This arrangement took the place of a regular hook switch.

Following this type came the set that was produced in 1896. The same type of transmitter was retained, but the hand generator and ringer were removed from the set and mounted in a separate box, as is the practice at the present time.

In 1897 a new type of stand was produced, the principal feature being in the transmitter, which was provided with gold-plated gauze for electrodes. This material proved so satisfactory that the question of packing could be eliminated; consequently the transmitter was mounted stationary. This feature has always been retained, the company using at the present day the transmitter with gold-plated gauze for electrodes, the transmitter differing only in mechanical construction.

Desk Telephone of 1897 with Gold Plated Gauze Transmitter Electrode.

A new set was produced in 1901, which has remained the standard of the company up to the present time, and will be continued as one of the standard sets in the future. This instrument differs in a number of respects from the one produced in 1897. It is an all-nickel-plated desk set, the upright portion of the set being made of cast brass. The transmitter is mounted on a short arm, which is adjustable. The induction coil of the instrument is mounted in the base.

The set which was placed on the market the beginning of 1904 is a pronounced departure from the one produced in 1901. This set is furnished with either a standard type of receiver, as shown, or with an all-rubber-type receiver. The transmitter is the same in design and operation, but the mechanical construction has been changed, and these changes have resulted in many improvements of the talking qualities of the instrument. The stand is what is commonly known as the self-contained type, and by removing a screw in the pedestal part of the instrument, all connections can be removed, which makes it convenient for inspection or adjustment. With this type of instrument the induction coil can be mounted in the extension bell.

DESK SET OF 1904 WITH IMPROVED TRANSMITTER.

The Butte Electric Railway Company, by J. R. Wharton, manager, has applied to the county commissioners for a franchise to build a new trolley line on the flat south of Butte, Mont.

Indiana Telephone Items.

The following-named new telephone companies filed articles of incorporation with the secretary of state during the last week: The Reese Mill Co-operative Telephone Company, capital stock $1,000; incorporators, D. W. Umborhill, W. W. Buntin and H. C. Lawrence; postoffice, Lebanon, Ind. The Laurel Telephone Company, to build and operate a complete telephone system in Clark County, with the exchange and office in Borden; capital stock $1,000; incorporators, E. J. Ross, C. F. Schleicher, George Jackson. The Mount Zion Telephone Company, capital stock $6,000; Mount Zion and Wells County; incorporators, N. J. Clark, I. N. Neff and J. E. Beaty.

A local telephone company connecting with the Princeton and Vincennes Independent companies has been organized at Hazleton. The officers of the new company are: President and manager, C. S. Stevens of Princeton; vice-president, Carl Chambers; secretary, W. W. Spain, and treasurer, H. M. Arthur.

The Central Union Telephone Company has paid to the city of Indianapolis $3,000, its semi-annual payment to the city as a franchise tax. The company has petitioned the county and city authorities for permission to place six conduits under the sidewalk and along the south curb line of the new bridge over the river in West Washington Street.

Independent telephone men in Northern Indiana and Southern Michigan held a meeting at South Bend on February 27th and organized the Northern Indiana and Southern Michigan Toll Line Association. The association represents a territory in which there are 15,000 Independent telephones and 2,000 miles or more of toll lines. South Bend has been chosen as headquarters for the clearing house. The officers are: Manager of the clearing house, Theodore Thorward; secretary and treasurer, J. K. Johnson. C. A. Reeves, J. W. Scott and Claud R. Sloops with the foregoing officers compose the traffic committee. The cities included in the deal and the number of telephones in operation are: South Bend, 520; Elkhart and Goshen, 1,742; Michigan City, 750; Benton Harbor, Mich., 1,575; Knox and Hamlet, Ind., 201; Winnamac and Kewanna, 315; Wakarusa, 175; Millersburg, 785; Dunlap, 150; Warsaw, 400; Plymouth, 300; Rochester, 430; Bremen, 136; Napannee, 275; Milford, 276; Columbia City, 900; Silver Lake, 125; Star Point, 200; Argus, 65; North Judson, 50; Teegarden, 105; Bristol, 100; Lagrange, 1,600.

Judge Artman, of the Boone County Circuit Court, rendered a decision recently in the case of the Thorntown Co-operative Telephone Company against the Lebanon Telephone Company for a writ of mandamus, finding for the defendant and denying the writ. In 1897 the Lebanon company entered into a contract with the Thorntown Independent company whereby the latter was to be granted exclusive service between Lebanon and Thorntown. Later the Thorntown co-operative company applied for admission to the Lebanon company's switchboard, but was refused on the ground that the contract with the other company rendered it impossible to grant such service. The Thorntown co-operative company applied for a writ of mandamus to compel the Lebanon company to give connection, setting up in its complaint allegations to show that the Lebanon company was a common carrier and as such could not discriminate against companies asking admission to its switchboard. In making up the issues of the case a few months ago the plaintiff achieved a temporary victory, Judge Altman holding that if the allegations in the complaint were true the Lebanon company was a common carrier, and as such was bound to grant connections to all companies seeking admission. The case then went to trial on the question of facts, and after considering the matter for two months Judge Artman rendered a special finding, holding in effect that the allegations in the complaint were not apparent and that it had not been established that the Lebanon company was a common carrier, hence his verdict must be for the defendant. An appeal will be taken to the Supreme Court, as the telephone companies regard the question of great importance and all are anxious that the matter may be passed upon by the court of last resort. There is also a belief that there will be an attempt to pass a law by the next Legislature to compel companies to admit other companies to switchboard privileges. F.

Telephone News from the Northwest.

The Benson County Telephone Company has bought the Minnewaukan (N. D.) telephone exchange and has arranged with the Northwestern Telephone Exchange Company for long-distance service.

The city of Owatonna, Minn., has lost its first point in the case brought by the Tri-state Telephone and Telegraph Company to compel the City Council to allow the construction of a line through the city. The city moved to quash the alternative writ, which was denied, and the case will be tried on its merits.

The Barron (Wis.) Telephone Company has made a flat rate of 15 cents for toll service anywhere on its lines for three minutes.

Mapleton, Minn., now has long-distance connection with the Twin Cities over the lines of the Citizens' Telephone Company.

The Neighbor State Telephone Company of Comstock, Minn., has been incorporated with $25,000 capital stock.

A telephone and electric-railway company is proposed by farmers near Grantsburg, Wis. Lines are planned from Grantsburg to Spooner, Wis.

W. Z. Parmenter and others will incorporate a local telephone company at Kenesaw, Neb., with a capital stock of $10,000.

The Wisconsin Independent Telephone Company is contemplating extending its line from Ashland to the Gogebic towns in Michigan.

The Central Telephone Company of Broken Bow has applied for a franchise at Ravenna, Neb. R.

Telephone Development on the Pacific Slope.

Construction has been started on the Red Prairie and Sheridan (Ore.) rural telephone line. There are at present six telephone lines running into Sheridan, Ore.

The Ewatsville Telephone Company of Pullman, Wash., has just completed 50 miles of poles and wire. The line runs south to Union Flat and Almota Creek. Two wires run down Willow Creek to Little Almota Creek.

The Enterprise Commercial Club of Enterprise, Ore., contemplates building a telephone line to Imnaha by way of Chico. Already $400 has been subscribed.

E. C. Drews of the Pacific States Telephone Company has submitted a proposition to the Palouse (Wash.) business men to buy the local telephone exchange. This action on the part of the Pacific States Telephone Company is taken to shut out competing companies from this territory. Such a proposition was made and accepted at Genesee, Idaho. The Palouse exchange is valued at $3,600.

A telephone line will soon be constructed between Ferndale and Mount View, Wash., by Edwin Lopas.

Construction has been started on the Joseph-Buckhorn (Ore.) telephone line and a contract for 5,000 poles has been let. Work will be rushed to completion and an exchange will be installed at Joseph.

The citizens of Crowe, Ore., have organized a stock company to build a telephone line from that place to Elmira, a distance of six miles. Elmira people have agreed to put up a line between that place and Eugene, a distance of 13 miles.

The Haines Mercantile Company, which is operating a telephone line from Baker City to Rock Creek, Ore., is arranging to extend the system through the surrounding farming region and also to connect with the Pacific States Telephone Company.

Construction has been started by the Skagit County Farmers' Telephone Company on the line between Silvana and Marysville, Wash. The line has been surveyed from Arlington to Oso, and the subscription list for the branch to Granite Falls is about completed.

The City Council of Forest Grove, Ore., has granted S. G. Hughes, manager of the Washington County Independent telephone system, a 15-year telephone franchise. The conditions of the contract are that Mr. Hughes shall operate an all-night telephone and give service all day on Sunday. An exclusive franchise was not granted, but any other telephone company will have to comply with the terms of this franchise should it wish to operate a system there.

The Pioneer Mutual Telephone Company has been organized and incorporated and has secured a franchise to establish a local exchange in Brownsville, Ore., with a line to Albany, Lebanon and Talmon.

A new telephone company has been organized in Garfield, Wash., with Thomas Hanchin, president, and William Carter, secretary. A rural telephone line to connect with the Palouse and Colfax system will be built.

The City Council of Centralia, Wash., has granted the Home Telephone Company a franchise for the construction and operation of a telephone line along the right-of-way leading from Chehalis to Mossy Rock, Wash.

The Interstate Telephone Company, which was organized in Spokane, Wash., about a year ago and which has now about 150 miles of line in Northern Idaho, is petitioning for a franchise to enter Spokane, with the idea of making it a terminal. If the franchise asked of the City Council of Spokane is passed, the Interstate Telephone Company will immediately begin the construction of its telephone line from there to Northern Idaho. The line is now being built from Rathdrum, Idaho, to Laclede. As soon as this line is in active operation, an extension will be built to Cœur d'Alene, Hope and Bonners Ferry. This will practically take in every town of importance east of Spokane. The line when complete will cost between $70,000 and $80,000.

Articles of incorporation have been filed in Oregon for the organization of the Wild Horse Telephone Company, capitalized at $1,000. W. M. Blakney, W. W. Harrah and William Caldwell are the incorporators. The line will run from Eastland to Adams, Ore., and will be connected with the public system at Pendleton.

Arrangements are about completed for a telegraph line from Elgin to Lostine, Ore. It will be used in connection with the telephone wire. A duplex system will be worked, both circuits being on one wire, and will be directly connected with the Western Union office at Elgin.

The city of Genesee, Idaho, is about to incorporate a telephone company, articles of incorporation having been forwarded to the state capital. The capital stock is $4,000. This corporation is to purchase all poles, wires, central offices, etc., at Genesee, of the Inland Telephone Company. P.

Ohio Telephone Notes.

The gross earnings of the Cuyahoga Telephone Company for January were slightly over $500 less than for the same month last year, and there was a reduction of about the same amount in surplus. A new switchboard will be installed this month.

The Central Union Telephone Company is planning to expend about $30,000 on its plant at Mansfield, beginning this spring. New poles will be set and new wires strung over a part of the system.

The Farmers' Independent Telephone Company has been organized at Caldwell by L. W. Wheeler, H. W. Kuntz and E. W. Spannagel.

The Middletown Home Telephone Company of Middletown has been incorporated with a capital stock of $10,000 by Albert Emanuel, Charles N. Bosler, N. P. Ramsey, Robert E. Kline and H. P. Miller. The charter will allow the company to build and operate an exchange in Middletown.

Prominent residents of Salem Township, southwest of Leetonia, are endeavoring to organize a telephone company to cover territory which has not been touched by any other system. In case of organization, connections will likely be made with the Columbiana County Telephone Company.

F. S. Dickson, president of the Cuyahoga Telephone Company; Cyrus Huling, president of the Citizens' Telephone Company of Columbus, and E. L. Barber, president of the Home Telephone Company of Toledo, compose the committee that will go to Washington to confer with President Roosevelt in regard to the recent order issued by the Postoffice Department that will shut out the Independent service. Written protests have been made by all the companies over the country and the matter has been taken up by the president and Postmaster General Payne. While some modifications of the original order have been made, the officers think that it is still unfair to their companies and believe that by a personal interview something may be done to improve the situation.

The Maumee Valley Telephone Company of Perrysburg has been organized by Norman L. Hanson and others for the purpose of building lines through Wood, Henry and Lucas Counties. The capital stock is $15,000. C.

TELEPHONE MEN.

F. H. Runkel of Neillsville, Wis., has recently accepted the management of the Portage Telephone Company, Portage, Wis., and is taking active charge of re-equipping and rebuilding the entire system. The plant will have all of its principal leads transferred from open wire lines to cable construction and the main leads put underground. A special building has been completed for the central office, which will be equipped with central-energy apparatus.

It is understood that W. J. Berry, division superintendent of the Michigan Telephone Company at Grand Rapids, will go to Detroit as general superintendent, to succeed James F. Land, appointed general manager. A. L. Boyce, formerly of Detroit and for several months past general manager of the Missouri and Kansas Telephone Company, will return as engineer for the new Michigan State Telephone Company. C. E. Wilde, division superintendent at Marquette, becomes district manager at Grand Rapids. The office of division superintendent will be abolished and the field divided into about 60 districts.

MANUFACTURERS AND DEALERS.

William J. Murdock & Co. of Chelsea, Mass., manufacturers of the "solid" receiver, say that they are putting on the market new styles of their receivers. Their new style H and W receivers are worth seeing, they say.

The Automatic Telephone Company, recently incorporated, will manufacture electrical apparatus in Chicago. The company has a capitalization of $25,000, and the incorporators are J. K. Norstrom, H. M. Grais and G. T. May, Jr.

The International Telephone Manufacturing Company of Chicago is having a good demand for its new self-restoring drop switchboard. It is said that its orders for the last 30 days have averaged more than 100 drops a day, included in switchboards of from 50 lines to 600 lines equipped.

The S. H. Couch Company of Boston, Mass., is now distributing its bulletin No. 7, which contains descriptive matter relative to hook switches, plugs with reinforced cords, four-point spring jacks and small push buttons for telephone work. Some of the good points of the Justrite hook switch are compactness, uniformity of action and pointed contacts, preventing the accumulation of dust. The same company is also sending out a small folder describing its telephone sets with rotary switch for intercommunicating work.

Thomas H. Castle, E. Steadgall and H. R. Griffith have organized the Oak Grove Telephone Company at Abingdon, Ill., and will operate a telephone system in that town. The company has been incorporated.

Bell Telephones in Canada.

At the recent annual meeting of the Bell Telephone Company of Canada the directors were authorized to issue $2,000,000 new stock. This will bring the capitalization up to $8,000,000. The annual report of the company shows that 8,691 subscribers were added to the list during the last year. The total number of instruments now earning rental in the Dominion is 57,172. The company now owns and operates 421 exchanges and 672 agencies. About 4,121 miles of wire were added to the long-distance system in 1903, and the long-distance lines now opened and operated by the company comprise 30,969 miles of wire on 7,685 miles of poles.

Independent Long-distance Extensions from St. Louis.

The stockholders of the Kinloch Long-distance Telephone Company of St. Louis have voted to increase the capitalized stock from $300,000 to $5,000,000. President Forster states that the $4,700,000 increase in capital will be used by the company in extending its lines to cities now exclusively reached by the Bell company. The plan of the company is to extend its toll lines to Joplin, Kansas City, Chicago, Cairo, Ill., and all points south. The southern connections of the Kinloch company will all be through Joplin.

GENERAL TELEPHONE NEWS.

Fire in Leominster, Mass., on February 19th damaged the telephone exchange and shut off the service temporarily in the town.

The Southwestern Telephone and Telegraph Company will spend $10,000 in improving its telephone system at Oak Cliff, a suburb of Dallas, Tex.

The New England Telephone and Telegraph Company has purchased the Independent telephone line that has been in operation for several years in North Bennington, Vt.

The Baraboo Telephone Company of Baraboo, Wis., is re-equipping its exchange at North Freedom, installing a complete new International self-restoring drop-switchboard equipment.

The directors of the Nezperce Co-operative Telephone Company at Nezperce, Idaho, are considering the proposition of consolidating with the Inland Bell Telephone Company, now operating long-distance wires all over the vicinity.

Work on the outside construction for the new Independent telephone exchange at Sioux City, Iowa, has commenced. The construction of the exchange will be in charge of Stanley Muir of Chicago, who hopes to have the system in operation by August.

The government of the state of Sinaloa, Mexico, has granted a concession to Antonio Echevarria to establish a telephone system in the Mocorinto district of the state. All the principal towns and villages in the district will be connected by long-distance lines.

A telephone system will be constructed throughout Clay and Leslie Counties, Ky., by the Hyden Telephone Company, which was recently organized by R. M. Jackson and John Woodward of London, Ky., Abner Asher of Hyden, and H. C. Faulkner of Barboursville, Ky.

It is said that the Cumberland Telephone Company will begin this spring the construction of its proposed line from New Orleans to Scranton, Miss., where connection will be made with New York and other eastern cities. The contemplated improvements are to cost about $100,000.

The City Council of Billings, Mont., has granted the petition of the Moffett Telephone Company for an extension of its franchise, which would have expired in 1909, for a period of 20 years. This was done over the protest of the Rocky Mountain Bell Telephone Company, which urged that competitive bids be received.

The telephone company organized in South Lyon, Mich., last fall by 10 business men has contracted for about 200 telephones. The company started with 135 telephones in the village, put up a first-class line, and has contracted for rural telephones branching six miles east, west, north and south from the village. It is expected 300 telephones will be in operation as soon as they can be placed in the spring.

At the recent annual meeting of the Rocky Mountain Bell Telephone Company's stockholders, held at Salt Lake City, Utah, a report was submitted showing an increase of 25 per cent. in the business over the preceding fiscal year. The gross earnings were reported to be $863,144 for the fiscal year. G. Y. Wallace was re-elected president and D. S. Murray general manager of the company. The Rocky Mountain company has in contemplation the extension of its lines from Sheridan, Wyo., to a connection with the system at Billings, Mont.

A telephone system will be constructed and operated in Anchor, Ill., by the Anchor Telephone Company, incorporated by Jacob Morten, J. F. Ward and J. H. Nefziger.

BOOK TABLE.

MACHINE DESIGN. By Charles L. Griffin. Published by the American School of Correspondence at Armour Institute of Technology, Chicago. 1904. Pp. (6⅞ by 9⅝ inches) 74, with 16 illustrations.

"Machine Design" is a typical instruction paper sent out to correspondence students of the American School of Correspondence, and is bound in pamphlet form. Reaching, as it does, the student who must, of necessity, depend more upon himself for knowledge gained than the man who rubs elbows with a professor, the paper is admirably suited to the requirements. The definitions are well worded and the explanations clear. While by no means pretending to be a treatise on mechanics, enough of this subject has been embodied to enable the solution of the simpler problems involving tension, compression and torsion, and working stresses and strains. A commendable feature of the paper is the stress which is laid upon the importance of keeping accurate data, notes and sketches of each piece of machinery designed. Such notes and sketches, if properly entered in a notebook for the purpose, are valuable for reference to the designer and draftsman and are a saving of time in the end. They are of recognized value in a well-conducted drafting room, and there is no reason why the student should not be taught in the beginning to keep such data in a systematic manner. The greater part of the paper is taken up by the explanation of the design of a piece of mechanical apparatus which involves numerous practical problems, with the correct method of solution of each. In the back of the pamphlet is a list of examination questions which the student, after he has thoroughly mastered the contents of the paper, must answer and submit for correction.

Electricity in Farming.

Considerable interest is manifested by some of the large farmers of the West in the development of some sort of power which will supersede horses and oxen in doing farm work. Many of the farmers are now using steam tractors for operating plows, cultivators and harvesters, but these are said to greatly endanger crops by fire, especially in dry weather, and other means are being looked to. The Bismarck (N. D.) Tribune says that one Dakota farmer is experimenting with an electric tractor, which is described as follows:

"Power is generated by a mill some distance away—perhaps several miles—and transmitted in the usual way to a power mast 40 feet high, set in the open ground. At the top of this mast a double conducting cable is connected, this in turn being connected to the tractor, which consists of a 25-horsepower motor on a heavy carriage. A spar 10 feet high is carried on the carriage, with a universal-joint pulley on top, over which the cable is led to a drum on the carriage, which automatically takes up any slack as the tractor approaches the power mast, the power being transmitted by suitable connections through the drum to the motor. The tractor, when in operation, is hitched to a gang plow, cultivator or harvester, the cable being kept from sagging by the action of the drum.

"The work has proved so satisfactory that it is proposed to extend the system to cover 600 acres, which will require a number of masts at suitable intervals. The owners of this farm, on which they are using this method, propose, when planting time comes for the spring wheat, to install arc lamps on the masts and carry poles, so that their operators may go on night and day, thus saving valuable time."

New Space-Telegraph Dectector.

A new detector of electric waves for space telegraphy, by means of the Morse instrument, has been introduced in Germany through the Society for Wireless Telegraphy. It consists of a polarization cell with platinum or gold electrodes in dilute acid, and is connected to a source of current whose electromotive force is a little higher than the counter electromotive force of the cell. A film of gas is produced on the electrodes, and an ammeter in circuit shows that when Hertzian waves reach the cell the current is increased. The effect is strengthened by decreasing the surface of the electrodes, and it is said that good results are obtained when the positive electrodes have a diameter of 0.001 millimeter and a length of not more than 0.01 millimeter. The negative electrodes may be of any shape or size.

The Copper Situation.

Of late the copper market has been somewhat erratic, due in part to the eastern war and partly to the Baltimore fire. The trading basis was 13 cents a pound during the last of January, which dropped to 12½ cents, and later, during the early part of February, declined to 12¼ cents. The latter part of February, however, saw a strengthening of the market and the offerings on February 24th were at 12½ to 12⅝ cents a pound for electrolytic copper, with indications of a stronger market. Shipments of copper from Japan to Europe are expected to be somewhat curtailed, on account of the war, which will affect to some extent the European market.

CORRESPONDENCE.

Great Britain.

London, February 20.—The royal commission on London traffic has appointed three technical experts to advise the commission upon certain questions connected with locomotion and transport in London. The three experts are Sir John Wolfe Barry, one of the royal commissioners; Sir Benjamin Baker, and Mr. W. Barclay Parsons, consulting engineer to the board of rapid transit commissioners of New York. The commissioners have taken a mass of evidence upon proposals which, it is suggested, would alleviate existing conditions of traffic and afford further facilities; and the advisers above referred to will report upon the engineering and other technical considerations involved in these proposals. It will not be the duty of the technical advisers to the commissioners to make any report upon specific schemes which have formed the subject of applications to Parliament.

Some further contracts have been given out by Mr. Yerkes' company, the Underground Electric Railways Company of London. It has been decided to use an American system of signaling upon the 15 miles of double track comprising the inner circle. This will be the Westinghouse electro-pneumatic system and will be supplied by the Westinghouse Brake Company. There are 200 signal points, and a 14-minute service is to be arranged for. The British Thomson-Houston Company will supply the motors for the trains on these lines. I have already reported that the British Thomson-Houston (Sprague) system of multiple-unit control has been adopted.

A statement has been issued regarding the composition and work of the engineering standards committee, and this being the first comprehensive review of its kind a few particulars will be interesting. The committee commenced operations in April, 1901, the whole of the work being in the hands of a main committee consisting of representatives of the Institution of Civil Engineers, Institution of Mechanical Engineers, Institution of Naval Architects, Iron and Steel Institute, and the Institution of Electrical Engineers. There are 12 sectional committees, and under these there are 18 sub-committees, whose total membership is 192. The chairman of the electrical section is Sir W. H. Preece, F. R. S., K. C. B. There are sub-committees on generators, motors and transformers, physical standards, electrical nomenclature, electric tramways, telegraphs and telephones and cables, three others being in process of formation. The necessary funds are provided by the government, the five institutions named above, the railway companies, and the leading engineering firms. The funds are administered by two committees under the main committee.

A great deal has been written with regard to risk of fire in British theaters since the unfortunate Chicago disaster. The theaters and music halls committee of the London County Council now recommends that it should be granted extra funds in order to provide expert assistance in the work of inspecting the electrical arrangements in the places of public entertainment under the council's jurisdiction. One of the largest theaters in London (Drury Lane) has recently had its electrical equipment thoroughly overhauled. This took place, however, prior to the Iroquois catastrophe, and the work has just been completed.

Municipal telephony has not created extraordinary interest lately, but some discussion has arisen in consequence of the action of the Local Government Board in refusing to grant a loan for extensions of the Portsmouth municipal telephone system. At the local council meeting after the receipt of the intimation from the Local Government Board some caustic remarks were made. Unfortunately no reason appears to have been assigned for this action on the part of the government department, and it is one which is seldom taken. No definite line of action in the matter has been foreshadowed by the Portsmouth corporation. At Bournemouth the local authority has adopted a different attitude in the matter of its telephone system than has hitherto been the case on the part of municipalities. An engineering company has prepared a scheme for the equipment of a telephone exchange in the Bournemouth area which would compete with the system of the National Telephone Company. This has been approved by the local authorities, who, it is stated, will support the company's application to the postmaster-general for a license. On December 31, 1903, the National company had 1,072 exchanges, 3,571 call-office stations, 247,471 exchange stations, and 30,118 private stations upon its system.

A bill providing for the construction of over 50 miles of electric railway in Yorkshire was deposited in Parliament at the beginning of the year. When the bill was called for consideration, however, no one answered, and it was accordingly struck off the list. The proposed capital was nearly $5,000,000.

The Schuler single-phase alternating-current motor, the rights of which have hitherto been in the possession of Messrs. Ferranti, is now being [illegible] solely by the Lahmeyer Electrical Company, which now owns all rights.

It is expected that the electrified portion of the Lancashire and Yorkshire Railway will be [illegible] service within the next two months. G.

New York.

New York, February 27.—The problem of dealing with the ever-increasing demand for better transit facilities in New York city is developing into a bitter struggle between the financial giants. Four years ago Mr. J. B. McDonald, supported by Mr. August Belmont, induced the city to expend $35,000,000 toward the construction of the Interborough subways, and now, months before it can be demonstrated that an untried underground system of electrical traction is a commercial success, the Ryan and Vreeland group of financiers, which controls the Metropolitan system of surface cars west of Third Avenue, comes forward to declare war in the enemy's camp by applying for a franchise for two tunnels to run the length of Manhattan Island, along Lexington and Eighth Avenues, respectively, thus threatening the Interborough interests in a very formidable way. Features of the Metropolitan proposal are plans to get downtown below Fourteenth Street by burrowing under the Belmont Fourth Avenue tunnel, and going under West Broadway, and to cross the city on Forty-second Street so as to connect the Grand Central Depot with the projected terminal of the Pennsylvania Railroad. These Metropolitan tunnels are apparently part of a still more comprehensive idea of unifying the short and long-haul traffic of Greater New York.

Opposed to this scheme is the announcement by the Belmont syndicate of a new tunnel extension from Long Acre Square to get downtown from Fourteenth Street by the West Broadway route, as already selected by the Metropolitan. The most alluring point about Mr. Ryan's proposals is an offer to give transfers from the subway to the surface cars at a single five-cent fare. This is a better card than any rival can possibly play, for at the best the Interborough can only give transfers from its elevated lines to the underground, with no crosstown facilities. The Rapid Transit Commission has casually examined both sets of plans, and will probably act in the direction of inducing the two companies to offer the best terms possible to the city in return for their franchises; and at the same time the commission will express its views as to what routes are most desirable for efficient public service.

The same struggle, with the same interests involved, is proceeding in regard to The Bronx, where the resident population is increasing at an unheard-of rate. There the Union Railway Company, which is only another name for Belmont, is seeking to effect 13 new connections to increase intercommunication facilities and, incidentally, to prevent competing interests obtaining a foothold. From the electrical engineering point of view, The Bronx problem is easy, for the trolley pole is permitted there, but in Manhattan every sort of overhead wire is interdicted, and conduits and tunnels have to be planned and maintained.

That the electrical advisers of the Interborough subway system anticipate several kinds of dangers and are taking every possible means to provide for every emergency, is evident by the elaborate precautions in the way of fireproof materials and automatic safety devices that are being tried. Nevertheless hostile criticism is directed against the proposed provision of all-steel cars. Mr. H. W. Sprang comes forward this week with statements that a return current cannot be confined to a return rail, and that it also takes an appreciable fraction of time for a safety fuse to blow out, so that, in spite of the non-inflammable cars, death-dealing shocks may be experienced by passengers should abnormal conditions of the circuit arise.

Contrary to general expectation, Mayor McClellan has vetoed the aldermanic ordinance in favor of the franchise of the Westchester and Boston Railroad to lay tracks in the northern parts of the city. He has taken this step on the ground that no compensation to the city for the use of its streets is provided for and also that there are no safeguards against possible nuisances and unsightly structures. The promoters of the Portchester line were recently unsuccessful in a similar venture, and now both schemes are to be revived in applications which it is hoped will meet the mayor's objections. Meanwhile the people who will be served by the improved traffic facilities in that neighborhood are giving a more or less organized support to the proposals. Another body of taxpayers is watching certain proceedings at Albany, which, if carried through, will revive a number of unutilized franchises for trolley lines in The Bronx.

While all these various schemes are mainly of a political character, yet electrical engineers are following the developments with keen interest. Not only does each new projected line—conduit, trolley or tunnel—involve the solution of electrical problems and the improvement of methods, but they imply the fact that when they come to be put into execution, there will be plenty of room at the top (as well as at the bottom) for competent electricians, and they further demonstrate the fact that electrical traction has come to stay in New York city. So much has the superiority of electricity over steam been proved, that it is taken as a matter of course that all schemes for new traction lines are intended for electricity, unless otherwise specified.

The various methods now under consideration for alleviating the crush during the rush hours at Brooklyn Bridge do not concern the electrician very much. The only point of interest is that at present both the trolley and third-rail lines are so overworked that serious delays and lamentable accidents are of frequent occurrence. Never a week passes but a car catches fire, or a cable circuit is hors de combat. The fact is that Brooklyn Bridge can only safely carry a maximum number of cars per hour. This maximum was reached some months ago, and it is only the unceasing watchfulness of the officials that averts quite serious disaster. Mayor McClellan promises that trolley cars shall be running over the new Williamsburg Bridge at an early date; and now a line is planned to connect the new bridges, preferably by acquiring a strip of private property for the purpose, the estimated cost of such connecting link being $2,000,000.

Quite a number of public benefactors, or cranks, or grafters (according to individual taste) are busy up at Albany introducing all sorts of bills affecting the street traffic of New York. Among the ideas worth noticing is one to abolish the Saturday, Sunday and holiday 10-cent fare to Coney Island, and to have a flat-nickel fare every day of the year. Even under present conditions, people flock thither by the hundred thousand on Sunday afternoons in summer, and the rush for the return journey is, if anything, worse than that of Brooklyn Bridge. If the fare is reduced as promised, the Coney Island trolley tracks ought to be quadrupled.

The Brooklyn Rapid Transit Company is carrying out its threat to hold a physical examination of its motormen, of which it employs from 1,700 to 2,500, according to season. Quite a number of recent mishaps on this line have been due to the want of such personal examination, and although the men are protesting loudly against the requirements, they gain no real sympathy.

Some apparently well-designed and satisfactory electrically propelled launches are now on exhibition at the Sportsman's Show, and can be seen in operation on the temporary lake at Madison Square Garden. A 21-foot boat, capable of traveling 30 miles at seven miles an hour, has a weight of only 1,600 pounds; a 30-foot boat will travel 60 miles with one charging, and a 36-foot boat, 75 miles. A 60-foot launch, with a combined electrical and oil-engine equipment, develops enough power to travel at the rate of 14 miles an hour. All these launches are built by the Electric Launch Company of Bayonne, N. J., and the only reason why New Yorkers do not take kindly to such smootm-working craft is the difficulty of finding recharging stations along the Hudson River.

The expenditure has been sanctioned of a sum of $120,000 for the improvement of the Metropolitan Museum in this city. A nice little portion of this money is for increased electric lighting, but so far no contracts for the work have been given out.

A free public lecture on radium attracted a big audience to hear Professor E. R. von Nardroff at the Cooper Union on Wednesday evening last. A tube of radium was shown, its peculiar glow exhibited and a photograph taken by its emanations. Professor Nardroff explained, among other things, the three kinds of rays which radium emits, and he illustrated the principle of the spinthariscope, in which, he said, the emanation strikes violently against a screen of sulphide of zinc, and is made visible by the violence of the impact. Talking of radium, it should be recorded that Mr. W. J. Hammer of this city took a trip to Denver, Colo., this week for the express purpose of delivering a lecture on radium, his honorarium for the lecture being the record fee of $500. D. W. W.

Dominion of Canada.

Ottawa, Ont., February 27.—According to the official returns of the Department of Railways and Canals for Canada, just issued, giving statistical information for the last fiscal year in respect to railways in Canada, it is shown that the mileage of electric railways was 759, as against 558 in the previous year. In addition to this there were 32 miles of sidings. The gross earnings of electric railways totaled $7,223,677, as against $6,406,438 for the previous year. The net earnings were $2,760,819. There were also large increases in the number of passengers and freight carried. Last year there were 155,662,812 passengers carried and 371,182 tons of freight moved.

The syndicate represented by E. W. Bachus of Minneapolis, Minn., has concluded an agreement with the Ontario government for the sale of water-power on the Rainy River at Fort Francis. The agreement provides that the syndicate shall develop the power to its full capacity and shall render permanently available, on the Canadian side, one-half of the whole capacity of the stream. The syndicate agrees to supply power to Canadian users at a price to be fixed by the government, in case of disagreement, and not to charge more for power on the Canadian side than on the American side. The development is to be completed by May 1, 1906, and within nine months of the date of the agreement $50,000 is to be expended. The purchase price is $5,000. There is about 16,000 horsepower capable of development.

Offices have been opened in the city of Kingston, Ont., for the Ontario Electric Company, which proposes to construct lines of electric railway from Kingston to Toronto, and also eastward to Cornwall and Ottawa.

Cable advices from London, England, announce that the city of Kingston, Ont., has won before the Imperial Privy Council in the appeal of the Light, Heat and Power Company. This case has been before the courts for over two years. In 1901 the arbitrators fixed the value of the company's plant, which the city is taking over, at the sum of $170,373. They decided that there was no franchise and left the company to appeal to the courts upon that point. If there could be shown to be a franchise, then the value was fixed at $80,000. The company appealed first to high courts in Canada, and finally to the Privy Council of Great Britain. All the appeals were decided against the company and now the city gets the plant at the arbitrators' award of $170,373, less a sum to be fixed for depreciation since 1901.

Anatole Poidron, the Canadian agent at Paris, France, reports to the Department of Trade at Ottawa that he has inquired of the French government respecting the possibility of placing Canadian corundum upon the minimum tariff of France as crushed emery, dutiable at $8 a ton. Mr. Poidron has been assured that if Canada reciprocates on certain French products, Canadian corundum will be admitted at the French minimum tariff. W.

New England.

Boston, February 27.—The new Boston and Worcester railway appears to be a paying institution from the start, gross receipts for the six months ended December 31, 1903, amounting to $166,547, against operating expenses of $80,715, leaving a net profit of $85,832, which was $5,117 greater than the cost of running the road. From this profit the sum of $28,125 interest was deducted, leaving a surplus of $57,707, equivalent to 4½ per cent. on the stock for the year, after charging against net earnings six months interest on the bonds.

An unusually acute warfare between the town officials of Amesbury and the street-railway company operating in that town has been in progress during the last fortnight. Owing to difficulty in keeping the thoroughfare in condition for use, by reason of the heavy snowfall, the town authorities demanded that only one track should be kept open on the principal street. The railway company insisted on clearing both tracks. The town authorities covered one track the entire length of the business section with snow and called out the fire department to wet down the snow and allow it to freeze. A pickaxe brigade has been at work for the railway company since that occurred, but at last accounts the town officials had filled up the gaps anew and were blocking the railway's operations.

Hon. E. Moody Boynton was before the legislative committee on street railways at the State House a few days ago asking for the revival and extension of the charter of the Boston, Quincy and Fall River Bicycle Railway Company, a one-rail system, invented by the petitioner, with which, it is claimed, great speed can be attained, as shown by the working of experimental lines heretofore built. B.

Southeastern States.

Charlotte, N. C., February 27.—Directors of the Kentucky Traction Company met in Louisville a few days ago and discussed the building of a line from that city to Nashville. It is said that it was fully decided to build the road to Nashville at once. It will probably follow the Ohio River to Owensville and then southward to the latter city. It has been said that the late Senator Hanna was largely interested in the proposed road.

The Huntington and Charleston Railroad Company of Huntington, W. Va., has been incorporated with a capital stock of $20,000 to build a steam or electric road connecting the two cities. W. R. Thompson, E. M. Watts, T. J. Bryan and others are interested.

The Henderson City Railway Company of Henderson, Ky., has been chartered by A. L. Rich of Cincinnati, R. W. Richardson and J. E. Bohannan of Louisville. The capital stock is $250,000.

H. H. Hunt of Boston, southern representative of the Stone and Webster syndicate of that city, visited Columbus, Ga., recently to inspect the properties there, inciuding the street railway. The company will soon begin the erection of a power plant at a point near the city of Columbus, the property and site having already been secured.

The million-dollar improvements of the Birmingham (Ala.) Railway, Light and Power Company includes an addition to the power plant of one 60-cycle, three-phase, 2,300-volt alternating unit and one direct-current, 1,600-kilowatt, 375-volt generator; also several large boilers. The company is also completing a new power plant on the North Bessemer car line near Woodward Station.

At an important meeting of citizens, resolutions were passed in Washington, D. C., urging the passage of a bill providing for extensions of the Capital Railway Company's electric line along Florida Avenue; also favoring the bill giving the District commissioners control of the street-railway systems of the District.

It is stated at Lexington, Ky., that the Fayette Interurban Company will shortly begin the work of building several proposed interurban lines. L.

Ohio.

Cleveland, February 27.—A corps of surveyors is now engaged in locating the route for an electric railway to be built by the Hooven syndicate between Cincinnati and Indianapolis. The road will

pass through Greensburg and Shelbyville, Ind., two of the best towns in the territory to be opened.

The Thomas bill, providing for the consolidation of gas, water, power, electric-light and transportation companies, has passed the House of Representatives. The only public-utility corporations not included in the bill are telephone corporations. Just why these are omitted is not clear. It is claimed the bill is for the purpose of relieving a peculiar situation in Warren. Considerable opposition has developed, and the bill may not have an easy time in the Senate.

The Johnson bill, designed to turn over that portion of the Miami and Erie Canal between Cincinnati and Dayton to the Miami and Erie Canal Transportation Company, has been amended in such a manner as to prevent the company from interfering with the canal as a waterway or obstructing the towpath. In case such obstruction is made, a new towpath is to be built. The rental period is for 30 years and the rent must be paid quarterly. At the end of 30 years a commission is provided to fix the rental for another like period. The lease may be canceled at any time after the first period expires and the state shall have a lien on the tracks and property of the company to guarantee the rental.

Directors of the National Carbon Company, elected a few days ago, are as follows: John S. Bartlett, Boston; N. C. Cotabish, Cleveland; J. S. Crider, Pittsburg; D. D. Dickey, Pittsburg; H. E. Hackenberg, Cleveland; Hugh H. Hamill, Trenton; Webb C. Hayes, Fremont; Myron T. Herrick, Cleveland; James Marmelee, New York; John P. Wilson, Chicago; A. M. Young, New York. The report of Treasurer Hackenberg showed net earnings for the last year of $736,441. Deducting fixed charges, dividends and other payments, the balance to the profit-and-loss account is $141,012.

Capitalists and brokers are discussing the future of the Cincinnati, Dayton and Toledo Traction Company. It was supposed that the Widener-Dolan syndicate would lease it, but so far no move has been made in that direction. On account of needed improvements, some action will have to be taken to secure capital. The Philadelphia syndicate is said to be ready to take the property on lease, if certain conditions can be fulfilled. Whether the present owners will be willing to lease on the terms specified is not known.

The Dittrick and Jordon Electric Company of Cleveland has been incorporated with a capital of $12,000 to manufacture and deal in electric supplies. A. R. Dittrick, W. E. Davis, A. A. Dittrick, J. Jordon, F. A. Little and James Matthers are the incorporators.

The Cleveland Electric Railway Company is now furnishing its men with distilled water in order to prevent an epidemic of typhoid fever among them. The water is sent from the Cedar Avenue power station, where it is distilled.

An ordinance for a contract with the Cleveland Electric Illuminating Company for the maintenance of arc lamps at $75 a year has been passed by the City Council.

The net earnings of the Cincinnati, Newport and Covington Light and Traction Company for the year ended December 31st are $270,030.

The Cardington Electric Light, Heat and Power Company of Cardington has been incorporated with a capital of $15,000. G. M. Schwambs, A. E. Curtis and others are the incorporators.

The employes of the Jewett Car Company at Newark tendered Superintendent Neil Paulson a surprise a few days ago on the announcement that he was soon to take a new position as superintendent of the Cincinnati car shops. He was presented with a handsome watch, chain and charm, Assistant Superintendent Krebs making the address.

O. M. C.

Michigan.

Detroit, February 27.—The council of St. Joseph has appropriated the $10,000 forfeit of the Indiana and Southern Michigan Electric Railway Company for failure to fulfill the contract and construct the road to St. Joseph.

The Bay City Street Railway Company has inaugurated the sale of six tickets for 25 cents on the city lines. This move is a popular one with the people and has resulted in increased patronage for the street-car company.

Peter N. Jacobson, who promoted the Detroit and Monroe electric railway, is trying to interest Monroe capitalists in another electric road, this one to run from Monroe to Dundee, a distance of 15 miles.

H. B. Hoyt of the Union Trust Company has taken charge of the affairs of the Michigan Electric Company of Detroit under a chattel mortgage filed with the city clerk, turning its property over to the trust company as receiver. This company is capitalized at $50,000, with $30,000 paid in, and has been organized since 1893. Its total liabilities are about $68,000. Vice-president Hance of the Union Trust Company says the assets of the electrical company are estimated to be about equal to the liabilities.

At the recent annual meeting of the Grand Rapids, Grand Haven and Muskegon Railway Company (electric) it was decided to add to the rolling stock. The freight business has become so large that the company will have to double its capacity to take care of it. The company is now running three freight cars between Grand Rapids and Muskegon and has decided to order three more cars. The freight is all package stuff. It was also decided to order two new passenger cars. C. G. W.

Indiana.

Indianapolis, February 29.—As the result of an ordinance recently passed by the Cambridge City Council, requiring interurban cars to stop for passengers at all street crossings, the crew of the Indianapolis and Eastern Traction Company was arrested and fined for failing to stop for a passenger. Officers of the company say they will carry the case to the Supreme Court before they will obey the local law. They assert that the interurban cars are for long-distance travel and that they cannot be expected to do the work of the local city cars in small towns.

The City Council of Aurora has refused to make another contract with the Aurora Gas Light, Coal and Coke Company and let the contract to light the streets to the Sun Vapor Street Lighting Company of Canton, Ohio. This is thought to be a step backward, but was done to hasten the installation of an electric-light plant.

William T. Benallack of Detroit, Mich., addressed the Indianapolis Board of Underwriters in Indianapolis on the 23d inst. on the subject of faulty wiring. Mr. Benallack said a large number of fires were due to faulty wiring. There were a large number of electrical engineers present, and many questions were asked and satisfactorily answered. At the close of the lecture there was a demonstration of space telegraphy.

A majority of the Marion County Council has declined to appropriate money or provide for a bond issue to build four new and much-needed bridges over White River in Indianapolis, on the ground that "they are opposed to building bridges for the street-railway company."

C. C. Reynolds, general manager, and C. R. Williams, master mechanic, of the Indianapolis and Northwestern Traction Company, were in Cincinnati last week and ordered a large amount of necessary machinery for the repair shops that are to be built at Lebanon this spring. The buildings will cost $20,000. They will be used for the repair of all parts of the cars and the manufacture of small parts, such as brakeshoes, etc.

The Consolidated Traction Company has let a contract to Westinghouse, Church, Kerr & Co. to design, construct and install completely the electric and mechanical equipment for its road between Indianapolis and Crawfordsville. The engineering work is to be begun with the advent of good weather and the work of building the power house at Crawfordsville is to be begun in about two weeks. It has not yet been decided whether the overhead or the third-rail system will be used.

The electric road at Angolia, extending to Lake James, Ind., has been bought by M. B. Kelley, treasurer of the American Steel Company, at the receiver's sale. The consideration was $6,100, but there are debts aggregating $40,000. Mr. Kelley says he bought the road as an individual investment.

The contract for all the material to be used in the completion of the Wabash and Rochester electric railway was awarded in New York on the 27th inst. The contract includes rails and overhead work, power-house machinery and cars. The work of grading the line will begin March 1st.

F.

Texas and Mexico.

Austin, Tex., February 25.—It is reported that another electric-light and power plant is to be installed at Sour Lake, Tex. D. O. Lively can probably give information in regard to the proposed enterprise.

An electric-light and power plant is to be installed at Jasper, Tex.

The City Council of Monclova, Mex., has awarded the contract for the installation of an electric-light and power plant at that place to Victor M. Braschi & Bro. of the City of Mexico. The plant will cost about $100,000 gold.

The governor of the state of San Luis Potosi, Mexico, has called for bids for the establishment of a municipal electric-light and power plant for the city of San Luis Potosi.

M. H. Soberon, president of the street-railway company at San Luis Potosi, Mexico, has taken steps looking to the converting of the lines of that system into electric transit. Other important improvements to the system will be made.

The Guggenheim Exploration Company, which is a branch of the American Smelting and Refining Company, will install a large electric power plant at its Santa Barbara mines, situated in the state of Chihuahua, Mexico.

The government of the state of Coahuila, Mexico, has granted a concession to a syndicate of American and Mexican capitalists to build and operate a tramway, to be operated either by electricity or mules from the city of Saltillo to the town of Villa de Artega. F. H. Dillon of Monterey, Mexico, can probably give information in regard to the project.

The federal government of Mexico will build a new telegraph line from Culiacan to the port of Altata, by way of Navolato.

The government of the state of Michoacan, Mexico, has granted a concession to a syndicate of capitalists for the construction and operation of a system of street railways in Jiquilpan. Authority is also granted to extend the proposed system to the towns of Sahuayo and Palma.

The Mexican government has granted a concession to Archbishop Gillow of Puebla, Mexico, for the construction and operation of an electric-light and power plant on his Chiautla hacienda, situated in that state. Waterpower will be used to generate the electrical energy.

The Pennsylvania men who contemplated building an interurban electric railway between Temple, Texas, and Belton have abandoned the project, after making a personal investigation of the situation. They asked that local citizens subscribe to $50,000 of the stock of the company, which proposition was refused.

H.

Northwestern States.

Minneapolis, February 27.—Bids will be received at Ogden, Iowa, until March 15th for the construction of an electric-light plant.

The Union Manufacturing, Heating, Lighting and Power Company's plant at St. Anthony Park, St. Paul, Minn., has been destroyed by fire. The loss was $35,000.

The Eau Claire (Wis.) Gas Light Company has amended its articles of incorporation, allowing it to engage in the electric-light business and to increase its capital from $25,000 to $40,000.

The Edison Sault Electric Company will erect at once a sub-station on Arlington Street, Sault Ste. Marie, Mich.

The Electric Company of Mitchell, S. D., will enlarge and improve its electric-lighting system.

The Omro (Wis.) Electric Light Company has incorporated with a capital of $10,000. John Chaloner heads the list of incorporators.

The Chicago, Joliet and Iowa Railway Company is to incorporate with a capital of $1,625,000. An electric road may be built from Chicago and Joliet into Iowa.

The Owosso (Mich.) Sugar Company will build a trolley line from Prairie Farms to Owosso.

The contract for the construction of the Marshalltown (Iowa) Electric Street and Interurban railway has been awarded to J. G. White & Co. of New York. The line will be built from Marshalltown to Grundy Center, and possibly to Parkersburg and Charles City.

The Electrical Workers' Union has asked for an ordinance in Minneapolis providing for the insulation of all wires in the city, regardless of the current to be carried.

R.

Pacific Slope.

San Francisco, February 25.—The Fort Wayne Electric Works of Fort Wayne, Ind., has opened offices in San Francisco in the Crossley Building on New Montgomery Street.

The Martland Electrical Company has the contract for the electrical equipment of an eight-story apartment house on Sutter Street belonging to Edward B. Hindes. The contract price is $3,650.

Chief Engineer Miller of the Benecia, Vallejo and Napa Valley electric road states that the road will be in operation by July 4th and that it has been decided not to make Napa the northern terminus but to proceed up the valley.

Grading will begin in a few days at Los Angeles on the new Pacific electric-railway line to Anaheim Landing, the new Bay City. The road will branch from the Long Beach line, about 10 miles from this city, turning southwest. When completed it will be 26 miles long and the cars will make the run in 45 minutes. The road will be double-tracked, standard gauge.

Charles G. Glass, the expert secured by the City Council to ascertain the estimate for installing an electric-lighting plant at Long Beach, Cal., has submitted his report, placing the cost at $100,000. No definite action has been taken on the matter as yet.

Manuel Preria of Fort Jones, Cal., has sold his electric-light plant, which has been supplying light for Fort Jones for several years, to the Etna-Siskiyou Electric Power Company. This company has its plant on Fall Creek, and conducts its electricity through Montague and Yreka to Fort Jones. Several mines and mills along the route derive their power from this line. The people of Greenview are using every inducement to bring the power line as far as their town, which means about seven miles of wires.

Dr. J. F. Cropp of Walla Walla, Wash., is behind a movement to erect a new electric-light plant in that city.

Articles of incorporation have been filed in Portland, Ore., by the following-named electric companies: Deschutes Irrigation and Power Company, capital stock, $2,500,000; incorporators, W. A. Munly, George H. Hill and E. B. Holmes. Cottage Grove Electric Company of Cottage Grove, Ore., capital stock, $20,000; incorporators, H. O. Thompson, William Sheehy and Katie Sheehy. Baker City Street Railway Company of Baker City, Ore.; capital stock, $500,000; directorate, C. L. Palmer, Charles W. Hall, Charles M. Sage.

An additional electric-light and power plant is to be installed in the basement of the Rialto Building in San Francisco for the purpose of supplying the new hotel building which is to be erected on the site of the Bishop Block on Market Street, adjoining the Palace Hotel. The contracts for the plant, with

the exception of the boilers, are ready to be signed. Herbert E. Law, proprietor of both buildings, is in the East, where he will probably close contracts for the remainder of the plant. It is understood that the capacity of the machinery will be about 500 horsepower. Underground conduits will connect the two buildings. A.

Seattle, Wash., February 25.—The Town Council of Prineville, Ore., has closed a contract with George Morley to install an electric fire-alarm system covering the entire city.

S. J. Crutcher, A. G. Smith, Alexander Gustan and William Moreland of Pine City, Wash., are asking the county commissioners for a right-of-way for an electric railway through Whitman County from the Spokane County line to Colfax. The total length of the road will be about 75 miles.

The steamer Lurline, plying between Portland and Astoria, Ore., is being fitted up with a $2,000 electric-light plant. When completed it will be one of the finest steamer plants in the Northwest. A 3,000-candlepower searchlight is being used.

The citizens of West Seattle, Wash., are contemplating bonding the town for the purpose of securing an electric-light plant estimated to cost $18,000. A water system will follow the installation of the power plant.

The Astoria Electric Company of Astoria, Ore., has in contemplation a number of extensive improvements and extensions. General Manager Coolidge has ordered two new boilers with a capacity of 300 horsepower. A fuel house, with a capacity of 3,300 cubic feet, will be added.

Construction has been completed on the high-tension electric power line from Phœnix to Greenwood, B. C. The work was done by the Cascade Water Power and Light Company. The distance of the new extension is about five miles and is a three-phase system. A private telephone line has also been put up on the new extension. The power will come at a voltage of 22,000 and will be transformed down to 2,200 volts.

The capital stock of the Snoqualmie Falls and White River Power Company has been increased to $3,000,000.

The Wenatchee Electric Company has secured a franchise to erect poles and string wires for the transmission of electricity through the public roads of Chelan County and into Mission and Leavenworth, Wash. The life of the franchise is 50 years.

A franchise asked on behalf of the Snoqualmie Power Company of Seattle, to furnish power and light in the city of Bellingham, Wash., has been granted. The ordinance provides that, before the franchise shall become operative, the company must build an electric railway to Lynden, a distance of 15 miles.

The light committee of the city of Port Angeles, Wash., has recommended the abandonment of the plan to repair the old boilers, engine and engine house of the electric-light plant, and will purchase new engines and boilers and erect a new power house. The necessary steps will be taken at once.

Colonel Lunceford, president of the proposed trolley line from Davenport to Miles, Wash., is contemplating building his line north from Davenport to the Spokane River near its junction with the Columbia.

G. L. Campbell and associates of Pomeroy, Wash., have taken an option on the electric-light plant in that city, and if they are successful in purchasing it will make many needed improvements.

R. M. Roberts and F. G. Dorety have incorporated the Acme Development Company with a capital stock of $20,000. The principal place of business is in Seattle. This is the company that proposes to develop 15,000 horsepower at Sunset Falls, Wash., and furnish Everett with electric light and power. P.

PERSONAL.

L. R. Notbohm has resigned as superintendent of the Washington Water Power Company at Spokane, Wash.

Clarence O. Scranton, recently general passenger agent of the Lake Erie, Alliance and Wheeling Railroad Company, has taken the position of auditor of the Stark Electric Railway Company at Alliance, Ohio.

Theodore Stebbins will fill the position of general manager of the Appleyard electric-railway lines in Ohio in the absence of General Manager Emory, who is in Florida for the benefit of his health. Mr. Stebbins is well acquainted with the duties of the position.

George J. Martin of San Francisco has been appointed manager for the Stanislaus Milling and Power Company in Modesta, Cal., and has assumed charge of the installation of the plant. A carload of wire for the power and electric-light lines has already arrived at Stockton.

Edward C. Lombard of Jackson, Mich., a member of the Carter-Lombard-Carter Company, electricians, died from injuries he received by being struck by a train recently. Mr. Lombard was a well-known electrical engineer, having graduated from Cornell 10 years ago with high honors.

It is expected that Benjamin S. Hanchett of Grand Rapids, Mich., secretary and treasurer of the Grand Rapids Railway Company, and president of the Grand Rapids, Holland and Lake Michigan Interurban Company, will succeed the late G. Stewart Johnson as manager of the Grand Rapids Street Railway Company. He entered the employment of the railway company as an office boy 20 years ago.

George Frederick Gilbert, since 1896 connected with the H. W. Johns-Manville Company of New York as its general sales agent for Northern and Western New York, died of typhoid fever at St. Mary's Hospital, Rochester, N. Y., at the age of 42 years. Mr. Gilbert was a resident of Lakeville, Livingston County, N. Y. For several years he was engaged in the produce business and was postmaster for four years.

George W. Jackson, general manager of the Illinois Tunnel Company of Chicago, has recently submitted his report to the commission on high-pressure water systems for the city of Chicago. The report is an elaborate and excellent one, and evidently Mr. Jackson has put no small amount of time on its preparation. It contains many drawings, figures and estimates. Among other things, Mr. Jackson advocates the use of the gas engine in the pumping plant as altogether the most satisfactory for the purpose.

Vice-president William B. Rankine of the Niagara Falls Power Company has announced the appointment of A. Howell Van Cleve to be resident engineer of that company and its allied companies. In this promotion Mr. Van Cleve will fill the vacancy caused by the resignation of W. A. Brackenridge, who has been appointed a member of the State Advisory Canal Board. Mr. Van Cleve has been connected with the engineer corps of the Niagara Falls Power Company continuously since April, 1892, and at the time of his appointment as resident engineer to succeed Mr. Brackenridge he held the position of assistant engineer. He is a graduate of Lehigh University, a member of the class of 1890, with the degree of C. E., and before his connection with the Niagara Falls Power Company he had served on the engineer corps of the Lehigh Valley and the Brooklyn Elevated railroads. He is a member of the Board of Public Works of Niagara Falls.

ELECTRIC LIGHTING.

Williams & Co. are contemplating putting in an electric-light plant at Mountainview, Mo.

The town of Lena, Ill., is agitating the question of erecting an electric-light plant to cost about $10,000.

J. A. Reynolds of Clayton, Ga., has charge of the building of a municipal electric-light plant for the city of Clayton.

The Ballinger Light and Ice Company of Ballinger, Texas, wants bids on engines, pumps, shafting, belts, ice machinery, etc.

The city of Ocilla, Ga., will receive bids for 30 days for the installation of a $5,000 electric-light plant in that city.

The Copper Queen Company of Bisbee, Ariz., has in contemplation the erection of a central electric plant for mines, smelter, stores and offices.

It is reported that the city of Sweetwater, Tenn., will expend about $40,000 in city improvements, including the installation of an electric-light plant.

The city of Goldsboro, N. C., proposes to expend $10,000 in improving its electric-light plant. A duplicate engine, boiler and dynamo will be installed.

An effort is being made to establish an electric-light and power plant in Fort Gaines, Ga. M. E. Peterson is interested in the proposed improvement.

Garden, Mich., is to be lighted by electricity, a 20-year franchise having been granted to E. Drisco and associates for an electric-light, power and heating plant.

The city of West End, Ala., contemplates building an electric-light plant in connection with a system of waterworks, the whole improvement to cost about $100,000.

A contract for building an electric-light plant and system of waterworks in Sandersville, Ga., has been let to McKenzie & Son of Augusta. The contract price is $39,000.

The application of the town of Shell Lake, Wis., for a $10,000 loan from the trust fund of the state has been accepted by the commissioners, and electric lights will now be installed in the town.

A. Brown has purchased the controlling interest in the Carroll (Iowa) electric-light and heating plant. Plans are being prepared for improvements, including a new boiler and engine and a new dynamo.

The Village Board of Monticello, Wis., has adopted a resolution in favor of bonding the village for $8,000 to build and operate an electric-light plant. A popular vote will be taken on the proposition on March 11th.

The Economy Light and Power Company of Joliet, Ill., is about to install two 1,000-horsepower steam-turbine engines at the Jackson Street power house. They will be used to reinforce the plant when ice or other difficulties cut off the usual flow of water.

ELECTRIC RAILWAYS.

The city of Canton, Ill., has passed an ordinance granting permission to the Illinois Central Electric Railway Company to construct and operate an electric street railway in Canton. The company is also given permission to erect the necessary buildings and transmission lines for furnishing electric power for commercial purposes.

The county commissioners of Adams County, Colo., have granted a franchise to Tom L. Johnson & Co. of Cleveland for an electric railway to pass from the southern boundary of Adams County to Brighton, Colo. This is the first move in carrying out the proposed plan of connecting Denver with cities and towns in Northern Colorado.

The Frankfort and Versailles Traction Company now has about seven miles of road in operation in Frankfort, Ky., and it is proposed to add four miles more in order to reach the factories and distilleries, which are not now reached by any line. The company has the right of eminent domain and is possessed of other advantages that will make it an excellent property.

The proposed interurban line from Lafayette to Danville, Ill., will be built this season by the Fountain-Warren Traction Company. The enterprise was projected last year and considerable of the preliminary work has been done. It is further given out that the bonds have been disposed of at a good margin and that sufficient money has been secured not only to construct but equip the line.

The proposed electric railway between Springview and Newport, Neb., is almost assured. At a meeting of the most prominent men in the enterprise it was estimated that $100,000 can be raised by Springview citizens, and probably half this amount can be raised at Newport. The remainder of the proposed $300,000 capital is to be raised by easterners who are financing the enterprise.

The Tri-city Railway Company, serving Rock Island and Moline, Ill., and Davenport, Iowa, is perfecting plans for concentrating all its power-generating plant into one large station on the site of the present plant in First Avenue, Rock Island, from which it will be able to furnish current for the operation of all its lines in the three cities. At the present time the Rock Island plant only furnishes sufficient power for the operation of the cars on the Illinois side of the river, and it has been found necessary to obtain power from the People's Power Company for the operation of the lines in Davenport. The improvements will involve a large investment of capital and will be made gradually so as not to interfere at all with the traffic of the company.

TELEGRAPH.

The Western Union Telegraph Company is handicapped in Chicago by the strike of 100 or more messenger boys. The situation for a time was quite serious, as in several instances emergency messengers were held up by the youthful strikers, who took the telegrams and destroyed them. Action was brought to bear based on the interstate-commerce law, by which Judge Kohlsaat issued an injunction restraining the boys from interfering with the business of the Western Union, American District, or Illinois District Telegraph Companies.

SPACE TELEGRAPHY.

After a period of experimentation lasting six months, space-telegraph communication has at last been established by the government between Fort Wright, Fishers Island and Fort Schuyler, New York, a distance of 97 miles. Messages of 1,000 words were exchanged at the rate of 30 words a minute, and it is said that they could be distinguished as readily as a land message through wires. The new apparatus will be taken to Alaska for use in communicating between Nome and St. Michaels, where it is impossible to establish ground lines during the winter, on account of the destruction of the pole lines by ice.

PUBLICATIONS.

Multipolar direct-current engine-type generators as built by the Sprague Electric Company of New York city are the subject of a recent bulletin from that company. These generators have been designed with the end in view of meeting the most exacting of modern requirements. The details of the construction of this type of machine are fully set forth in the bulletin. The sizes range from 25 to 200 kilowatts capacity and the weights from 3,400 to 22,800 pounds.

Number 1, Vol. I., of the Technical World has appeared. The Technical World is a journal published in the interests of science and engineering by the American School of Correspondence of Armour Institute of Technology, Chicago. The publication is to be issued monthly and is intended not only for the student but for the man interested in technical matters generally. The leading article is by Professor Robert A. Millikan of Chicago University upon the subject of radium. Pictures of Professor and Mrs. Curie and Marconi are contained in the

first issue. The magazine is handsomely illustrated and makes a creditable appearance.

MISCELLANEOUS.

The District of Columbia appropriation bill for the fiscal year 1905, as reported to the House of Representatives, carries with it the following appropriations for the electrical department: Electric arc lighting, $83,700; general supplies and repairs, $15,000; placing wires underground, $35,000; extension of fire-alarm telegraph, $5,000; salaries, $16,220.

Oskar Huber, director of works of the Lewis and Clark Centennial Exposition, is preparing a design for an electric clock with dials 50 feet in diameter, to be suspended in the air 300 feet above the ground, and held in place by a stationary balloon; the size and lifting power of the balloon are not stated. The dials and the figures will be illuminated at night by electricity, and it will be possible to notice the time from any part of the fair grounds. Mr. Huber is also working on the plans for an electric tower 300 feet in height, to be used for searchlight effects.

Samuel L. Grace, United States Consul at Fuchau, China, says that that city has no system of lighting its streets and public buildings. Kerosene is being extensively used by the better class of Chinese, and there is a great demand for foreign-made lamps. Many of these are of very cheap quality and are really unsafe to use. Most of the natives use small cups or tumblers about three-fourths full of oil, with a small piece of wood floating on the surface of the oil, through which a tin tube containing a round wick is placed. This is a very common form of lamp in which tea oil is burned, and is utterly unfit for kerosene.

TRADE NEWS.

The switchboard, batteries and central-station apparatus of the Houston, Tex., fire-alarm telegraph system having been recently destroyed by fire, the city will soon advertise for proposals for installing a new system.

The Nernst Lamp Company has appointed G. E. Bennett to act as district sales manager of its Buffalo district office, recently established at 17 West Mohawk Street. These quarters will include an office, show room, exhibition room and stock room, with a complete stock of lamps and supplies to meet the requirements of the trade in this territory.

Sealed proposals are being invited by the Interior Department until March 23d for furnishing the United States Indian school at Phœnix, Ariz., with a quantity of electrical material, including wire, insulators, switches, plugs, rosettes and sockets, dry batteries, etc., a full list of which, together with blank forms of proposal, may be obtained upon application to Charles W. Goodman, superintendent of the school.

William Roche, 42 Vesey Street, New York city, has leased the top floor of the building at 52 and 54 Park Place, to enable him to concentrate and handle the various branches of his business. Mr. Roche is the inventor and manufacturer of the New Standard dry battery and also handles many other electrical devices, such as storage cells for telephone, launch and automobile work, plugs, gas lighters, electric alarm clocks, "handy electric matches" and many other electrical specialties of a similar nature.

W. H. Coverdale & Co. have been incorporated to do a general engineering and contracting business, with offices at 66 Broadway, New York. Their organization includes engineers of experience in all matters relating to the design and construction of steam and electric railroads, lighting and power plants, coal and ore-handling machinery, etc. Mr. Coverdale was for many years in the engineering department of the Pennsylvania lines west of Pittsburg and was track-elevation engineer of that company in Chicago during 1898-99. He was also prominently identified with the construction of the Westinghouse shops at East Pittsburg, and for the last three years has been civil engineer for a New York firm of engineers and contractors.

BUSINESS.

The Medora Milling Company of Medora, Ind., reports good demand for its heavy chestnut fence posts and heavy guy stubs for special duty with electric railways, for which they are so well adapted.

The Electric Appliance Company, Chicago, has just issued a folder picturing and describing the Greenwood safety wire guard for which it is selling agent. This guard has many features of value to the electric-light man and contractor.

Although weather conditions recently have not been ideal for the sale of wires and cables, the Indiana Rubber and Insulated Wire Company of Jonesboro, Ind., says that it has continued to enjoy a brisk demand for its various products, working its shops to their full capacity to turn out orders. A large spring trade is looked for.

A prominent manufacturer of electrical machinery for high-tension work made a report recently on a test of a high-tension insulator made by the Hemingray Glass Company of Covington, Ky. This insulator, it is said, stood a test of 120,000 volts without a breakdown. The Hemingray company naturally is very proud of this record and has received many congratulations. In addition to making insulators for high-tension work, the Hemingray company produces standard screw-glass insulators for all other purposes.

The instrument department of the Wagner Electric Manufacturing Company of St. Louis is now prepared to handle a reasonable volume of portable and switchboard-instrument repairs and instrument calibrations of any kind. In the manufacture of its own standard portable and switchboard instruments it has been found necessary to equip the plant with complete standards, and this, therefore, makes possible doing some calibrating and repair work on other types of instruments. This announcement is being made to the trade reasonably near St. Louis, and any work of the character described sent the company will receive prompt and careful attention.

W. C. Sterling & Son of Monroe, Mich., are now entering their twenty-fifth year in the cedar business. They started with a small cedar yard at Monroe and have enlarged their business every year since, until now they have 11 yards in Michigan, carrying about 75,000 cedar poles, 150,000 cedar ties and 80,000 posts, besides their large stock of cedar shingles. Their spring trade is rapidly opening up and they report some large sales. They are in a good position to close a contract with an electric road for all its ties, poles and posts for prompt shipment. They carry a "special A" tie, as they have named it, for electric roads, and have met with good success in putting them on the market.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) February 23, 1904.

752,643. Electric Pump for Switching Mechanisms. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, Los Angeles, Cal. Application filed July 31, 1903.

Solenoid magnet armatures are so arranged that they automatically open and close check valves as the circuits are energized and de-energized.

752,652. Electrical Apparatus for Registering the Discharge of Liquids by Pumps. Hans J. S. Cassal, London, England, assignor to the Liquid (Electric) Register Syndicate, London, England. Application filed March 17, 1903.

Combined with a reciprocating contact rod adapted to be connected to the piston rod of a pump, is a plate movable with respect to the rod and provided with a number of contact strips arranged in converging lines. Means for adjusting the plate transversely with respect to contact rod in accordance with the stroke of the pump are supplied. Also a register electrically connected with the contact strips.

752,659. Safety and Signaling Device for Hoisting Mechanism. William N. Dickinson, Jr., Chicago, Ill., assignor to the Otis Elevator Company, New York, N. Y. Application filed January 4, 1902.

A safety switch on the car and in series with the controlling circuit is arranged to be opened by imposing the weight of the attendant, the switch being normally in closed relation with respect to the circuit.

752,689. Electrically Propelled Vehicle. Louis Krieger, Courbevoie, France. Application filed February 26, 1903.

In a motor vehicle, carrying a prime mover, is a dynamo and an electric motor, the dynamo and motor serving to transmit the energy of the prime mover to the driving member of the vehicle. The dynamo has several main field coils and a series field coil wound in opposition to the main coils, one of the main coils being in shunt with the terminals of the dynamo. A battery is in circuit with the other main coil.

752,690. Method of Producing Sparks in the Cylinders of Internal-combustion Engines. Leon J. Le Pontois, New Rochelle, N. Y. Application filed August 22, 1903.

Ignition is brought about by delivering two or more alternating currents differing in phase from each other to a multiple circuit-breaker located in the combustion chamber and causing the breaker to interrupt their respective circuits simultaneously so that the total heat value of the spark or sparks produced at any given time is almost constant.

752,691. Inductor Alternator. Leon J. Le Pontois, New Rochelle, N. Y. Application filed August 22, 1903.

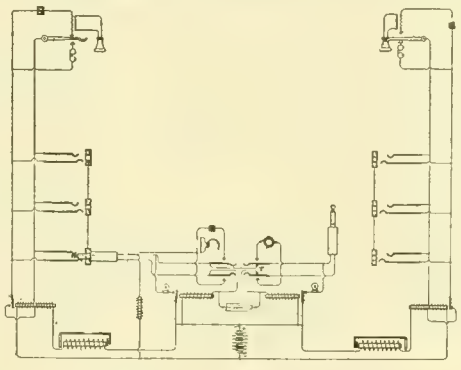
Oppositely polarized pole pieces separated from each other co-operate with an inductor arranged between the pole pieces. Polar projections on the inductor are placed opposite each other, with means for moving the pole pieces and the inductor relatively to each other.

752,692. Polyphase Magneto Alternator. Leon J. Le Pontois, New Rochelle, N. Y. Application filed November 7, 1903.

A polyphase alternating-current generator consists of permanently magnetized circular steel shells, each shell having inner polar projections. Pole pieces displaced with respect to each other are mounted on the shells. Coils on the pole pieces and a rotating inductor in the air gap between the polar projections and the pole pieces complete the apparatus.

752,696. Electric Cord Adjuster. Jonathan E. Masterson, Spokane, Wash. Application filed May 23, 1903.

A spool attachment on the device, which is mounted on the incandescent lamp casing, winds up the cord.



NO. 752,761. MULTIPLE-SWITCHBOARD SYSTEM.

752,710. Means for Synchronizing the Instruments of Telephone Systems. Hope Redmon, Rufus L. Hall and Robert H. Conway, Cynthiana, Ky. Application filed September 17, 1903.

The device contains an electromagnet whose armature carries a feed pawl. A stop connected with the armature trips a detent pawl, which regulates the action of the feed pawl. A permanent magnet is pivotally mounted upon and carried by the armature and controlled by a change of polarity in the electromagnet. Means for normally limiting the amplitude of movement of the armature are adapted to be thrown out of action by reverse movement of the permanent magnet for tripping the detent pawl to admit of synchronizing all the instruments of a system.

752,719. Automatic Signaling System for Electric Railways. Harry B. Snell, Cement City, Mich., assignor to the Snell Electric Signal Company. Application filed July 17, 1903.

Indicating mechanism located at opposite ends of a block are each provided with a dial and a rotatable shaft carrying an indicator hand and an oppositely toothed ratchet wheel. A pair of pivoted armatures adapted to be actuated independently to engage a ratchet wheel and rotate it intermittently in either direction are operated by electromagnets in branch circuits from the trolley line. Switch devices at the ends of the block are adapted to control the circuits to cause the mechanisms to indicate at both ends of the block the number of cars having entered.

752,722. Switchboard. Alfred Stromberg, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed May 13, 1902.

In a multiple switchboard are combined a front vertical support formed in one integral piece provided with a number of horizontal rows of plug openings. Test thimbles within the plug openings carry lugs, while the support is provided with an equal number of corresponding recesses within which the lugs may be received to prevent rotation of the test thimbles.

752,737. Trolley. Thomas F. Wetton, Newark, Ohio, assignor of one-half to Charles E. Krebs, Newark, Ohio. Application filed October 27, 1903.

The trolley wheel is arranged between forked members on the harp, a shaft carrying the wheel being journaled in the fork members.

752,761. Multiple-switchboard System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed December 7, 1900.

Means at the exchange for increasing the energization of one of the coils of a differentially wound line relay with respect to the other to effect the operation of the relay to cut out the line indicator are the prominent features. Jack switches provided with switch-contact parts are connected with the limbs of the telephone line, while a third contact part acting as a testing means, is located in front of the jack switches, but normally insulated therefrom and from the line. (See cut.)

752,768. Temperature-regulating Apparatus. Adam M. Goodwin, Pittsburg, Pa., assignor to the Goodwin Company, Pittsburg, Pa. Application filed July 22, 1903.

A melting tank is heated by fuel, the supply of which is regulated by a valve operated by an electromagnet. A thermostatic arrangement within the tank opens or closes the electric circuit of the magnet, according to the temperature rise or fall within.

752,812. Electric Block-signal System. Charles W. S. Turner, Mountville, Va. Application filed April 3, 1903.

A rail divided by insulation into sections or blocks, each of which forms an electrical conductor, is combined with a second electrical conductor insulated therefrom and running substantially parallel, but crossing and recrossing at intervals. Trolleys comprising independent sets of contacts are alternately brought into operation so that the intermediate contacts engage the rail, while the others alternately engage the outside and inside portions of the crossing conductor.

752,820. Dynamo Brush. Max Bünnig, Gardelegen, Germany. Application filed October 5, 1903.

Metallic dust and tar are pressed into form, being then heated to a temperature for coking the tar.

752,822. Alarm Signal for Railway Trains. Hugh E. Butler and Joab L. McCollum, Atlanta, Ga. Application filed November 12, 1903.

In an alarm mechanism for [illegible] the cars of a railway train there is an operating cord connected with one of the cars and extending rearwardly

over the rear cars of the train. An alarm circuit and circuit-controlling apparatus for the alarm circuit with which the rear end of the cord is detachably connected rings an electric bell if the train parts.

752,824. Electric-railway Switch. Harry H. Chandler, Waltham, Mass. Application filed October 24, 1903.

An insulated section of track includes a pair of switches. An electric circuit connected to the insulated section of track is adapted to energize a magnet which operates the tongue of the switch.

752,832. Sparking Apparatus for Explosive Engines. Lincoln H. Fey, Northfield, Minn. Application filed February 19, 1903.

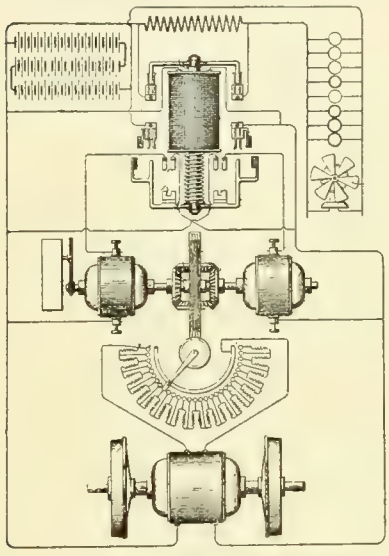
An oscillating electrode operated by a pawl and ratchet makes and breaks the circuit to produce the spark.

752,833. Attachment Plug. Philip H. Fielding, New York, N. Y. Application filed June 27, 1903.

An attachment plug for lamp cords is described.

752,834. Electrical Receptacle. Philip H. Fielding, New York, N. Y. Application filed June 27, 1903.

The receptacle is adapted to fasten directly to the exterior of an electrical conduit and engage the wires through an opening in the wall of the conduit.



NO. 752,839.—AXLE LIGHTING SYSTEM.

752,839. System of Electric Train Lighting. David C. Henry, Denver, Colo., assignor to the Henry Electric Equipment Company, Denver, Colo. Application filed September 23, 1901.

In an axle-generating and translating system a number of armatures are mounted on a bushing adapted to be secured to the axle of the car truck. (See cut.)

752,840. Flexible Conducting Cord. Howard B. Holmes, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 27, 1902.

A flat spring-metal wire of great tensile strength and toughness is wound helically upon a core and forms a conducting strand for the cord. A protective insulating covering surrounds the helical conductor. (See cut.)

752,843. Signaling Apparatus. Robert B. Kernohan, Pittsburg, Pa. Application filed May 23, 1903.

Combined with a main electric circuit is an auxiliary circuit. A fluid-pressure main contains a signal whistle. An electromagnet in the auxiliary circuit operates a valve opening into the whistle, and a switch makes and breaks connection between the main and auxiliary circuits.

752,858. Electromagnetic Switch Device for Apparatus for Magnetically Recording and Strengthening the Reproduction of Speech, etc. Peder O. Pedersen, Copenhagen, Denmark. Application filed June 21, 1901.

In two circuits, each containing transmitting and receiving apparatus, is a paramagnetic body adapted to receive magnetic cords of electrical impulses or signals traversing either of the circuits, and means whereby the signals recorded by either of the circuits in the body are reproduced and augmented in the other circuit.

752,894. Selective Signaling. Reginald A. Fessenden, Fort Monroe, Va., assignor to the National Electric Signaling Company, Pittsburg, Pa. Application filed December 29, 1902.

By radiating prolonged series of electromagnetic waves from the space-telegraph sending station in groups of a predetermined frequency lower than the frequency of the waves forming the groups, selective signaling may be accomplished. The waves are received at a receiving station on a current-operated receiver and produce indications or signals at the receiving station by selecting groups of the predetermined frequency.

752,895. Signaling by Electromagnetic Waves. Reginald A. Fessenden, Pittsburg, Pa., assignor to the National Electric Signaling Company, Pittsburg, Pa. Application filed March 14, 1903.

At a station are two conductors and a receiver for electromagnetic waves, the conductors being adapted to oppose the effects on the receiver produced by disturbing electrical impulses while permitting waves of the desired periodicity to affect the receiver.

752,909. Telephone Signaling Mechanism. Oscar O. Lee, Chicago, Ill. Application filed January 11, 1900.

The signaling apparatus is normally in circuit with the line wires, but the battery and induction coil operating the vibrator are thrown into a talking circuit upon movement of the receiver support to its limit of upward movement.

752,923. Electric Telegraph System. Charles Adams-Randall, New York, N. Y. Application filed September 6, 1902.

A double-wound coil is contained in the main-line circuit which is inductively grounded through the medium of the coil, one side of the helix being connected in the line and mechanically ungrounded. Alternating-current impulses are used for the signals.

752,942. End-cell Switch. John W. Achard, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed May 17, 1902.

The brush consists of carbon and an embedded conductor arranged transversely of the brush which operates to decrease and increase the resistance of the brush throughout its depth.

753,027. Oscillating Electric Fan. Jacob Amrom, New York, N. Y., assignor of one-half to David Euer, New York, N. Y. Application filed June 27, 1903.

An electrically operated fan is mounted on an oscillative cylindrical fan-support having a recess in its wall. A pivoted armature is provided with a lever engaging the recess and an electromagnet with retracting spring and circuit-making and breaking device for oscillating the armature.

753,035. Combined Percussion and Electric Primer. Thomas G. Bennett and William Mason, New Haven, Conn., assignors to the Winchester Repeating Arms Company, New Haven, Conn. Application filed November 23, 1903.

An electric-firing device is combined with a percussion primer for assuring the discharge of the cartridge by either one or the other means.

753,062. Microphone. Pierre Germain, Fontenay aux Roses, France. Application filed October 7, 1899.

Granulated material in the transmitter chamber is composed of a mixture of carbon and some metal of good conductivity. Means for applying heat to the material and means within the chamber to eliminate the oxygen are the other features.

753,067. Telephone or Telegraph System. Robert Hamilton, Milton, Mass. Application filed February 10, 1903.

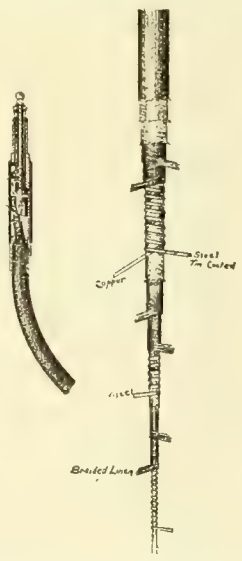
Each station contains an instrument normally on an open circuit. A normally open switch at each station can be operated by a subscriber at any other station to connect his instrument with the first.

753,091. Governing Mechanism for Internal-combustion Engines. Walter J. McVicker, Rogers, Neb. Application filed March 7, 1903.

A centrifugal device on the flywheel of the engine operates to open the circuit of the igniter when the speed reaches a predetermined point.

753,134. Electrical Illuminating Device for Showwindows. John H. Goehst, Chicago, Ill. Application filed May 6, 1903.

A casing opened at one side is provided on the inner face of its side wall with interior reflector and a lamp-support extending across and detachably secured to the side walls. The casing is made wider at its open side than at the part to which support is attached, whereby the support, sockets and wiring may be removed from the casing or assembled structure.



NO. 752,840.—FLEXIBLE CONDUCTING CORD.

753,136. Alarm System. John W. Hasburg, Chicago, Ill., assignor to the National Burglar and Fire Alarm Company, Chicago, Ill. Application filed July 23, 1903.

In an alarm system is an alarm circuit and a controlling circuit, a drop being arranged to control both of the circuits. A timing device controlled by the controlling circuit and adapted when in operation to move the drop to inactive position at predetermined intervals is arranged to be started when the drop is moved to active position.

753,138. Portable Electric Lamp. Harry C. Hubbell, Brooklyn, N. Y., assignor to Horace W. Fuller, New York, N. Y. Application filed July 2, 1903.

A steel cell in the lamp has its sides lined with a metal capable of being amalgamated and contains an alkaline solution. A wire projects upward from the bottom of the cell and is protected from the solution. One or more silver-oxid pencils suspended from the upper part of the wire form the cathode.

753,157. Railway Block System. Joseph Morton, New Westminster, Canada. Application filed October 19, 1903.

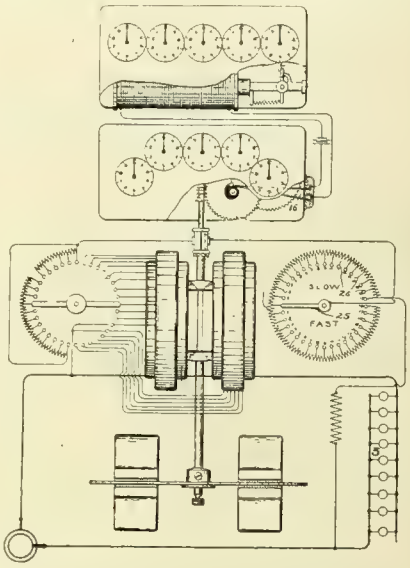
An electric bell-ringing mechanism on the locomotive has its circuit operated by upwardly projecting members on the track, which may be moved in or out of the path of the mechanism.

753,183. Telephone Selecting Device. William D. Watkins, San Jose, Cal., assignor to the Watkins Manufacturing Company, San Jose, Cal. Application filed August 29, 1902.

A pair of toothed disks with means for imparting a step-by-step movement to one disk and an oscillatory movement to the second disk co-operates with a locking arm for engaging the clapper rod of the telephone call-bell. A catch holds the locking arm in position, and means carried by the oscillating disk release the catch and permit the locking arm to move from engagement with the clapper rod.

753,191. Electric Meter. Thomas Duncan, Chicago, Ill. Application filed July 11, 1901.

The winding of the meter produces a supplemental torque. A resistance is placed in circuit with the winding and also switching mechanism whereby resistance is included in circuit as turns of the supplemental winding are cut out of circuit and vice versa. (See cut.)



NO. 753,191.—ELECTRIC METER.

753,192. Electric Meter. Thomas Duncan, Chicago, Ill. Application filed July 18, 1901.

A motor meter is provided with an armature winding, a commutator for the armature, commutator brushes for engaging the commutator to connect the armature in circuit, a detachable support for the commutator brushes, a sleeve, and a screw passing through it into engagement with the detachable support.

753,193. Electric Meter. Thomas Duncan, Lafayette, Ind. Application filed October 23, 1903.

Details are described of a meter whose armature is carried on a spindle formed in three sections, one carrying the armature, one the commutator and one the worm for operating the measuring element.

753,194. Electric Meter. Thomas Duncan, Lafayette, Ind. Application filed January 2, 1904.

An auxiliary coil for adjusting the voltage of the meter is a feature of the invention.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on March 1, 1904:

358,464. Galvanic Battery. J. B. Perreur-Lloyd, Paris, France.
358,493. Regulator for Induction Coils. Marmaduke M. M. Slattery, Woburn, Mass.
358,492. Sealing in of Wires for Incandescent Lamps. Marmaduke M. M. Slattery, Woburn, Mass.
358,511. Thermostat. Edgar W. Upton, Peabody, Mass.
358,512. Suspended Conductor for Electric Railways. Charles J. Van Depoele, Chicago, Ill.
358,518. Binding Post. George Westinghouse, Jr., Pittsburg, Pa.
358,519. Electropneumatic Interlocking Apparatus. George Westinghouse, Jr., Pittsburg, Pa.
358,520. Electric Fluid-pressure Engine. George Westinghouse, Jr., Pittsburg, Pa.
358,521. Electrically Actuated Fluid-pressure Motor. George Westinghouse, Jr., Pittsburg, Pa.
358,592. Insulating Tube for Electric Conductors. C. L. Clarke, East Orange, N. J.
358,599. Incandescent Electric Lamp. Thomas A. Edison, Menlo Park, N. J.
358,600. Incandescing Electric Lamp. Thomas A. Edison, Menlo Park, N. J.
358,609. Electric Conduit. Robert L. Harris, Brooklyn, N. Y.
358,614. Extension-table Call-bell. John E. Johnson, Newark, N. J.
358,645. Electric Station-Indicating Apparatus. Willard L. Bundy, Auburn, N. Y.
358,682. Electric Motor. Malcom W. Long, Harrisburg, Pa.
358,691. Automatic Electric Fluid Regulator. Ransom C. Page and Francis H. Soden, Chicago, Ill.
358,694. Transmitting Signal Instrument. Frederick Pearce, New York, and James Jones, Brooklyn, N. Y.
358,713. Electrically Actuated Fluid-pressure Motor and Circuits Therefor. George Westinghouse, Jr., Pittsburg, Pa.
358,753. Method of and Apparatus for Synchronizing and Regulating the Movements of Motors. J. Harris Rogers, Bladensburg, Md.
358,775. Electrical Apparatus for Operating Valves in Mains. Fred B. Graves, Rochester, N. Y.
358,778. Duct-Conduit for Electrical Conductors. Geo. D. Holt and William T. McGinty, Minneapolis, Minn.
358,793. Induction Coil. Marmaduke M. M. Slattery, Woburn, Mass.
358,812. Telephone. Warren D. Hoise, Kansas City, Mo.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, MARCH 12, 1904 No. 11

Series Alternating Enclosed Arc Lighting in the Union Stock Yards.

Series alternating enclosed arc-light systems are few in number in Chicago; in fact there are but three at the present time. By far the largest of these is the system just completed for the Union Stock Yard and Transit Company. This company owns the Chicago Union Stock Yards, including the Exchange Building and the Transit House, located at the yards. For the purpose of lighting these properties and also the tracks of the Chicago Junction Railway Company, extending from the yards to Lake Michigan, nearly 2½ miles, the new plant has been installed, taking the place of an old installation which had become inadequate for the purpose.

The principal part of the load comprises the arc-lighting system, which lights the yards and stock pens and the tracks of the Junction road. Incandescent lighting is supplied to the Transit House and Exchange Building, while a very small motor load is also carried, the most of which is taken by two elevators in the Exchange Building.

The power house is built as an addition to the pumping plant, furnishing water to the Yards, and the steam for the two is generated by a single boiler plant consisting of three 250-horsepower water-tube boilers made by the Aultman & Taylor Machinery Company, which carry 125 pounds pressure. In the engine room of the new part of the power house are the two engines and alternating-current generators (Fig. 1), which comprise the electrical portion of the plant. The generators are both of the General Electric make and are driven by Buckeye cross-compound engines. They are of the revolving-field type and generate 2,300 volts at 60 cycles, three-phase. The larger machine has a capacity of 75.5 amperes, running at 150 revolutions per minute, while the smaller generates 53 amperes at a speed of 200 revolutions per minute. Each generator is excited by a small dynamo, belt-driven from its own flywheel, the larger exciter having an output of 30 kilowatts and the smaller 17.5 kilowatts.

The switchboard is of gray marble and contains 13 panels, as shown in Fig. 2. Beginning at the right, the first five panels contain the plug switches for the various arc circuits and the main switch of the arc-light buses. The sixth and seventh panels are for the incandescent lighting of the Exchange Building and the Transit House respectively, while the next embraces a few outside circuits of incandescent lamps. The power leads are brought into panel nine, while the next two are for the main generator leads. The last two are the exciter panels. Thomson instruments are used, except the four electrostatic ground detectors shown on the right end of the board and the voltage regulator at the left. Oil switches are also used, except of course for the exciter circuits.

Three potential regulators back of the board are connected directly on the three incandescent-lighting lines, while the potential transformers for the switchboard instruments are, with the exception of a few on the right-hand panels, mounted on a wall panel, also back of the board.

Having now described the general features of the generating plant, the subject of the arc-lighting system which absorbs the major portion of the power generated naturally follows. This system is of the series alternating enclosed type, made by the Western Electric Company, which furnished the apparatus, including transformers, regulators and lamps. As before stated, the machines generate 2,300 volts. This is passed through step-up transformers and raised to 8,600 volts, or 4,300 volts, according to which secondary terminals are used. On non-inductive load the two secondary terminal pressures of the transformers are 9,200 and 4,600 volts.

The transformers are four in number, of 56 kilowatts each, and are of the oil-insulated self-cooling type. Three of them are shown in Fig. 3. Above the transformers are mounted the regulators, as shown. This arrangement, as will be observed, is economical of floor space besides securing good ventilation.

A diagram of connections is shown in Fig. 4. As will be seen in the drawing, there are six terminals on the secondary connection board of the transformer which allow of four possible combinations in the lighting circuit of each transformer. At present each transformer is connected, as shown in the diagram, for two 50-light circuits in multiple. One circuit connects to taps (1) and (3), and the other to taps (4) and (6) on the secondary connection board. For operating 100 lights in series, taps (3) and (4) are connected. When it is desired to operate two 25-light circuits in multiple, lead (3) is shifted to post (2) and (6) to (5). The final combination for operating 75 lights in series is accomplished by connecting (8) of the primary board in series with tap (4) and then connecting the outside leads of the arc circuit with tap (1) and post (5).

As already mentioned, the transformers, including the three in the picture, and one not shown, mounted at the end of the switchboard, each supplies two 50-light circuits in multiple, making 400 arc lamps for the ultimate load. At present 300 arcs are burned.

In Fig. 3 may be seen the principal features of the construction of the multivoltage regulators. Laminated iron cores composed of vertical limbs cross-connected at the top are supported upon rigid uprights attached to an iron sub-base. The reactance coils are mounted below the cores and guided at their lower ends by forks, which engage the vertical guide rods on either side. From the upper ends of the coils chains extend upward and are connected to levers mounted upon antifriction bearings and provided with an adjustable counterbalancing weight. In the operation of the machine the weight is ad-

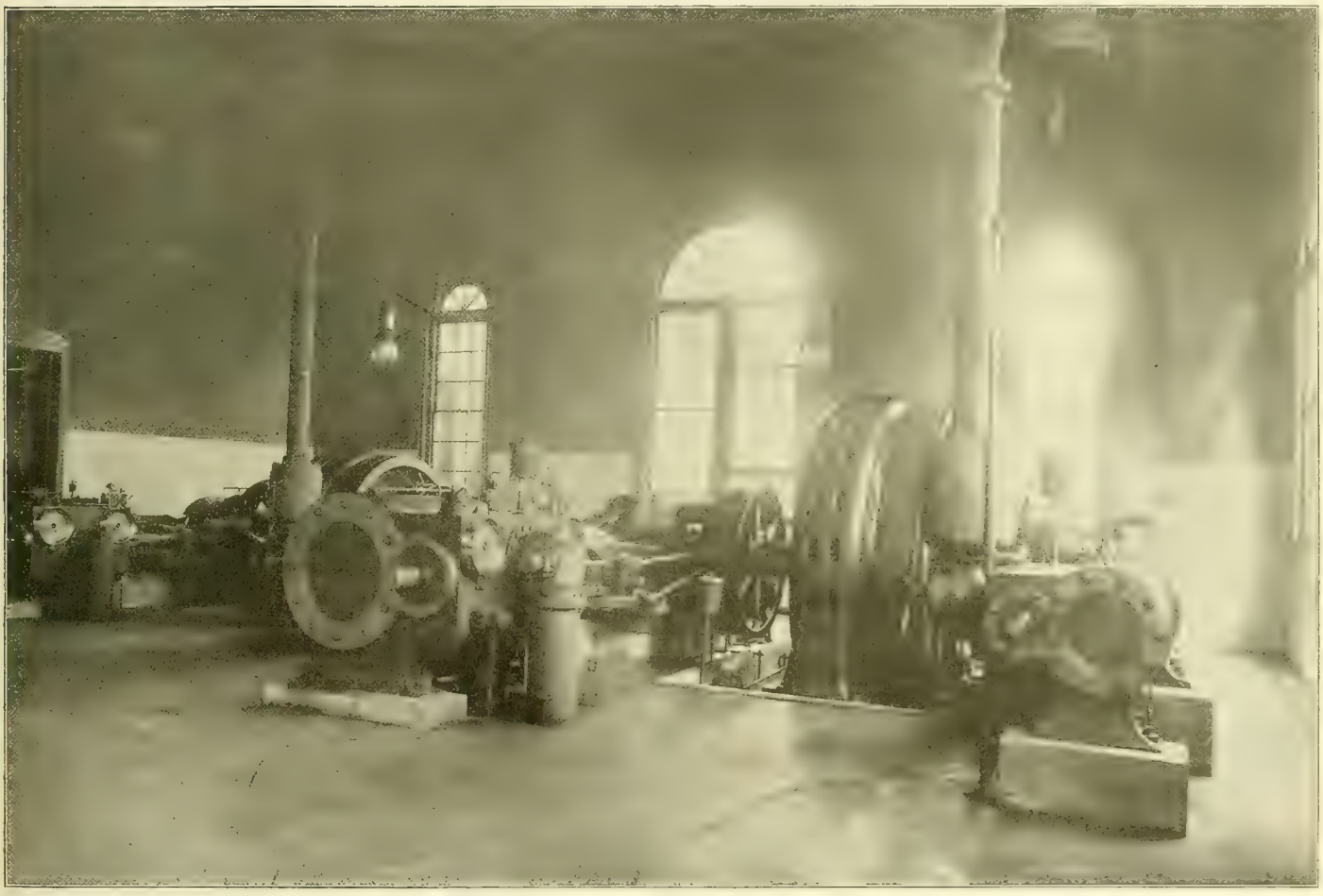


FIG. 1. SERIES ALTERNATING ENCLOSED ARC LIGHTING IN THE UNION STOCK YARDS. THE TWO GENERATING UNITS

justed to a position where it balances that portion of the weight of the coils which is not lifted by the attractive force, so that the weight of the coils constitutes the retractile agency operating in opposition to the pull. The multivoltage type, such as is illustrated in the picture, is built to permit of the operation of two circuits from the same regulator.

One of the arc lamps used in this installation is shown in Fig. 5. These lamps are supplied with a tubular guide and shield for the upper carbon holder. The carbon holder slides freely within the square

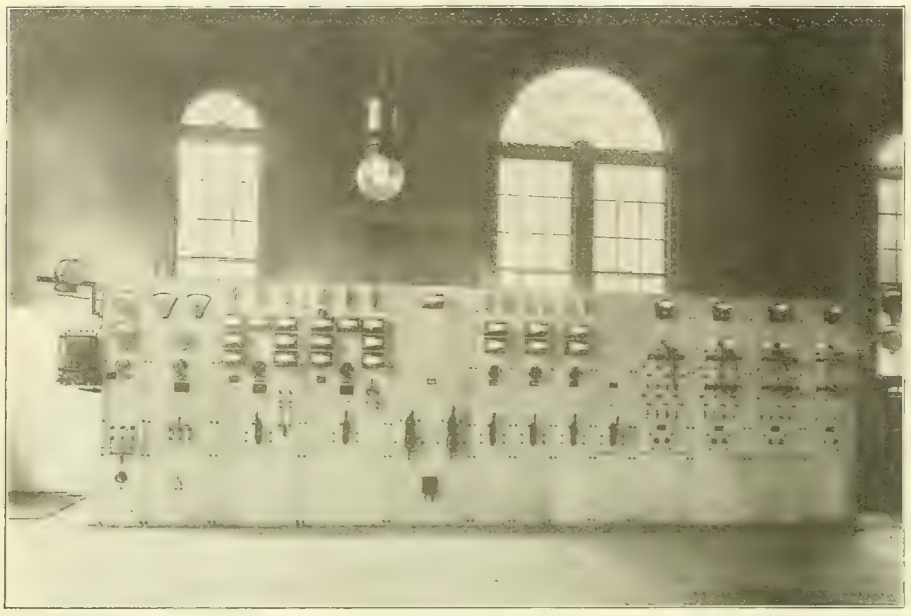


FIG. 2 SERIES ALTERNATING ENCLOSED ARC LIGHTING IN THE UNION STOCK YARDS.—THIRTEEN-PANEL SWITCHBOARD.

tube and is positively connected in circuit by means of a folding copper ribbon, which eliminates sliding and rolling contacts for carrying current. The lamp stands cut out when not in operation and the cut-out mechanism acts automatically to open when the circuit is established, but if for any reason the carbon is not fed downward as consumed, it cuts the arc out, substituting a small starting resistance in its place. The shade is of metal, 22 inches in diameter, enameled white on the inside and black on the outside. This shade is fastened to a ring rigidly attached to the lamp and need not be removed in trimming. The outer globe is spring-suspended from a ring detachable from the metal shade ring. These lamps absorb 72 volts at the arc, 76 volts at the terminals, and a total of 86 volts each, including line and regulator loss, which brings the total drop for 100 lamps up to the 8,600 volts of the transformer secondary pressure. The current is seven amperes.

The consulting engineer in charge of the installing work was George M. Brill of Chicago. A. G. Leonard is general manager of the Union Stock Yard and Transit Company.

Cable-cutting History.

Discussing the possible effect of the Russo-Japanese war on the submarine telegraph cables of the Far East the London Electrician gives some interesting information in relation to the aftermath of the cable-cutting during the recent Spanish-American war. It says: "During the Spanish-American war possession was taken by the Americans of certain cables belonging to the Cuba Submarine Telegraph Company. These cables landed within the area covered by the war. The Cuba Subamrine company, although it received the support of the Foreign Office and of the late President McKinley, has so far not only failed to obtain any compensation (£8,174 was claimed as the cost of repair), but the subsidy of about £2,000 per annum which it previously received from the Spanish government toward the working and maintenance of the coast cables around Cuba, has not yet been resumed by the United States or Cuban government, and is five years in arrear. The Senate authorized the payment of the £8,174, but this was not passed by the House of Representatives. The matter is still open, and we trust that the company will receive fair treatment, for the claim is a moderate one, and, moreover, the indirect damage to the company's property during the war was considerable. The Eastern Extension company's cable at Manila was also cut by the Americans, and the actual cost of the repair was claimed at the conclusion of the war, but this company also is still awaiting the decision of the United States government."

Radium and Other Radio-active Substances.

William J. Hammer of New York gave an interesting lecture on radium and radio-activity before a large and enthusiastic audience at the Central Presbyterian Church, Denver, a couple of weeks ago. The lecture was under the auspices of the Colorado Scientific Society and was attended by numerous professional men, with a liberal sprinkling of ladies. It was illustrated by many beautiful experiments.

In beginning his lecture Mr. Hammer stated that in his opinion radium is likely to teach more about the ultimate construction of matter than any discovery since the beginning of the world. He traced the investigation of radio-active substances from Roentgen's discovery of the X-rays in 1895 down to the present day, showing how Professor Becquerel of Paris, in 1896, discovered uranium-rays or "Becquerel rays," through the accidental exposure of a photographic plate to the double sulphide of potassium and uranium in a dark drawer; how in 1890 Professor and Mme. Curie discovered polonium in pitchblende, and in the same year made radium known to the world, through continued investigations of this same pitchblende.

Radio-active substances require no stimulation. Radium manufactured in the dark and kept out of the light is active from the moment of its birth. Mr. Hammer then showed a piece of Colorado pitchblende, which he said was the finest specimen he had ever seen, and dwelt upon the importance of being able to secure pitchblende in this country, as the Austrian and Bohemian governments are shortly to prohibit its sale to French and probably other foreign experimenters. Pitchblende is technically known as uraninite and is found in rather small quantities in various parts of the world, and for some years valuable uranium products have been regularly thrown away by unsuspecting investigators. Radium rays pass through glass, iron and pretty much everything, although with different degrees of absorption.

Polonium is allied with bismuth and radium with barium in its chemical characteristics. The pitchblende used by the Curies in the discovery of polonium gave rays four times as strong as the original rays of Becquerel, obtained from uranium. In 1899 traces of another element called actinium were seen, but, thus far, not enough of this substance has been obtained to secure a good spectrum, so its identity remains in doubt. Pitchblende is remarkable for the number of radio-active materials it contains, such as uranium, polonium, radium, tellurium, actinium, etc. The oxide of thorium, used in Welsbach mantles, is radio-active, and if crushed and placed near a photographic plate it will affect it.

Radium is a metal, but it is not made in the metallic form because it is very unstable. It is usually prepared in the form of a chloride or bromide. The most delicate investigations show absolutely no loss in weight, although it is believed that the radiations go on for ages, throwing off particles of matter at half the speed of light—a velocity of 93,000 miles per second. In appearance it resembles common white salt, and, owing to its action on glass, it is sometimes mistaken in color, and said to be brownish or yellow. It would take 5,000 tons of uranium residues to produce a kilogram of radium, and as it costs $2,000 a ton to refine it, it is easy to see where the high price comes in. Professor J. J. Thomson says that there is more gold in sea water than there is radium in pitchblende. The present process of extracting radium from pitchblende takes about a month and requires a most expert chemist for success. A detailed account of this process is given in Mme. Curie's thesis. Radium has been proved to be an entirely new element. Its atomic weight is 225. Professor Curie has in his possession the only chemically pure specimen in the world. The present cost of radium is about $6,000 a gram, or $2,721,500 a pound. In the last six months the price has gone up 10 times.

The rays given off by radium are classified as α, β and γ rays. The α rays constitute 99 per cent of these and are positively charged, electrically speaking. Rutherford of Montreal has succeeded in deflecting these rays in part. The β rays are negatively charged, and will affect a photographic plate through a block of iron a foot thick. These rays are readily deflected by a magnet.

Lord Kelvin states that the smallest particle visible in modern microscopes contains about 20,000,000 atoms. Up to recently the hydrogen atom was the smallest known substance in the scientific world, but an atom is now recognized as being a very complicated affair. The mass, electric charge and velocity of particles a thousand times smaller than an atom have been measured.

The lecturer then performed a beautiful experiment with cathode rays, bending them, by means of a large horseshoe permanent magnet, and stated that they are very similar to the β rays emanating from radium.

Radium makes every surrounding substance radio-active and produces many chemical changes, transforming oxygen to ozone, etc. It makes air an electrical conductor, and by this property it is measured. The electrical method of measurement is far more sensitive than spectrum analysis, and a million times more sensitive than any chemical method. The power of radium is determined by the use of a gold-leaf electroscope, which is charged with electricity, and then subjected to the influence of the radium in question, without actual contact. The radium makes the surrounding air a conductor, and the gold-leaf electroscope discharges. The power of radium is a function of the time required for the discharge. A specimen of 300,000 radio-activity is thus 300,000 times as powerful as the original rays discovered by Becquerel in his studies of uranium. After a storm the rain and snow have been found to be radio-active, and it is believed that all substances are more or less so. Professor Dewar has shown that the waters of various mineral springs at Bath, England, are powerfully radio-active, and Mr. Hammer stated that he had himself suggested that the valuable properties of various medicinal springs in this country might be due to radio-activity.

The physiological effects of radium are very powerful. If the substance is allowed to act on the human body in certain ways it produces terrible ulcers. No effect is noticeable for about two weeks. Professor Curie received a painful ulcer from a small bit of

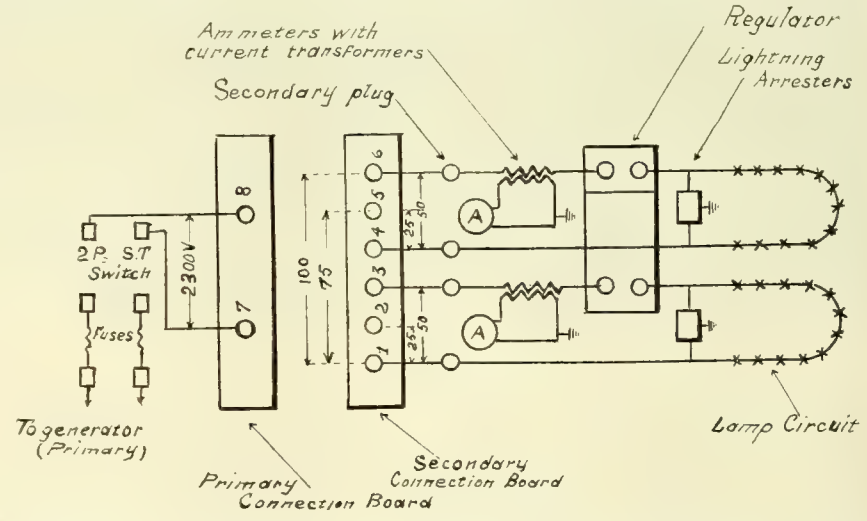


FIG. 4. SERIES ALTERNATING ENCLOSED ARC LIGHTING IN THE UNION STOCK YARDS.—DIAGRAM OF CONNECTIONS.

radium of 7,000 activity which rested 1½ hours on his coat sleeve, and a five-minute contact of a stronger specimen with the back of his hand turned the flesh raw. There is little doubt that radium is going to be of importance in the treatment of stubborn internal disease, for its effect on various bacteria is most powerfully destructive. Experiments in the way of making liquids radio-active are most encouraging in their results, and it has been suggested that the exposure of medicines to radium may be followed with still more successful treatment of diseases. Possibilities in the line of cataphoresis, the treatment of cancer, external or skin tuberculosis, and perhaps internal malignant diseases opens up a wonderfully interesting field of investigation. Mice closely exposed to

FIG. 3. SERIES ALTERNATING ENCLOSED ARC LIGHTING IN THE UNION STOCK YARDS. TRANSFORMERS WITH REGULATORS MOUNTED.

radium lose their hair, while rabbits, less closely exposed, gain a growth of long silky hair; tadpoles, exposed shortly after birth, become monstrosities, with lungs in their backs, while the development of cocoons is checked.

Another use of radium is as a test of the genuineness of diamonds. Real diamonds phosphoresce brilliantly in a dark room when exposed to radium. Some day radium may become an important illuminating agent. It continuously gives off heat without loss in weight at a temperature of five or six degrees Fahrenheit above its surroundings. This is one of the most extraordinary properties yet discovered. Professor Becquerel states that one square centimeter of surface covered with chemically pure radium might lose 0.001 milligram in 1,000,000 years time.

Mr. Hammer then spoke of the gaseous emanations from radium, outlining briefly Ramsay's experiment with helium, when the spectrum of gas emanating from radium was found to be marked with helium lines, which grew stronger and stronger, until the lines became all helium. Ramsay then witnessed the transmutation of metals.

The luminosity of radium is about zero. The impurities in it are stimulated by the radiations, so that the most impure samples glow the strongest. The spinthariscope of Professor Crookes was then exhibited. It consists of a small tube fitted at one end with a microscope, and at the other with a small screen of zincblende. Near the zincblende is an adjustable pointer carrying 0.05 grain of radium bromide of 300,000 activity. Upon looking through the miscroscope the phosphorescence of the zincblende under the terrific bombardment of radium, "corpuscles" or rays, as the case may be, presents the beautiful appearance of a sky filled with exquisite shooting stars. The lecturer closed by referring to the two principal theories of radio-activity now held by the scientific world. One of these is that radium is a sort of energy transformer with peculiar relations to the ether; that a disintegration is going on which changes matter into simpler forms. The other theory holds that the energy given out is present in the radium itself, and is continually yielded up without sensible loss of material. Lord Kelvin has said that the discovery of radio-activity has placed the first question mark against the long-accepted principle of the conservation of energy. Through radium we may perhaps finally learn what gravitation is. Despite the apparent contradictions, the ablest scientific minds lean toward the second theory, and the future doubtless has in store many remarkable discoveries in connection with this modern philosopher's stone—radium.

N-rays Given Off by the Human Body.

That the human body possesses the power to give off N-rays is upheld by such authorities as Charpentier, Dr. Hugh Walsham and Leslie Miller. These scientists have performed experiments which seem to prove this without a doubt.

These emanations from the human body and their effect upon a fluorescent screen were first observed by Charpentier while studying Blondlot rays, or the so-called N-rays.

When certain conditions are observed there is no difficulty in obtaining confirmation of Charpentier's observations, and the most satisfactory procedure is as follows: Screens are prepared with hexagonal zincblende, which is placed in form of a thin film on paper, goldbeaters' skin, or celluloid. The screen is excited by exposing it to ultra-violet rays of sunlight, or, better still, to a magnesium light. The fluorescent light of the screen is then allowed to die away until it has reached the steady stage. At this point, if the muscle in a state of contraction, as, for example, the contracting abductor and abductor pollicis of the thumb, be placed underneath the fluorescent screen the latter will be seen to brighten perceptibly.

Charpentier, however, not satisfied with this, has gone one step farther, and seems to have proved that the brain and nerve centers not only give off N-rays, but also a new form of emanation which is peculiar to them. The N-rays will pass through an aluminum screen, while these new rays will not.

The latter discovery was made in experimenting with N-ray emanations from the brain and spinal cord. To explore the rays, Charpentier uses straight tubes of lead, from two to four inches long, one end being placed against the body and the other, containing a small disk of cork or cardboard covered with the phosphorescent sulphide. Large screens cannot be used, as each part is influenced by the others, and the whole gives a uniform brightness when the rays fall upon it. One of the most interesting experiments is made upon the brain, by localizing the different centers of its surface. For instance, the so-called psycho-motor zones of the brain surface should, according to these experiments, show a local emission of N-rays during their special activity. This was found true for some of the best-defined zones. Among the latter is the zone which was found by Broca to be the center for articulate speech. Its projection upon the skull has been determined with a certain precision by recognized rules. Charpentier found that when the subject spoke with a loud voice, or even in less degree, the proof-screen showed a greater activity in this region. He has reason to believe that even the action of thought, attention, and other mental effort gives rise to an increased emission of the N-rays from the brain, and is now making observations on this point. The same effect was found in the case of other centers allotted to the act of writing, movements of the upper members, etc. The conclusion is that a nervous center increases its emission of N-rays when in a state of activity. These rays are transmitted by divergence according to optical laws. They are refracted more or less by different media and are manifested by an increase of brightness in the proof-screen, which is variable according to the intensity of the emission and the distance.

In making these observations Charpentier discovered what is apparently a new emanation from the brain and nerve centers, the striking characteristic of which is the fact that it will not easily penetrate an aluminum screen. A sheet 0.02 of an inch thick is sufficient to cut down considerably the rays emitted by a point of the brain. The portion of the rays which passes through the screen is no longer cut off by new screens of the same metal, even an inch thick. This latter part, therefore, consists of N-rays proper. On the contrary, the rays from the heart, diaphragm and the different muscles are scarcely modified by the aluminum screen. This forms a characteristic distinction between the muscular and the nerve radiations.

Is Electrical Apparatus Contraband of War?

The naval war between Russia and Japan naturally turns our thoughts to the question, whether and how far the commercial relationship of this country to the belligerent states is likely to be affected. So far as peaceful commerce is concerned this will probably continue as usual. At the same time English manufacturers must needs consider whether the commodities which they are forwarding to Japanese or Russian ports are likely to be intercepted and detained as contraband of war. It is obvious to everyone—even to those who have never had to consider questions of international law—that the muniments of war must not be supplied to either belligerent by the citizens of any neutral state. As it would obviously be beyond the power of the neutral government to restrain its subjects from infringing this rule, a rude method of enforcing it is prescribed by international law, the rules of which provide that any ship suspected of having contraband of war on board may be held up, and that, if no satisfactory statement is made as to the cargo which she carries, she may be searched. But, it may be asked, of what interest is all this to the electrical world? The answer is supplied when we consider what is to be included in the term contraband of war. Owing to the fact that modern naval warfare between first-class powers is a rare occurrence, the definition of what is contraband has not been properly kept up to date. A definition which was given in the "Admiralty Manual" is wholly inapplicable to naval warfare in the twentieth century. That definition of contraband included only the muniments of war strictly so-called, and it referred to a number of other articles which might, if specially consigned to the enemy, be deemed contraband. At the present day, however, the list of articles provisionally contraband will be considerably extended, and extended along lines which

FIG. 5. ALTERNATING ENCLOSED ARC LAMP USED AT UNION STOCK YARDS.

closely affect the interests of electrical engineers. The dynamo, the motor, the searchlight have all become part and parcel of the essential machinery of a modern battleship, and will probably be required to be kept at the naval base of a belligerent power in time of war. It has, of course, not been decided that such things are contraband, but we firmly believe that the first opportunity would be taken to decide the point. In these circumstances it will be well for every manufacturer who is consigning machinery of this class to Russian or Japanese ports in Far Eastern waters to have a care that they are not consigned directly to the government of either country, for if that course is adopted, and the ship is stopped by a warship of a belligerent, it is unlikely that the goods will ever reach their destination.—Electrical Review (London).

The electric-light plant to be built at Baton Rouge, La., by C. H. Kretz is to have three units and will produce 120 kilowatts at 220 volts.

Single-phase Railroads.[1]

By W. A. Blanck.

In perhaps no line of electrical industry has there been greater activity than in that of interurban-railroad construction, until, at the present time, not only throughout the whole United States, but particularly in the central states, this development has reached a magnitude entirely beyond the expectations of the most sanguine persons a decade since. In fact, this development has gone so far that in some sections most of the best propositions are already exploited; however, there are still a great many, which, while of doubtful value with the present direct-current system, involving the use of rotary-converter substation and low-trolley voltage, will be very profitable in case a system can be developed which will materially reduce the cost per mile. For some time the perfection of a single-phase motor has been suggested as the solution of this problem, since it allows great reduction in the cost of the transmission system.

The present activity in the evolution of the single-phase railway motor gives added interest to the problem of developing and perfecting all details of the single-phase system.

Consideration of the fundamental characteristics of the motors, some details in the construction of the line, and the noticeable decrease in the costs of a typical road with high-voltage trolley and static transformer stations in the single-phase railway system, will form the subject of this paper.

The first vital question which arises is the development of a single-phase alternating-current motor which will operate satisfactorily under the conditions imposed by railroad service. The importance of this problem was early recognized, and its solution has been the aim of many of the ablest engineers both here and abroad.

While the attention given by the technical press to this subject has familiarized all with the single-phase motor, a short account of the present state of the art will not be out of place.

Synchronous Motor.—Since the synchronous motor requires a separately excited field, has no starting torque, and cannot be run at variable speed, its direct application in railway traction is impossible. It has, therefore, been proposed by Ward Leonard to use the synchronous motor in combination with a direct-current generator, the latter to furnish direct current to the standard axle motors, as shown in Fig. 1, which has been lettered so as to be self-explanatory.

Induction Motor.—The induction motor shows the same peculiarities in respect to starting and speed control as the synchronous motor, but to overcome these Bion J. Arnold proposes a suitable combination of the induction motor with a mechanical storage battery, consisting of an air compressor and tank. The various members of this combination are indicated in Fig. 2. In this system both parts of the motor are free to rotate and maintain a constant relative speed. The rotor is geared to the axle and also connected to one air cylinder. The stator is connected to a second air cylinder, in which air is being compressed when the car is running at less than full speed. With the car running at full speed the stator is at rest and no compression work done. By admitting air to this cylinder and rotating the stator in the same direction as the rotor the car can be run with over synchronous speed. This combination with the induction motor continually running makes it possible to store energy when the car is coasting or stopped and to utilize this energy during acceleration. It is further seen that this system allows the operation of the car by compressed air for a limited period in case it is desirable to run without overhead conductor.

Series Motor.—The alternating-current series motor, as proposed by Lamme and Finzi, manufactured by the Westinghouse company, possesses all the characteristics of a direct-current series motor, and is, therefore, directly applicable to railroad work. As shown in Fig. 3, the current passes in series through the field and armature, which latter is similar to the ordinary direct-current drum-type armature with commutator. As the direction of rotation in the ordinary direct-current motor is not dependent on the direction of the current, it is seen that it will operate with alternating as well as with direct current.

Since the series-commutator motor cannot be operated at high voltage, it is necessary to use a step-down transformer in connection with a high-tension trolley, thus increasing the weight of the car equipment.

Repulsion Induction Motor.—The repulsion induction motor developed by Steinmetz and Schüler, manufactured by the General Electric Company, shows in general the same performance as the straight series motor and can be fed directly from the high-tension trolley, since, as it is indicated in Fig. 4, the armature is independent of the field. The current is induced in the armature by transformer action and can be of any desired voltage. The brushes are short-circuited and placed at such angle as will give best running conditions.

Repulsion Series Motors.—The repulsion series motor developed by Winter-Eichberg and built by the Union Electric Company, Berlin, Germany, is similar to the repulsion inductor motor with the addition of a second set of brushes, displaced 90 degrees from the short-circuited brushes, as shown in Fig. 5. Through these brushes current is supplied by a series transformer for the purpose of decreasing the sparking at less than synchronous speed and at the same time securing the important additional advantages of raising the power factor nearly to unity.

Controllers.—In general the operation of the last three motor systems is effected by master controllers operating suitable contactors to get the desired combinations. Induction regulators are used in all three cases to secure the voltage variation necessary for speed control, thus avoiding the losses consequent to the rheostatic control of the direct-current system.

Car Wiring.—In order to protect passengers and crew from the high potential used in this system it is necessary that the wiring should be done in metallic conduit; this should be connected to the trucks so that any defect in the insulation of the circuit will result in the tripping of the automatic circuit breaker in the car. Moreover, it will be necessary to insulate the steps and handrails to guard the passengers from shocks which might result from wet weather or car standing on a dirty rail.

Trolley Bow.—With the high-tension working conductor it is necessary to provide against any possible short-circuiting of the trolley and its suspensions. On account of the serious results which would follow the slipping of the trolley pole, so common in the present system, a suitable bow must be used instead.

The bow should be of such length that no manipulation will be necessary in reversing the car. This trolley bow is mounted on a well-insulated platform on the roof of the car, which also supports the springs necessary to maintain the requisite pressure between the bow and the trolley wire. A small air cylinder, mounted on the same platform, operated by compressed air from the brake system, should be so connected as to lay the bow flat on the roof of the car, in case the necessity arises to temporarily disconnect the bow from the trolley.

The contact part of the bow can be made either of soft copper or aluminum and the necessary lubrication is accomplished by grease applied in a slot extending the length of the bow.

The bow trolley in use on the Valtellina road in Northern Italy, with a working pressure of 3,000 volts, consists of copper cylinders rolling in insulated ball bearings. Brushes take the current from these revolving cylinders to the steel tubes carrying the contact piece.

Trolley-line Construction.—Great care must be given to the construction of the high-tension trolley line in order to avoid damages to life and property. Notwithstanding the prevalent idea that the danger

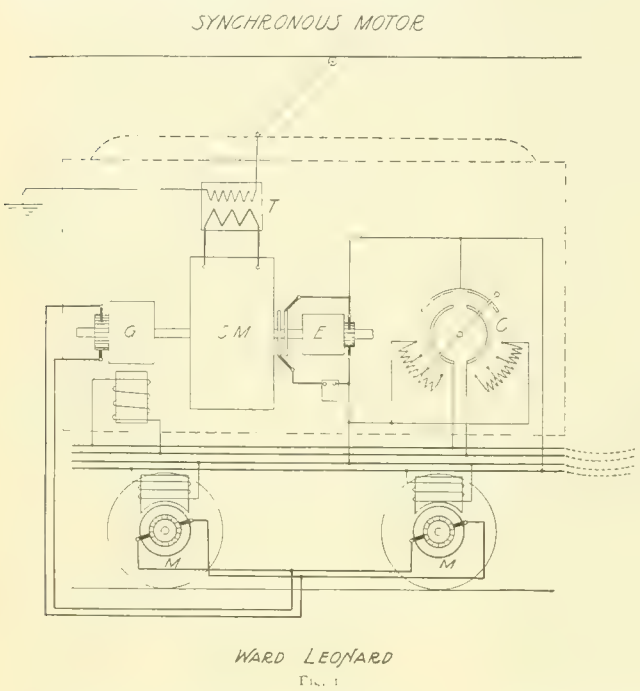


Fig. 1

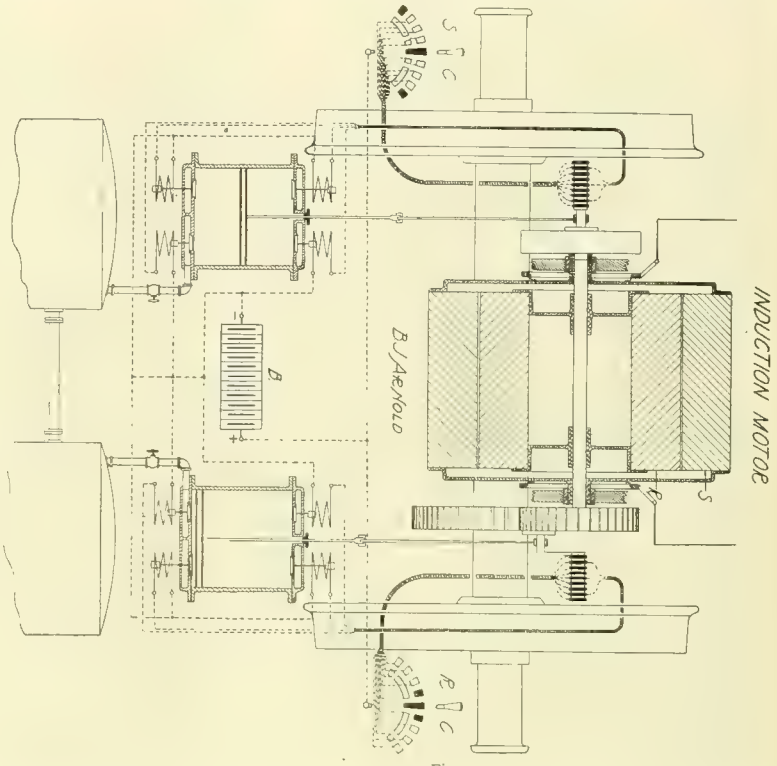


Fig. 2.

SINGLE-PHASE RAILROADS.

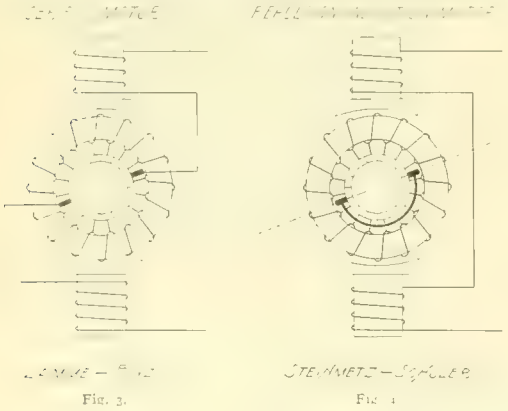


Fig. 3.

Fig. 4

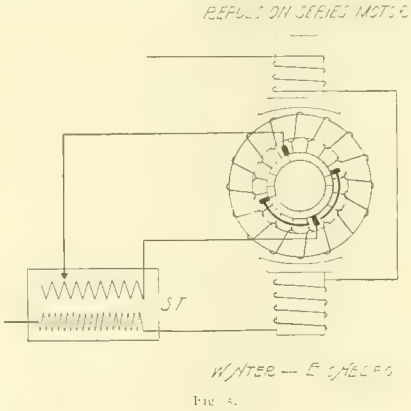


Fig. 5.

SINGLE-PHASE RAILROADS.

1 A paper read before the Cincinnati branch of the American Institute of Electrical Engineers February 18, 1904.

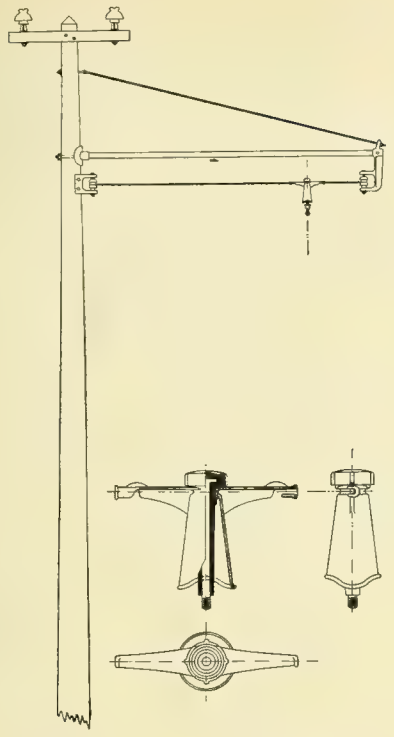


FIG. 6. VALTELLINA TROLLEY-LINE CONSTRUCTION.

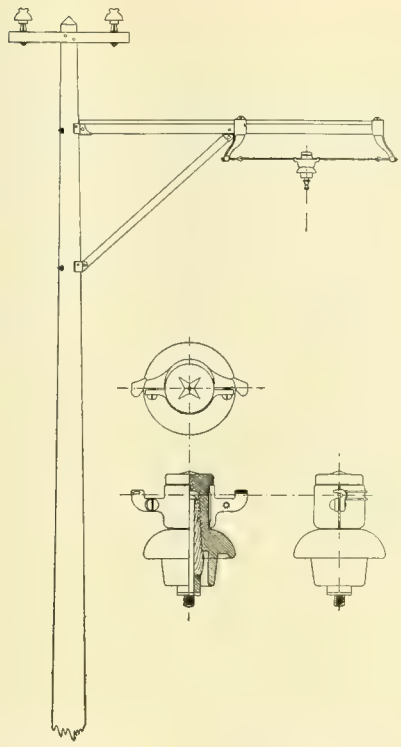


FIG. 7. LANSING-ST. JOHN TROLLEY-LINE CONSTRUCTION.

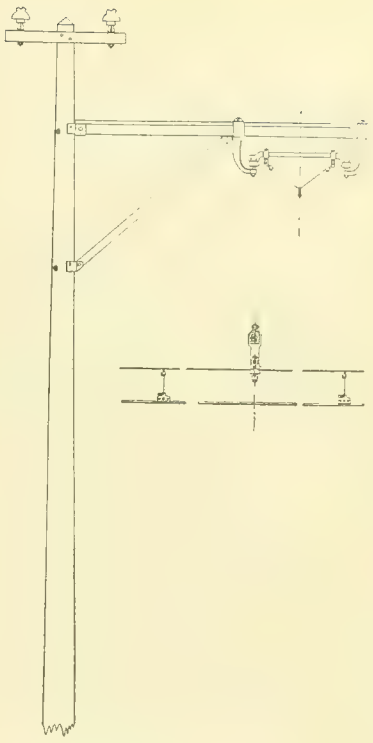


FIG. 8. PROPOSED OVERHEAD CONSTRUCTION.

of these high-tension trolleys will handicap the development of alternating-current railroads operated over public property, there is no reason why they should not be made as safe as the high-tension distributing systems of lighting companies now so common on public property.

It is of first importance to provide such a hanger as shall readily withstand the working pressure of the system and can be easily replaced in case of mechanical or electrical defect.

Fig. 6 shows a trolley-line construction with hangers similar to that used on the Valtellina railroad. The bolt carrying the trolley clamp is surrounded by an insulating compound, called amborine, and set into a malleable iron bell provided with clamp arms to secure it to the span wire. A cast-iron cap-screw holds the insulated bolt firmly in place.

Another construction, used on the Lansing-St. Johns road in Michigan, is shown in Fig. 7. The hanger consists here of a special high-tension glass insulator fastened to the span wire in the usual

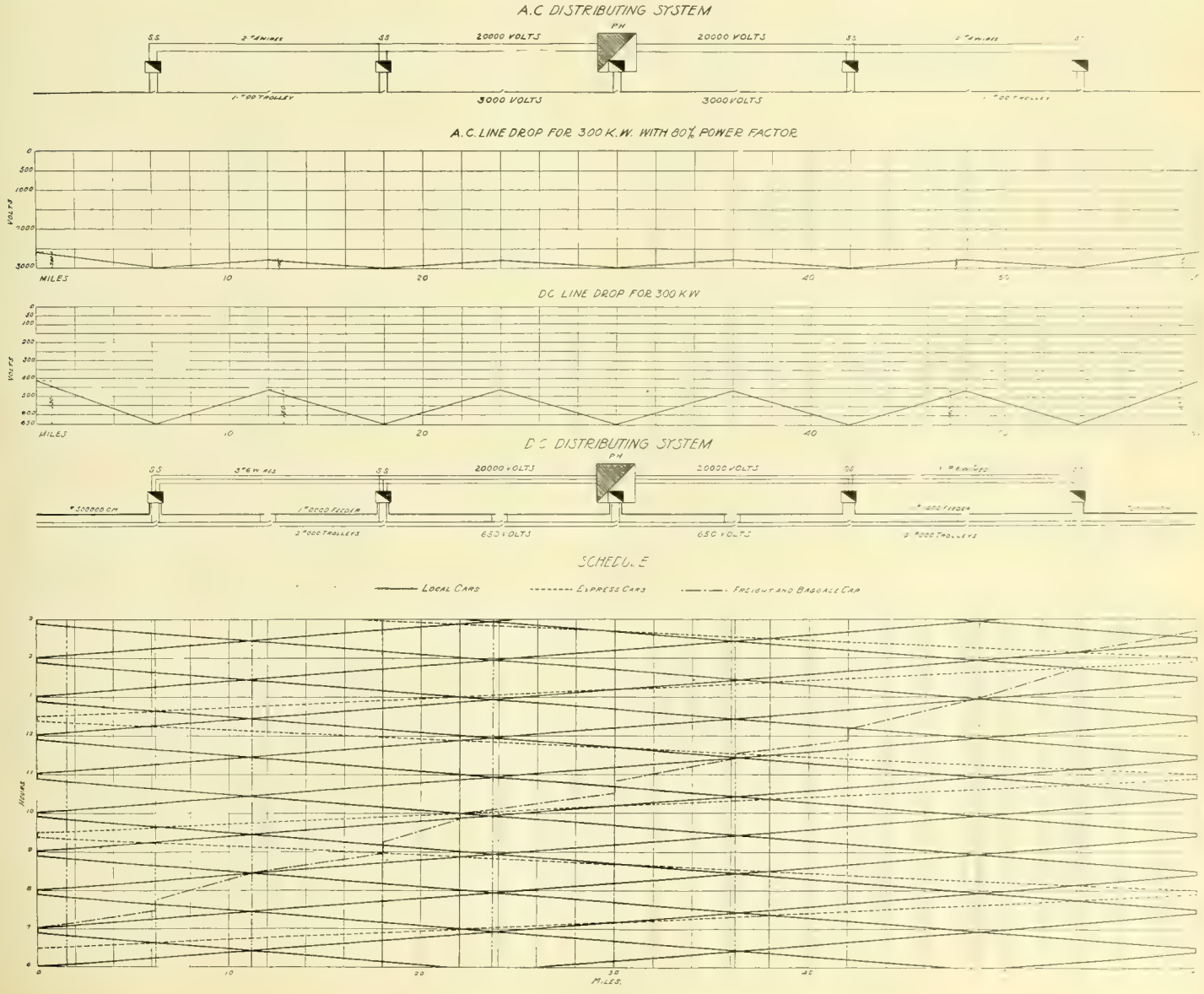


FIG. 9. SINGLE-PHASE RAILROADS. DIAGRAMS COMPARING D. C. AND A. C. SYSTEMS.

way. The working conductor is carried by an iron pin inserted in a wooden sleeve, on which a thread is turned to fit the glass of the insulator. A thin lead bushing allows the insulator to be firmly clamped by the malleable iron supports, thus preventing the hanger from jarring loose.

If the road passes along a public highway, special precautions should be taken to avoid accident. One solution is shown in Fig. 8, in which the working conductor is suspended at intervals of about 10 feet from two steel wires. In case of mechanical break in the trolley wire it is evident that the end cannot reach the ground or injure passers-by. It might be noted in passing that this construction increases the carrying capacity of the trolley with but slightly greater investment.

A construction somewhat similar to this is in use on the single-phase railroad near Berlin.

In regard to rail return, it may be said that, with the proposed frequency of 25 cycles per second and the small current required with the higher voltage, this portion of loss will be even smaller than in direct-current work, so that for normal interurban service it will be sufficient to bond only one rail. This has the advantage greatly to be desired in many cases of leaving the other rail free for the purpose of block signals. Furthermore, the evils of electrolysis are completely avoided with the alternating-current system.

Comparison of Alternating-current and Direct-current Systems.

In order to consider more in detail the relative merits of the alternating-current and direct-current systems of distribution, parallel computations and diagrams may be made for the case of a 60-mile single-track interurban road. We will assume the power house to be located at the center of the line and to contain one sub-station, and that the four remaining sub-stations are located at equal intervals on the line, as shown in Fig. 9.

Although the alternating-current system would not require sub-stations at so frequent intervals, they are retained, as in the direct-current system, on account of the advantage to be derived from the sectionalizing of the line and the more advantageous distribution of power due to the larger number of feeding points.

The schedule proposed, as shown in the diagram, consists of five local cars having one hour headway, one express car making the round trip in three hours, and one freight and baggage car making the trip between the two terminals in about eight hours.

The average power required by the various cars in kilowatts will be as follows:

	Weight in Tons.	Schedule Speed in M. P. H.	Watt Hours per Ton-mile.	K. W. Hours per Trip.	Average Power in K. W.
Local car	30	25	80	144	60
Express car	35	25	80	231	165
Freight car	—	—	—	110	25

With the schedule outlined above the average load on all five sub-stations will be about 500 kilowatts, or 100 kilowatts per sub-station, while the maximum load per sub-station under certain conditions is 450 kilowatts, as when, for instance, the case arises that the express car is starting and two locals are running in one section. With a proper momentary overload allowance this assumed condition will require one 300-kilowatt rotary converter per sub-station to be installed in the direct-current system. In the alternating-current system, however, a static transformer of 200-kilowatt capacity per sub-station will be ample.

The maximum load at the power house will be 800 kilowatts, and two 400-kilowatt units will suffice, if for the purpose of this comparative study no reserve capacity be provided either in power house or sub-stations.

Some idea of the relative simplicity of the transmission systems in the two cases may be obtained from the consideration of the accompanying wiring diagram (Fig. 10), showing the apparatus and connections required in each case. In both cases step-up transformers raise the total generator output to the high-transmission voltage and a step-down transformer set is placed in the power house. Although the power-house sub-station could take its supply directly from the generators, it was preferred to use one general form for all sub-stations and thus avoid special switch arrangements.

For the three-phase transmission lines of the direct-current railroad system three No. 6 wires are assumed, and for the single-phase transmission line two No. 4 wires, costing respectively $10,000 and $11,500.

The proportions of the distributing system have been worked out along the following lines: For the direct-current system it was assumed the maximum drop of a car starting at its maximum distance from sub-stations should be approximately 200 volts, or about 30 per cent. This will be accomplished by installing two No. 000 trolleys and No. 0000-feeder capacity between sub-stations and 500,000-circular-mils feeder for the stub ends. The cost of the copper under these conditions will be about $95,000. For the alternating-current system the size of the trolley has been determined rather from mechanical than from electrical considerations. A No. 00 grooved trolley has been assumed installed throughout the length of the line, since for this class of service it is not practical to use smaller sizes. The cost of the copper in this case will be $21,500.

In determining the drop for this system 80-per cent. power factor has been assumed, and it will be noted that the maximum drop under the same conditions as above mentioned will be 190 volts between sub-stations, or 6.25 per cent., and 380 volts on stub ends, or 12.5 per cent., showing a very considerable advantage in favor of this system.

As to the motor equipment in the two systems, at present the alternating-current motor weighs somewhat more than the direct-current motor and operates at a slightly lower efficiency. However, the smaller efficiency of the alternating-current motor is more than counterbalanced by the small percentage loss in the alternating-current distributing system. And, furthermore, with the rapid development now taking place in the alternating-current motor it is safe to assume that in the very near future its characteristics as to weight and efficiency will soon equal those of the direct-current motor, thus making the advantage of the alternating-current railroad system still more evident.

An idea of the relative investments for the two systems may be best obtained by arranging in parallel columns the cost of the various items, as is done below in the table: (See also diagram of Fig. 11.)

Estimated Cost of the Electrical Equipment of a 60-mile Single-track Interurban Railroad.

Power House:	D. C. System.	A. C. System.
Building	$ 10,000	$ 10,000
Foundations	2,500	2,500
Boilers and settings	12,000	12,000
Steam piping and covering	7,500	7,500
Engines	22,000	22,000
Exciters	1,000	1,000
Generators, two 400-kilowatt	18,000	23,000
Step-up transformers, 800-kilowatt	8,000	7,500
Switchboard	3,500	3,000
Wiring	3,000	2,500
Feed-water heater	800	800
Pumps	800	800
Coal storage	1,000	1,000
Smokestack and flues	2,000	2,000
Fuel economizers	3,000	3,000
Stokers	3,500	3,500
Incidentals	4,400	4,400
Total	$103,000	$106,500

Sub-station in Power House:	D. C.	A. C.
Building extension	$ 1,000	$ 600
Rotary converter, 300-kilowatt	4,800	.....
Transformer, 300-kilowatt; 200-kilowatt A. C.	3,200	2,000
Switchboard	2,000	1,300
Wiring	1,000	500
Incidentals	600	200
Total	$ 12,600	$ 4,600

Forty-eight-mile Transmission Line:	D. C.	A. C.
Poles charged to trolley line	.....	.....
Copper	$ 10,000	$ 11,500
Insulators, pins and cross-arms	7,500	5,000
Erection	4,000	3,000
Incidentals	1,000	1,000
Total	$ 22,500	$ 20,500

Sub-station Along the Road:	D. C.	A. C.
Building	$ 2,000	$ 1,000
Rotary converter	4,800	.....
Step-down transformers	3,200	2,000
Switchboard	2,000	1,300
Wiring	1,000	500
Incidentals	500	200
Total	$ 13,500	$ 5,000
Four sub-stations	$ 54,000	$ 20,000

— DIRECT CURRENT RAILWAY SYSTEM — — ALTERNATING CURRENT RAILWAY SYSTEM —

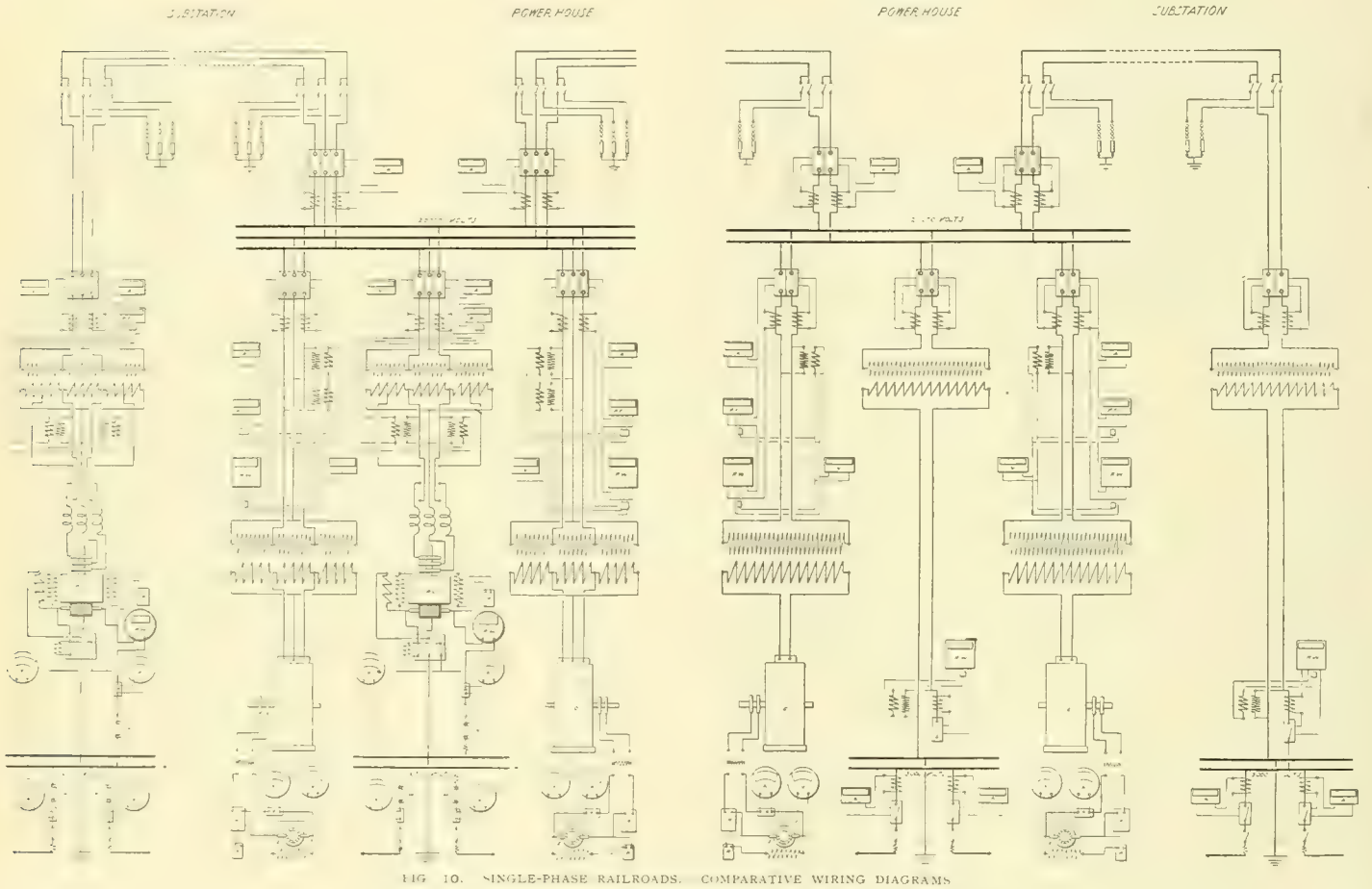


FIG. 10. SINGLE-PHASE RAILROADS. COMPARATIVE WIRING DIAGRAMS

Trolley Line and Feeder:	D. C.	A. C.
Poles, 3,500	$ 17,500	$ 17,500
Poles distributed and set	4,000	4,000
Guys and anchors	2,000	2,000
Brackets with hangers	18,000	25,000
Copper, D. C.—		
Feeder, 12 miles, 500,000 C. M. / Feeder, 48 miles, No. 0000 / Trolley, 120 miles, No. 000	95,000	.....
Copper, A. C.—		
Trolley, 60 miles, No. 00	.....	21,500
Feeder insulators	2,000	.....
Erection	10,000	4,000
Incidentals	7,500	4,000
Total	$156,000	$ 78,000

Bonding of Rails:	D. C.	A. C.
Both rails bonded	$ 30,000	.....
One rail bonded	.....	$ 15,000
Cross bonds	2,000	1,000
Total	$ 32,000	$ 16,000

Rolling Stock:		
Ten vestibuled passenger cars, each equipped with four motors and weighing about 30 tons	$ 75,000	$ 85,000
Two express passenger cars, equipped with four motors, and weighing about 35 tons	18,000	20,500
Two baggage cars, each equipped with four motors, and weighing about 30 tons	10,000	12,000
Snowplow and construction car	7,000	8,500
Total	$110,000	$126,000

RECAPITULATION.

Power house	$103,000	$106,500
Sub-station in power house	12,600	4,600
Transmission line	22,500	20,500
Sub-stations	54,000	20,000
Trolley line and feeder	156,000	78,000
Bonding	32,000	16,000
Rolling stock	110,000	126,000
Total	$490,100	$371,600
Cost per mile, D. C. system	$490,100 / 60 = $8,168	
Cost per mile, A. C. system	371,600 / 60 = 6,193	
		$1,955
The decrease of A. C. cost in terms of D. C. investment		25%
The increase of D. C. cost in terms of A. C. investment		32%

REMARKS ON THE TABLE.

It is not necessary to take up in detail all the items, as they speak for themselves, but it may be of interest to note some items in which the costs vary more widely.

The single-phase generators, as would be expected, cost nearly 30 per cent. more than three-phase generators, amounting to $5,000. Small savings on switchboard and wiring reduce the total for the power house to $3,500 in favor of the direct-current system.

For the sub-station in the power house, principally on account of saving in converter and transformer capacity, the balance is $8,000 in favor of the alternating-current system.

The transmission systems are approximately the same, there being $2,000 in favor of the alternating-current system.

In the alternating-current distributing system, while the suspension of the trolley is noticeably more expensive than in the direct-current system, on account of special insulators, the immense saving in copper gives a balance of $78,000 in favor of the alternating-current system.

The necessity of bonding but one rail effects a saving of $16,000 in favor of the alternating-current system.

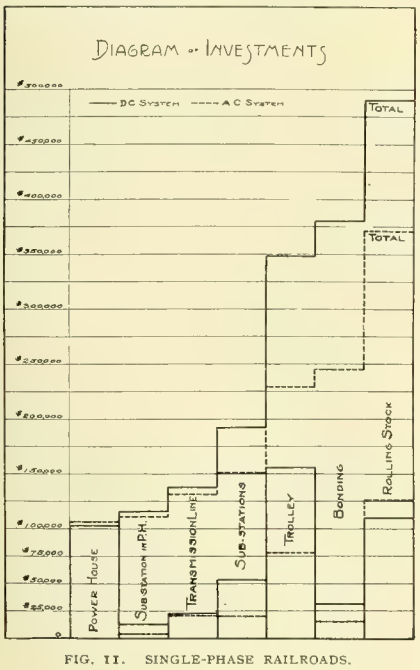


FIG. 11. SINGLE-PHASE RAILROADS.

A very liberal allowance has been made by placing the cost of the alternating-current motor equipments one-third in excess of that of the direct-current motor equipment. This, as before noted, is the present cost of alternating-current equipment, and without doubt in the near future this difference will be greatly reduced.

The sum total of the investment for the direct-current system under the assumed conditions is $490,100, while that of the alternating-current system is $371,600.

Reducing this to the cost per mile, it is found that the electrical equipment complete amounts to $8,168 for the direct-current system, and $6,193 for the alternating-current system, or a saving of $1,955 per mile in favor of the latter.

Expressed in percentage this means that the alternating-current system effects a saving of 25 per cent. of the cost of the direct-current system, or to state the relation in other words, the cost of the direct-current system is 32 per cent. more than the cost of the alternating-current system, a showing most favorable for the latter, and this indeed during the first year that this apparatus has been on the market.

With the alternating-current motor thus far perfected and the large number of propositions whose realization is conditioned by a cheaper electrical equipment, nothing can hinder the very wide adoption of this system.

Ohio Interurban Railroad Association.

The Ohio Interurban Railroad Association was organized at a meeting of prominent electric-railway men at Dayton recently. The officers elected are as follows: President, H. P. Clegg, of the Dayton and Troy road; vice-president, D. C. Spring, of the Dayton, Covington and Piqua line; secretary and treasurer, J. H. Merrill, of the Western Ohio system. The executive committee consists of Messrs. Gunn, of the Dayton, Springfield and Urbana; U. Boyer, of the Cincinnati, Dayton and Toledo; R. N. DeWeese, of the Dayton and Northern; Howard Frovell, of the Dayton and Western, and Anderson, of the Dayton and Xenia. The organization was formed for the purpose of looking after matters of common interest and embraces the lines in Ohio and Eastern Indiana. The most important subject discussed was the issue of an interchangeable mileage book. A committee was appointed to report on the subject. The association is expected to be of great benefit to the roads now operating in the two states.

Allis-Chalmers Plans.

That the Allis-Chalmers Company will cut a wide swath in the electrical field is becoming increasingly evident. The recent official announcement of Vice-president W. J. Chalmers that the company is to manufacture electrical machinery is now further supplemented by a statement that a sales combination has been effected between the Bullock Electric Manufacturing Company and the Allis-Chalmers Company. A report has been in circulation that a consolidation of the two interests had been effected, but this has not been confirmed. It may, however, be stated from information gained at the office of the Allis-Chalmers Company that an important deal, involving at least, as stated, a comprehensive sales combination, has been effected. The Wagner Electric Manufacturing Company, heretofore allied with the Bullock company, it is announced is not included in the deal.

Another item of news of more or less significance is the intimation in Milwaukee that B. H. Warren, former vice-president of the Westinghouse Electric and Manufacturing Company of Pittsburg, will probably succeed Charles Allis as president of the Allis-Chalmers Company. Apparently reliable authority is to be had for the statement that there will be a reorganization of the board of directors and that Mr. Allis will no doubt remain to represent the western interests, and act as treasurer.

Alternating-current Railway Motors Discussed at Chicago Institute Meeting.

The Chicago branch of the American Institute of Electrical Engineers met on March 8th for the discussion of the alternating-current motor for railway work, as set forth by the paper of Charles P. Steinmetz, read at the New York Institute meeting on January 29th, entitled "Alternating-current Railway Motors" (Western Electrician, February 6th). President Bion J. Arnold called the meeting to order. The small assembly room of the Western Society of Engineers was taxed to its utmost, there being at least 150 members and visitors present. President Arnold said a few words in regard to the present outlook for alternating current in street-railway work and its future possibilities. George A. Damon then briefly abstracted the Steinmetz paper and New York discussion, bringing out the main points for the refreshment of the memory of those present. Clarence Renshaw then gave an exceedingly clear and concise description of the two leading types of alternating-current motors, the straight series type and the transformer series type, making plain the advantages and disadvantages of both as applied to railway work. W. A. Blanck followed with his paper entitled "Single-phase Railroads," which appears on other pages of this issue. The papers were well received and brought out considerable discussion.

OBITUARY.

Andrew Howard.

Andrew Howard, president of the Phœnix Glass Company of Pittsburg, died at his home in Wilkinsburg, Pa., on February 27th after an illness of about 10 days. He suffered from an attack of the grip which developed into pneumonia. Mr. Howard was born in Pittsburg in 1837, and during his youth received a thorough mercantile education in the schools of that city. After holding responsible positions in various capacities he organized the Phœnix Glass Company in 1880, originally designed for the purpose of manufacturing glass insulators, and it is through his energy and enterprise that the company has grown to its present large proportions. He was a man of tact, discretion and judgment, and his kindly disposition made him beloved by all with whom he came in contact. The funeral was held in Pittsburg on February 29th. A widow, two sons and two daughters are left.

ANDREW HOWARD.

William A. McGuire.

William A. McGuire, president of the McGuire Manufacturing Company, Chicago, died of pneumonia at his home, 309 Webster Avenue, on February 29th. Mr. McGuire was born in Niagara, Ont., in 1840. In 1863 he came to Chicago and engaged in the iron-manufacturing business, soon after founding the McGuire Manufacturing Company, which engaged in the business of manufacturing trucks and cars for electric railways. He was the inventor of many railway appliances, among them being the electric-railway sweeper. He also invented many of the carwheels and trucks now in use by the electric-railway companies. Mr. McGuire was successful in business. He had contemplated retiring for a number of years, but not until January 1, 1904, did he sever active connection with the company bearing his name. The withdrawal of Mr. McGuire brought some changes in the firm. John J. Cummings, a director of the company and president of the Globe Iron Works, was made president and the company name was changed to the McGuire-Cummings Manufacturing Company.

Mr. McGuire was sick but three days. Only a few days before his death he disposed of the last of his stock in the company to Vice-president W. J. Cooke and several other gentlemen and had completed arrangements for an extended trip throughout the West and the Pacific Coast. On the Saturday preceding his death he took lunch downtown with Mr. Cummings. He was prominently engaged in charitable work and was well known as a philanthropist. Among the societies of which he was a member are the Knights of Columbus, Catholic Benevolent Legion, Royal Arcanum, Germania Club, Sheridan Club, Columbia Yacht Club and the Chicago Athletic Association.

The funeral services were held at St. Vincent's Church, of which parish he was a member. He is survived by a widow and three children and two brothers.

Ohio Electric-Light Association.

The Proceedings of the Ohio Electric Light Association for 1903 has just been published. It is substantially bound in cloth and is a complete record of the proceedings of the Columbus convention, held on October 13, 14 and 15, 1903. The officers for 1903-1904 are: President, S. M. Rust, Piqua; vice-president, J. H. Perkins, Youngstown; secretary-treasurer, D. L. Gaskill, Greenville. The active members of the society now number 49 and the associate members 29. The 11 papers read at the convention are given in full, with their respective discussions.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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DATES AHEAD.

American Electrochemical Society (annual business meeting), Washington, D. C., April 7th, 8th and 9th.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

SO MANY electrical problems, particularly those connected with the transmission and utilization of power, are likely to present themselves in the building of the Panama Canal that it would have been well if President Roosevelt had appointed as one of the members of the engineering commission a man especially trained in electrical work. However, the president has not seen fit to include an electrical engineer in his list, although, of course, the commission, as a whole, is made up of engineers of established reputation. William Barclay Parsons, one of the new commissioners, is the engineer of the Rapid Transit Commission of New York city, and as such probably has been brought into closer relation with practical electrical work of the present day than any other member of the body. However, every engineer, whether military or civil, is nowadays familiar with the accomplishments of applied electricity in a general way, although not all are equally unbiased in considering the subject. But, as the work progresses, it will not be difficult to retain such electrical specialists as may be desired, although it is to be regretted that no electrical man will have a voice and vote on the board of control.

FREEZING weather, long continued, during the winter which is now (it is to be hoped) about over has demonstrated some advantages of electricity not often considered. In many localities great trouble has been experienced from the occurrence of hoar frost in the gas pipes, which greatly diminishes or altogether cuts off the supply of gas. Gas pipes are usually laid about four feet below the surface of the ground, and in a normal winter the frost line does not strike down as far as this, but this winter the situation proved more difficult. The water in the gas becomes frozen by the deep cold, and complaints are coming from numbers of customers who state that not only is the quality of the light far below the average, but the amount of gas required to furnish that light is much in excess of the normal. This means heavier bills for poorer service, for the meters continue to grind out their records without any reference to the quality of gas furnished.

Complaints that cold weather affects electric-light mains never reach the ear of the station manager, whose plant supplies current day in and day out with absolute unconcern as to the height of the thermometer. In fact, the resistance of all electric-light and power circuits falls off somewhat with increase in cold, so that with a given load the potential and therefore the lamp brilliancy is at least fully as high as in the warmer weather. Then, too, the electric meter records the exact amount of ampere-hours or watt-hours consumed, which is a fair measure of the light burned. In both gas and electric installations, the lamps must be kept up to certain standards of efficiency if the meters are to measure the consumption of light fairly. It is a great advantage of the electric current that it is not an unstable chemical mixture or compound. The replacement of gas by electricity continues to prove the superiority of the latter as an illuminant. Safety, cleanliness, health, flexibility and freedom from weather conditions are all in its favor. Many new houses have no gas piping whatever, except for heating purposes, and it is pretty certain that when the electric light once comes in, it is sure to stay.

SELENIUM, with its peculiar properties, forms one of the most interesting elements in nature for the investigation of the physicist. In a recent issue of a German scientific journal R. Marc describes experiments to ascertain the suitability of selenium cells for spectro-photometric purposes, and to elucidate the processes occurring in the cell. The question as to the kind of light selenium is most sensitive to has been answered by Sale, who found that selenium is most sensitive to the infra-red rays, this sensitiveness decreasing continually from the red through orange, yellow, green, and blue toward violet, and disappearing entirely for actinic rays. This does not correspond exactly with the phenomena observed by Mr Marc. In fact, the relative sensitiveness with regard to the various colors is different for different temperatures; moreover, the resistance of the cell, as well as its relative sensitiveness to different kinds of light, is found to vary with the voltage, or, what is probably more correct, with the current. In by far the greater number of the cells tested, the sensitiveness to red is, however, found to be higher than the sensitiveness to blue rays. The sensitiveness of selenium to red light is strongly modified by a previous intense illumination with white light, or by a permanent blue illumination.

In the second part of this paper the influence of temperature on selenium, which is known to be of quite an extraordinary magnitude, is more closely studied. According as selenium on being heated either increases or diminishes in resistance, non-metallic or "soft" selenium should be distinguished from metallic or "hard" selenium. The former modification is found to be increasingly conductive up to 217° C., when the needle of the galvanometer, after some latent heat has been absorbed, will return suddenly to the deflection corresponding to the temperature 20°. Now if such selenium be cooled in the dark, the resistance, after increasing rapidly for some time, will decrease from +8° at an increasing rate, the selenium approaching in every respect the behavior of the other modification. The latter (metallic or hard) modification is generally distinguished by a higher conductivity and a much lower sensitiveness to light than "non-metallic" selenium. On being cooled, the resistance is found to fall at first extremely rapidly, the rate becoming slower at lower temperatures. On being heated, the resistance of a similar cell will at first increase, falling again from about 70°, when the cell distinctly assumes the properties of the other modification. From the above it is inferred that the metallic modification is stable below 8° and the non-metallic modification above 7°. The latter modification will, even at ordinary temperatures, though at extremely slow rates (often requiring years), be converted into the other form of selenium, this conversion being accelerated by white and especially by red light, whereas blue light will exert an opposite action. These interesting facts are obtained from an abstract of Mr. Marc's paper made by Dr. A. Gradenwitz for Science Abstracts.

MR. W. A. BLANCK'S recent Institute paper on "Single-phase Railroads," presented in full in this issue, is a valuable contribution to technical literature. The author outlines the various systems which have been tried—a synchronous motor in combination with direct-current generators and standard direct-current axle motors, as proposed by Ward Leonard; an induction motor in combination with air compressors, as proposed by Bion J. Arnold; the alternating-current series motor, as developed by Lamme and Finzi; the repulsion induction motor, as developed by Steinmetz and Schüler, and, finally, the repulsion series motor, developed by Winter-Eichberg. Further on, Mr. Blanck takes up the subjects of controllers, car wiring, trolley and line construction. He then considers, for illustration, a typical 60-mile road equipped by both the present direct-current system consisting of alternating-current generator with rotary-converter sub-stations, and what he terms the alternating-current system using static-transformer sub-stations and 3,000 volts on the trolley line. Comparing item for item, he shows that the direct-current system giving the same service as a single-phase system costs 32 per cent. more than the alternating-current systems. This calculation is certainly one of much importance. It seems to indicate that the era of the alternating-current railway is at hand. This is a most significant fact to all railroad men, for it is becoming evident that the operation of high-speed passenger trains on trunk railroads for long distances is now passing from the stage of possibility to that of probability.

The writer of the present paper is well fitted to discuss advanced electric-railway problems. He is an electrical engineer now located in Chicago, who has given much of his time of late to the high-tension single-phase railway work on the line running out of Lansing, Mich., on which the electropneumatic system of Bion J. Arnold is being developed. Before coming to this country Mr. Blanck was connected with Ganz & Co. of Budapest, working on high-tension distribution throughout Europe. He is an engineer of ability and standing and has written an impartial paper which will be studied attentively by all interested in the art.

The Gas Engine for Central-station Service.[1]

By Ralph D. Mershon.

Compression is one of the chief elements conducive to high efficiency in gas engines. There is, however, a limit to which this can be carried. The compression of the charge necessarily heats it, and if the compression be carried to a high enough point an ignition of the charge will result, due to compression alone. Indeed, in some types of engines, ignition is accomplished altogether by means of high compression. In the gas engine, as ordinarily employed, however, ignition due to compression or "pre-ignition," as it is called, is carefully avoided, principally because of the difficulty of controlling it and of its consequent unreliability. Ignition is generally accomplished by an electric spark, which method is capable of the complete control necessary for successful operation. Pre-ignition takes place more readily in a "rich" explosive mixture, that is, one whose calorific value is high, than in a "lean" mixture, or one whose calorific power is low, and it is therefore possible to compress lean mixtures to a higher point than rich ones. There obtains, therefore, a condition which at first thought is rather surprising, namely, that in general it is possible to obtain a higher efficiency in the gas engine when a lean gas is employed than when a rich one is used, because of the higher point to which compression may be safely carried. For this reason a considerable excess of air is often employed, that is, a good deal more air than is necessary to completely consume the gas supplied to the engine, and in some cases there is mixed with the gas, when a rich gas is the one available for use in the engine, an inert gas, such as, for instance, the cooled and cleaned products of combustion from the gas engine itself. By these expedients a higher compression may be employed and with resulting higher efficiency. Lean mixtures are also more readily ignited by the ignition spark when the compression is high.

In addition to the "four-cycle," or, as we shall call it, the four-stroke method of operating gas engines, there is another known as the "two-cycle," or, as we will designate it, the two-stroke method. These two methods are the ones most generally in use, and the only ones therefore which we will consider. The two-stroke method takes its name from the fact that there is a working stroke in every two strokes. The method of accomplishing this may be best explained by reference to Fig. 1, showing in section the cylinder of a two-stroke engine. This view

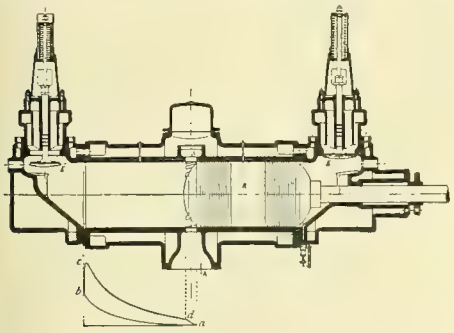


FIG. 1. GAS ENGINE FOR CENTRAL-STATION SERVICE. SECTION OF CYLINDER OF TWO-STROKE ENGINE.

shows a double-acting cylinder, that is, one in which there is produced alternately working impulses on each side of the piston. We will, however, consider for the present only one end of the cylinder. Suppose the piston to be at the back end of the cylinder, and in the clearance between the end of the piston and the cylinder there shall be a charge of gas and air compressed by the previous stroke of the piston. If this charge be ignited the piston will be urged forward until it begins to uncover the ports which you see at the middle of the cylinder, and through which the exhaust passes. These ports begin to be uncovered when the piston is near the end of its stroke, that is, a little before the crank has reached the dead center. The ports, therefore, remain more or less open from the time the crank has reached the position somewhat before the dead-center position, until it has reached a corresponding position on the other side of the dead center, that is, the exhaust ports are opened for quite an appreciable portion of the time occupied by a stroke of the engine, since they are open at a time when the piston is moving at a comparatively low speed. Now at the instant these ports are opened the hot gas that is in the cylinder begins to rush out through them, most of the products of combustion passing out, and the pressure falling to that of the atmosphere.

Shortly after this the inlet valve at the back end of the cylinder opens, admitting a certain amount of pure air, which has been previously compressed by a suitable pump. The air thus admitted pushes forward the products of combustion in the cylinders, forcing out of the exhaust a portion of what remains in the cylinder, after the pressure has been exhausted at atmospheric; that is, theoretically at least, there is next to the piston a layer of the products of combustion, and next to that a layer of pure air.

The gas-supply valve now opens, so that along with the air being admitted there is also admitted the proper proportion of gas for an explosive mixture, and it is admitted in such a way as to produce a thorough mingling of the gas and air entering the cylinder. The gas, as in the case of the air, is compressed by a pump to the low pressure necessary for forcing it into the cylinder. While the gas and air are entering the cylinder more of the products of combustion are being forced out of the exhaust ports, which are still open, and this admission of gas and air continues until sufficient of the mixture has been admitted for the work which the engine is doing.

The exhaust ports have, during all this time, been more or less open, as previously explained, and the admission of the layer of pure air and the succeeding layer of the mixture has been accomplished and the admission valve closed before the exhaust ports are closed by the piston making its return stroke. The piston now begins its return stroke, closing the exhaust ports and compressing the stratified contents of the cylinder, and near the end of the stroke the charge is ready for ignition and for a repetition of the cycle outlined.

It is clear that this engine will give a working impulse every forward stroke, just as in the case of a single-acting steam engine, and that if we duplicate the cylinder at the other end of the piston, there will result a double-acting engine, giving us an impulse every stroke, as in the case of the steam engine. Such an engine as described requires separate pumps for forcing the gas and air into the working cylinder.

Just below Fig. 1 is shown an indicator diagram of the working cylinder, showing the relation between the different points of the diagram and the cylinder itself.

Various means have been employed for igniting the charge in the cylinder of the gas engine, some involving the use of a hot tube, some a platinum wire heated electrically, some a gas flame which, by various ingenious methods, is made to ignite the charge, and some involving the use of an electric spark. The latter method is the one usually employed, the spark being usually obtained in one of two ways. One of these is to produce by means of an induction coil a continuous stream of sparks between two platinum points which are at the proper moment brought into contact with the charge in the cylinder by means of a valve. The other method, which is that most generally employed, is to make use of a small magneto-electric generator for generating the current required for the spark which takes place between two points normally in contact but separated by a cam movement at the instant when ignition is desired.

Various methods have been devised also for governing gas engines, but only two of these have been used to any great extent practically. One of these is the method used with the original Otto engine and still in use in many engines, especially those of the older type. This method consists in causing the engine to miss one or more working strokes. That is, instead of there being a working stroke in every four, there would at light loads be a working stroke in every eight or every 12, depending upon the load which the engine was carrying. This method of governing has the disadvantage of requiring a heavy flywheel, and that even with a heavy flywheel there will be considerable variation in speed. It has the advantage, however, of high efficiency at all loads, since, whether the load was heavy or light, the quality of the mixture and the compression previous to ignition are the same. The irregularity of the speed, however, consequent on this method of operation is such as to render it unsuitable for many kinds of work, especially for the driving of alternators in parallel.

The method usually employed, therefore, in governing gas engines, especially those of large sizes, and for electrical work, is that of varying the amount of mixture admitted to the cylinder, at the same time endeavoring to keep its quality constant. With heavy loads, when the engine is taking a cylinder full or practically full of explosive mixtures, the mixture can be suited for the compression which takes place, but with lighter loads it is evident that since the cylinder must be full, the only way to preserve the quality of the mixture the same or approximately the same will be to endeavor to stratify the contents of the cylinder. That is, as has previously been explained in connection with the two-stroke engine, to first admit air to the cylinder and then a layer of the mixture, endeavoring to admit the mixture in such a way that it will not mix with the air, or, at any rate, to only a small extent, and so that at the back end of the cylinder, at least, there shall be a mixture sufficiently rich to properly ignite under the compression which has taken place. Whether or not this stratification actually does take place has been the subject of considerable dispute, but whether this theory be wholly or only partially correct, or not correct at all, the fact remains that engines are operated successfully in the manner described.

The gas generators employed in connection with gas engines are of various types, but depend upon the same general principle. In them takes place one or both of two chemical reactions, which are expressed by the equations, $CO_2 + C = 2CO$ and $H_2O + C = 2H + CO$. The first equation expresses the fact that oxygen coming in contact with incandescent carbon results in the formation of carbonous oxide, an inflammable gas. This gas, however, is generally formed through the intermediate action expressed by the equation $C + O = CO_2$, in which carbonic anhydride is first formed, and this gas, coming in contact with hot carbon, takes up an additional atom of carbon, forming carbonous-oxide gas. The second equation expresses the fact that hot steam, on coming in contact with incandescent carbon, splits up, resulting in the formation of carbonous-oxide gas and hydrogen. The first of these actions, when once started, will continue because it, in itself, generates more than sufficient heat to continue the process, but the second action requires a supply of heat which must come either through heating the carbon before steam is supplied to it or by having the two actions mentioned proceed simultaneously, in which case the first reaction will supply heat for the second.

As an example of the gas generator, I would call your attention to Fig. 2, which represents a gas-generating plant. At the left we have shown the generator filled with the fuel from which the gas is to be obtained. This fuel burns at the bottom of the generator by reason of the air admitted to it at that point through the grate bars shown. The air, however, is not admitted by itself, but is forced in along with and by means of a steam jet entering the firebox below the grate bars by way of the pipe

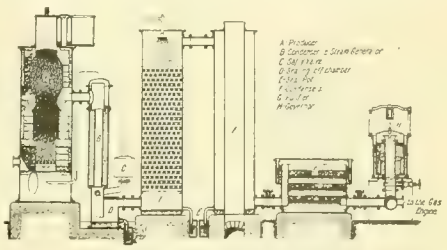


FIG. 2. GAS ENGINE FOR CENTRAL-STATION SERVICE. GAS GENERTING PLANT.

shown. The steam is supplied by the boiler (B) heated by the hot gases as they pass out of the generator. We may consider that the action in this generator is the combination of the actions previously described. The mixture of air and steam coming in contact with the hot fuel at the grate bars, the air burns a portion of the fuel, thus forming carbonic-oxide gas and supplying heat to split up the steam into its elements, the oxygen of the steam combining with a certain proportion of the incandescent carbon to form carbonous oxide. As this combination of carbonic oxide, carbonous oxide and hydrogen passes up through the hot bed of carbon, the carbonic oxide takes up an additional atom of carbon, forming carbonous oxide. There passes over from the generator, therefore, by way of the pipe (B) a mixture of hydrogen, carbonous oxide and the nitrogen contained in the air required for the process, along with a small proportion of carbonic oxide. The generator is fed, as shown, by a properly sealed opening at the top, so that it may be charged without interfering with its operation. After leaving the gas generator the hot gases pass out through the pipe (B), heating in their course the water in the boiler (B), as previously mentioned, and forming the steam for use in the generator. The gases then pass into the scrubber and the cooling chamber (F) (F), in which the gas is cooled and cleaned by a spray of water sent through a checker work, or through loosely piled coke. It then passes through the purifier (G), which removes such dust as there may remain in it and takes out the superfluous moisture. A small gas tank (H) or equalizer reduces the pulsation in the main occurring at the time when the engine is drawing a supply of gas.

Returning again to the question of the engine, one of the first points which arises when considering it for electrical work is that of the operation in parallel of direct-driven generators. With generators for supplying direct current, the problem is comparatively simple, since it depends principally upon the action of the governors of the various engines, and is not very difficult of solution. With alternators, however, there is a further question of the angular variation in the rotative effort of the engines, due to the impulses on the piston. Most of you are conversant with this problem as involved in connection with the steam engine, but in the case of the gas engine the solution is not quite so easily arrived at. In the case of a single-acting four-stroke engine giving an impulse for only one stroke in every four, it is very evident that in order to obtain a sufficiently uniform rotative effort a much heavier flywheel will be required than in the case of an engine giving an impulse every stroke.

In order to keep down the weight of flywheel required, various expedients have been resorted to. One of these is to use in one engine a number of single-acting cylinders, each acting upon its own crank, and so arranged as to give a rotative effort as uniform as possible. In order to accomplish this to the best advantage, as will be seen later on, pairs of cylinders should be arranged facing each other, although they are sometimes arranged in tandem and sometimes side by side. We will not give much consideration to this use of single-acting cylinders, however, for the reason that the present tendency, especially in large engines, is to make them double-acting, and to arrange the cylinders in tandem in such a way as to produce an impulse for every stroke of the engine. The method of making the two-stroke engine double acting has already been described. In it an impulse may be obtained at every stroke by

1. Abstract of a paper read before the New York Electrical Society on February 17, 1904.

means of what is in effect a single cylinder. But in the case of the four-stroke engine, it is necessary, in order to obtain an impulse every stroke, to not only employ a double-acting cylinder, but to employ two such cylinders in tandem. The reason for this will be apparent by referring to Fig. 3, which represents diagrammatically a four-stroke double-acting cylinder. Remembering that on each side of this piston there can only be one impulse for each four strokes and following the cycle of operations for each side of the piston in the manner indicated in the figure, we see that in the system illustrated there will be two impulses for every four strokes and that these impulses will come one immediately after the other, so that in operation we shall have two impulses in succession, then two idle strokes, then two impulses in succession again, and so on. This sequence of impulses will require a heavier flywheel than though there were an impulse every other stroke and will require a considerably heavier flywheel than though there were an impulse every stroke. In order, therefore, to obtain a still more uniform effect, two cylinders are generally combined in a tandem, as shown in Fig. 4. This arrangement gives an impulse every stroke, as will be seen by following out the action on each side of each piston, as outlined by the words below the figure.

The present tendency of gas-engine design for electrical work is toward the arrangement shown in Fig. 4, and in many cases two such systems as that shown are employed, each being connected to its own crank, the cranks being approximately 90° apart. In using the term flywheel in connection with the question of equalizing the rotative effort, the word must be considered as designating not simply the rotating masses of the engine, but all moving masses which will serve for the storage and the giving out again of energy. This will include the reciprocating parts of the engines, or, as it is sometimes termed, the reciprocating flywheel. The reciprocating flywheel is of even more importance in the double-acting gas engine of the character described than in the steam engine, for the reason that in the former, because, of the high compression employed,

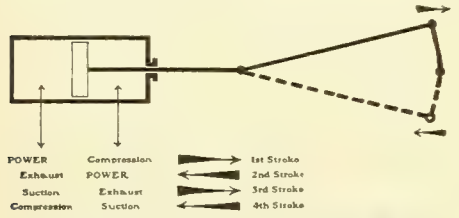


FIG 3. GAS ENGINE FOR CENTRAL-STATION SERVICE - DIAGRAM FOR FOUR-STROKE DOUBLE-ACTING CYLINDER.

it is possible to use greater reciprocating masses and therefore provide for considerably greater storage of energy in them.

By making use of the two double-acting four-stroke cylinders, as described, or one of the double-acting two-stroke cylinders, described sometime previously, it is possible to obtain the required uniformity of rotative effort for the proper paralleling of alternators, and the result may be accomplished without excessive weight in the flywheel or reciprocating parts.

The cost of the gas engine is considerably in excess of that of the steam engine, and, as compared with the steam turbine, the discrepancy is even greater. There is a point of difference between the steam prime movers and the gas engine which further exaggerates any relative cost which may be given per horsepower. The steam turbine and steam engine have a certain amount of overload capacity. That is to say, they are capable of operating, though at somewhat impaired efficiency, at loads considerably in excess of their rated output or the output at which they give the best performance. The gas engine, however, has properly, no overload capacity. Its performance improves up to the point where it cannot carry any further load and at which any further loading causes it to slow down. This is not strictly true for engines of the two-stroke type which have a slight overload capacity beyond the point of best performance, but this overload capacity does not exceed 20 per cent. of the rating capacity, and is probably less. With the four-stroke engine, however, the statement as regards overloads holds. It is necessary, then, in purchasing gas engines to provide for a rated capacity approximately equal to the overload which will have to be carried at any time, so that a comparison of prices on the basis of the cost per horsepower does not always give a correct idea of the relative costs, because in the case of the gas engine we must provide for a greater total number of rated horsepower.

The quoted prices on the gas engines in this country at the present time vary quite surprisingly. Depending on the maker quoting, the prices on a horsepower basis range from 60 per cent. greater than for a steam engine to over twice the steam-engine figures. In comparing the gas engine with the steam-turbine prices we find a still greater discrepancy. In order to make the comparison it is necessary to add to the cost of the gas engine, the price of a suitable alternator, since the steam turbines are always furnished with the alternator which they drive. If this is done, it will result in a cost per kilowatt of output at least twice as great in the case of the gas engine as in the case of the steam turbine, and if the comparison be made on the basis of a suitable overload capacity, the discrepancy will be even greater.

The cost of the gas-generating plant for use in connection with the gas engine may be taken as being about twice the cost of the steam boilers necessary for use in connection with a steam prime motor. This is for a simple gas generator and cleaning plant, without any installation for the production of by-products.

It will be seen, therefore, that the cost of a gas-engine plant, including the necessary gas generator, is considerably in excess of the cost of a steam plant for the same service, especially if the steam prime movers be turbines. The cost of maintenance and the figure which must be taken for depreciation on such plant is therefore correspondingly higher, and the cost of the attendance also greater, since it requires a somewhat better class of men to handle a gas plant. On the other hand, the efficiency of the gas plant is very much better than that of the steam

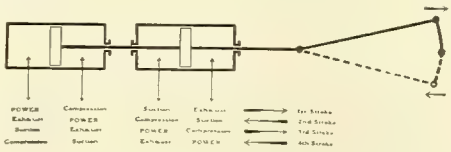


FIG. 4. GAS ENGINE FOR CENTRAL-STATION SERVICE FOUR-STROKE ENGINE WITH TWO CYLINDERS IN TANDEM.

plant, the gas plant requiring for the same service about half the coal required by the steam-engine plant and a little more than half that required by the steam-turbine plant.

In order to give you an idea as to the relative costs of electric power by the three types of plant, and the influence that the cost of fuel has upon the cost of power, I have prepared some figures for a steam-engine plant, a steam-turbine plant and a gas-engine plant, for the same service. In these figures I have included everything properly chargeable against the cost of power.

It is assumed in each case that current is to be supplied to a load having a load factor of .5, and that the peak load is 1,500 kilowatts. It is assumed that this load will be carried by four generators having a rated capacity of 400 kilowatts each, and operating, when necessary, at 25 per cent. overload. The generators to be cut in and out of service in such a way that the average efficiency of each unit will be the same as though it ran continuously at 75 per cent. of its rated capacity. The thermal value of the coal is taken as 12,500 British Thermal Units per pound, and it is assumed that this coal will evaporate seven pounds of steam when burned under the boilers, and when used in the gas generators will produce gas having a total thermal value of 10,000 British Thermal Units. It is assumed that a steam pressure of 150 pounds is to be used and that the steam is to be superheated to 150 degrees Fahrenheit above its normal temperature. Under these conditions the following figures for performance are taken, being such as will be guaranteed by the makers of the various pieces of apparatus:

Steam engine, 12 pounds per brake horsepower per hour; steam turbine, 18 pounds per kilowatt-hour; gas engine, 10,000 British Thermal Units per brake horspower per hour.

Suitable modifications of these values were made to take care of the fact that the units are to run at 75 per cent. of their rating capacity and to take care of condensation and auxiliaries in the case of the steam plants. Making use of these figures in connection with the costs necessary for such estimates, there were obtained the results embodied in the curves in Fig. 5. It is to be understood that

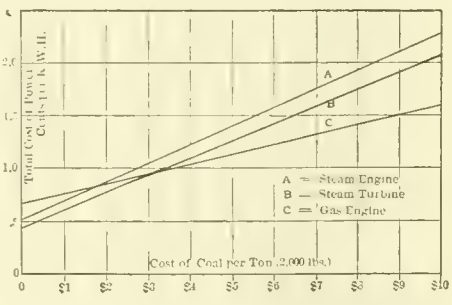


FIG. 5. GAS ENGINE FOR CENTRAL-STATION SERVICE. CURVES OF COST PER KILOWATT HOUR.

these curves include everything properly chargeable against the cost of power, including interest, depreciation and renewals on the whole installation and supplies, labor and fuel. The line (A) shows the cost for a steam-engine plant, (B) for a steam-turbine plant, and (C) for a gas-engine plant. The slope of these lines shows in each case the increase in power cost as the cost of the fuel increases. The point at which the line (C) crosses the other two lines shows the cost of fuel at which the gas-engine plant is on a parity with the steam-engine plant and the steam turbine, respectively, as regards the total cost of power.

These curves give us an idea, therefore, of the cost of fuel at which it would begin to pay, under the present prices for apparatus, to install a gas-engine plant rather than a steam plant. As will be seen from the curves, the gas-engine plant and the steam engine are at a parity with coal costing about $1.85, while the point of equality with respect to the steam-turbine plant is with coal at about $3. It is believed that these curves show the relative performance of such plants under the condition assumed pretty fairly, no matter what modifications might be made in the estimates, since, while the modifications might change to some extent, the actual value for the cost of power, the relative value will not be much changed by a modification common to all of the plants. It should be borne in mind also that these figures are made on the assumption of a load having a load factor of .5, and that for more continuous service the gas engine will make a much better showing. It should also be borne in mind that these estimates are made without reference to any recovery of by-products, and that such recovery would very materially alter the showing made.

An inspection of these curves at the point where the value of the fuel is zero, shows very plainly that if, as it has sometimes been proposed to do, plants be installed at coal mines for the generation of power, a steam-turbine and not a gas-engine plant should be used, unless a plant for the recovery of by-products be made a part of the installation.

The relative values here arrived at will no doubt have to be changed with the progress in the gas-engine art. The gas-engine equipment will become cheaper as its use becomes more general, and this, in connection with the fact that some hard work is being done in the endeavor to produce a gas turbine, makes me think we may look forward to a time not far off when gas prime movers of some sort will be installed instead of steam prime movers.

Acknowledgments for some of the illustrations reproduced herewith from their literature on the subject, should be made to Mr. Wilhelm von Oechelhaeuser, general director of the German Continental Gas Company; Mr. H. Gerdes, chief engineer of Julius Pintsch, Berlin; Allis-Chalmers Company, Chicago, in regard to the Nurnberg gas engine, and Korting Bros. of London.

New Members of the Institute.

The following-named gentlemen were elected to associate membership in the American Institute of Electrical Engineers at the directors' meeting held in New York city on February 26th:

Asotin, Wash.—U. S. Atkins, Lewiston Water and Power Company.

Atlanta, Ga.—S. M. Conant, Crocker-Wheeler Company; S. L. Rich, B.-R. Electric Company.

Baltimore, Md.—T. B. Entz, Electric Storage Battery Company.

Boston, Mass.—J. W. Cooke, Electric Storage Battery Company; Bradford Darrach, Jr., Electric Storage Battery Company; C. S. Davis, navy yard.

Brooklyn, N. Y.—H. F. Krantz, H. Krantz Manufacturing Company.

Buffalo, N. Y.—C. W. Underwood, Westinghouse Electric and Manufacturing Company.

Camden, N. J.—John McFeeley, Public Service Corporation of New Jersey.

Champaign, Ill.—J. M. Bryant, University of Illinois.

Chelsea, Mass.—John Campbell, consulting engineer.

Chicago, Ill.—H. C. Trow, Armour Institute of Technology; A. D. T. Libby, Kellogg Switchboard and Supply Company; J. I. Leitch, Albernee Stone Company.

Cincinnati, Ohio.—E. H. Haughton, Bryan-Marsh Company.

Cleveland, Ohio.—P. J. Boucher, Standard Water Purifying Company.

Columbus, Ohio.—H. R. Allensworth, Fire and Police Telegraph Department; J. B. Armack, Kilbourne-Jacobs Manufacturing Company; F. W. C. Bailey, consulting engineer; Victor Brunskog, Jeffrey Manufacturing Company; B. L. Chase, Columbus Railway and Light Company; H. L. Cook, Columbus Railway and Light Company; Leo Gudeman, Jeffrey Manufacturing Company; W. A. Hopkins, Jr., Erner-Hopkins Company; W. K. Liggett, Kinkade and Liggett Company; E. H. Monasmith, Columbus Railway and Light Company; J. H. Moore, Columbus Edison Company; M. A. Pixley, Erner-Hopkins Company; L. A. Sackett, Sackett Mine Supply Company; Samuel Scott, Jeffrey Manufacturing Company; H. T. Stewart, General Electric Company; Richard Stites Electric Supply and Construction Company; C. J. E. Waxborn, Jeffrey Manufacturing Company; E. B. Wharton, Case Manufacturing Company.

Detroit, Mich.—T. E. Clark, Thomas E. Clark Wireless Telegraph and Telephone Company.

Durham, N. C.—W. W. S. Butler, Durham Traction Company.

Great Barrington, Mass.—E. W. Gough, Stanley Instrument Company.

Lancaster, N. Y.—W. A. Turbayne, Gould Coupler Company.

Lynn, Mass.—G. H. Stickney, General Electric Company.

Malden, Mass.—F. C. Sargent, Malden Electric Company.

Melbourne, Australia.—E. G. Lind, Accumulatoren-Fabrik Aktiengesellschaft.

Montreal, Quebec.—R. H. Zavitz, Canadian General Electric Company.

New York, N. Y.—M. J. Levy, Burnet Company; Charles Mautner, H. Krantz Manufacturing Company; A. C. Vinal, American Telephone and Telegraph Company.

Philadelphia, Pa.—William McClellan, Philadelphia Rapid Transit Company; J. O. Spear, Jr., Ft. Wayne Electric Works.

Pittsfield, Mass.—H. P. Reid, Stanley Electric Manfacturing Company; S. H. Smith, Stanley Electric Manufacturing Company.

Rutherford, N. J.—E. H. Pryce, National Automatic Fire Alarm Company.

Sacramento, Cal.—Lawrence Ettrup, Sacramento Ashburton Mining Company.

St. Louis, Mo.—Frank Gaiennie, Kinloch Telephone Company.

Salt Lake City, Utah.—R. J. Decker.

San Francisco, Cal.—J. F. Tinsley, Signal Corps United States Army.

Schenectady, N. Y.—E. F. W. Alexanderson, General Electric Company; Kenneth McCaskill, General Electric Company; J. A. Seede, General Electric Company.

Seattle, Wash.—E. G. Allen, Seattle Electric Company.

Spokane, Wash.—A. H. Woodwell, Washington Water Power Company.

Steelton, Pa.—A. E. Peirce, Jr., Pennsylvania Steel Company.

Trenton, N. J.—F. A. Demarest, Interstate Telephone Company.

Toronto, Ont.—F. J. Parkin, Canadian General Electric Company; G. W. Watts, Canadian General Electric Company; Valentine Boyd, Canadian General Electric Company.

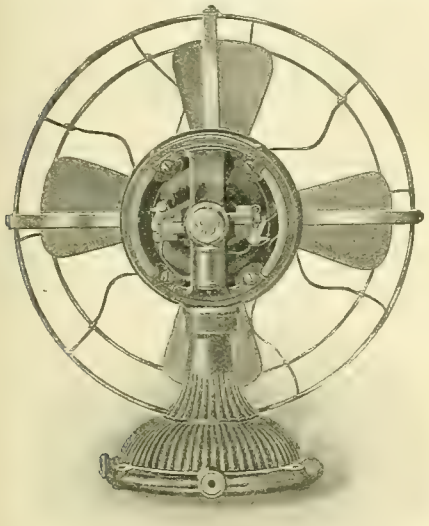
Washington, D. C.—H. B. Stabler, Chesapeake and Potomac Telephone Company.

Whitmore, Cal.—J. R. Read, Northern California Power Company.

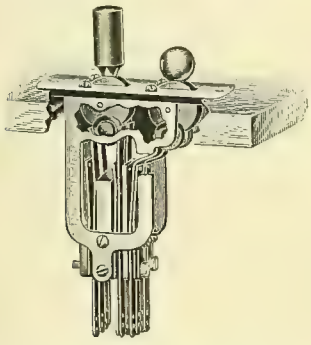
Double Ringing and Listening Key.

Among the many styles and types of switchboard circuit-changers on the market, one that contains many points of merit in its design and construction is the double ringing and listening key recently evolved by the International Telephone Manufacturing Company of Chicago.

A slightly rear and side view of one of these keys, with part of its side brace broken away to bring the springs in view, is shown in the accompanying cut. The key is self-contained and so constructed that it is readily mounted on any thickness of key shelf and is very compactly built, so that a number of keys may be placed on a comparatively small space.



The body of the key is composed of a heavy escutcheon plate, on which is mounted a heavy metal bracket with the spring block mounted between its arms. At the top of the bracket are mounted the cam levers, which consist of a round nickel-plated brass disk with rubber handle extended above the escutcheon and with rotary rubber plungers set between the springs. All the springs are mounted upon a brass spring block, insulated with mica and firmly clamped with four machine screws passing through the springs into a metal nut. The binding screws are threaded into metal and do not depend on threaded rubber; therefore, the springs are very rigid and durable and the spring block, with all the springs, is self-contained. The key is so constructed that the main generator spring is used for both the ringing and listening key and also the ring-back key, making the whole very simple and reliable.



DOUBLE RINGING AND LISTENING KEY.

While this key was especially designed for the International new type self-restoring drop-switchboard equipment, which is already widely known as an efficient and durable express switchboard, it is well adapted for mounting on any other make of switchboard.

Low-rate Duty on Carbons Sustained.

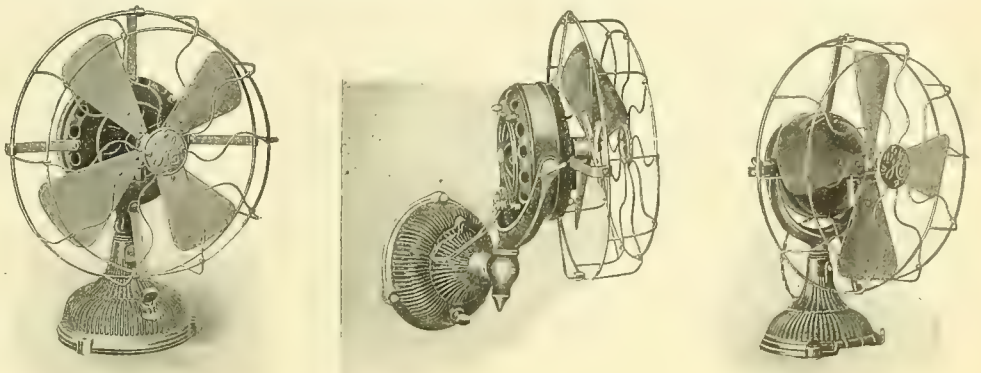
Judge Lacombe in the United States Circuit Court of Appeals, sitting in New York, has decided the case of the United States against R. F. Downing & Co., in favor of the importers, thereby materially reducing the duty to be exacted on carbons for electric arc lights.

These carbons, in the condition in which they are used, are 12 inches long, and they are specifically provided for in the tariff law at 90 cents a hundred. Some years ago the importers tried bringing them in in longer lengths, from 12½ to 20 inches, and the claim was made that they were entitled to classification as articles manufactured of carbon at 35 per cent. This claim was overruled by General Appraiser Fischer on November 7, 1901, and Judge Henderson M. Somerville wrote a dissenting opinion sustaining the importers' claim. This dissenting opinion is now confirmed by the Circuit Court of Appeals.

General Electric Fan Motors for 1904.

In this year's production of fan motors the General Electric Company presents a convertible-type motor. This marks a distinct advance in the design of fan motors and the convertible feature will be found of great convenience both to dealers and to customers. The desk motors may be changed to bracket motors simply by the use of a small adapter; thus dealers may carry a supply of desk motors and a few adapters and can supply on order either desk or bracket motors. Some of the applications of this motor are shown in the accompanying illustrations.

The general construction of the motors is similar to last year's design. As shown in the illustrations, the controlling switch for the alternating-current motor is now placed in the fan-motor base. The simplicity which has marked the construction of the alternating-current motors for several years is retained in this year's models. No moving wire or contacts are used, and the revolving parts are carefully balanced on one long bearing. The direct-current motors have enclosed dustproof frames, although the rectangular brushes and brush-holders are easily reached by means of a removable shield. In the convertible type this company offers 12 and 16-inch fans for both direct and alternating-current circuits.



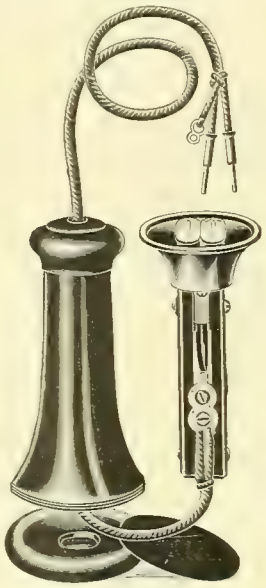
GENERAL ELECTRIC FAN MOTORS FOR 1904.

Besides the convertible type, a swivel-frame 12-inch fan for alternating current and a solid-frame 12-inch fan for direct current are offered.

Particular attention is called to the substantial guard, with two outer protection rings, which are used on these fans. All these motors are fitted with variable-speed switches; thus excellent control of the fan is provided. The standard finish is black enamel with polished brass fans and guards.

Spies Telephone Receiver.

The telephone receiver illustrated herewith is made by the Spies Electric Company of Chicago. It is described as a simple and effective piece of apparatus, well put together, with careful attention to detail. A feature is the effectiveness of adjustment. With the slight relaxation of a screw, which is readily accessible, the metal cup containing the coils is released, and may be turned so as to raise or lower the poles of the magnet in whatever direction adjustment is required. Resetting this screw effects the adjustment as desired, and neither jar nor fall can affect it, thus combining, it is urged, the good points of an adjustable instrument with that of one of the solid or non-adjustable type. The metal cup may also be entirely removed, leaving all other parts intact, and, with the cup removed, the coils stand free and open to inspection. The entire internal mechanism is self-contained and a change of shell is permissible without interference with the internal parts of the adjustment.



SPIES TELEPHONE RECEIVER.

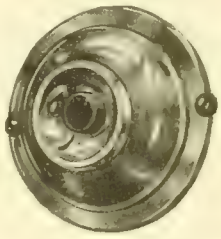
Salesmanship as a Science.

Salesmen of the Western Electric Company listened to an interesting and instructive lecture by Professor Sheldon, of the Sheldon School of Scientific Salesmanship, which was given for their benefit at the Grand Pacific Hotel, Chicago, on March 1st. Professor Sheldon maintained that salesmanship is a science, and as such is worthy of the most careful study in order that the salesman may be better qualified to analyze and study the characteristics of human nature. He believes that the old impression that a salesman is born, not made, is a false one, and that a good salesman is both born and made.

Before the lecture the party, including Mr. Sheldon and Mr. Cunningham, of the school, had dinner. During the dinner it was observed that a great many different colleges and universities were represented, some by two or three alumni. Those present were A. L. Tucker, Henry B. Otis, John M. Lea, Irving Parker, B. Griffin, C. A. S. Howlett, H. B. Squires, T. A. Ketchum, C. E. De Crow, W. S. Hine, A. McEwen, J. M. Hollister, J. T. Valenta, P. J. Aaron, F. J. Le Preau, W. L. Stockton, J. F. Little, A. G. Welling, W. W. Tenney, A. F. Brown, B. C. Holst, G. H. Lounsbery and W. P. Hoagland.

Push-button with Glass Body.

An unusual departure in the construction of push buttons, illustrated herewith, is the one manufactured by the Chicago Glass Novelty Company, 1206-1208 Branson Street, Marion, Ind. The cover of this push button is made of glass and gilded on the under side, the gold being fired into the glass. The manufacturers state that this button can be distinguished almost in the dark, as it reflects the faintest light that falls on it, and, being of glass, it will not tarnish but will retain its mirror-like appearance, never requiring burnishing.



PUSH BUTTON WITH GLASS BODY

The Technolexicon.

The "Universal Technical Dictionary," for translation purposes, in English, German and French, the compilation of which was begun in 1901 under the auspices of the Society of German Engineers, has received help up to the present time from 363 technical societies in Germany and other countries. All the outstanding contributions will be called in by Easter of this year, 1904, unless especial arrangements have been made with the editor-in-chief. As the printing of the Technolexicon is to be begun in the middle of 1906, delayed contributions can be made use of only in exceptional cases. All contributions should be addressed to Technolexicon, Dr. Hubert Jansen, Berlin (NW. 7), Dorotheenstrasse 49.

W. H. Armbrecht of the Meridian (Miss.) Light and Railway Company announces that the company will issue $750,000 in bonds for further improvements to its plant. An order for a 500-kilowatt generator direct-connected to a Curtis turbine and one 300-kilowatt rotary converter was recently placed.

Michigan Telephone Matters.

At a recent meeting of the stockholders of the Co-operative Telephone Company of Detroit several minor changes in the by-laws were made. The one of most interest was the change back to the original idea that every stockholder must be a subscriber for a telephone for every share of stock held. This restores the true co-operative feature of the company and allows every telephone subscriber to have a voice in the management of the company through the votes cast for directors at the annual meeting.

The northern division of the Michigan Telephone Company, with headquarters at Marquette, has been abolished. All the business of the company will be conducted from Detroit. The change is due to the fact that the nothern division is now well enough organized to get along without a special manager. C. E. Wilde, who has been in charge of the office there, will go to Grand Rapids to become district superintendent there in place of L. E. Corrigan, who will come to Detroit.

A short time ago Clare grocers and butchers entered into a compact to adopt one telephone for use in their stores, and by a decisive vote adopted the Union telephone, giving 30 days' notice that the Bell would be discarded. Much discussion arose over this action. The Bell company has a number of rural lines connected with the Clare exchange and farmers entered a protest. Some people said that to insure good service two competing lines must be maintained. The grocers and butchers didn't throw out the Bell telephone and both systems will continue in use. Both companies announce plans of future activity by which the whole surrounding country will be connected by telephone.

It is understood that the Home Telephone Company of South Bend will enter Niles in competition with the Michigan Bell Telephone Company. A fight is expected. The newcomers will extend side lines to Buchanan, Galien, Three Oaks and Cassopolis, supplying service to intervening territory.

W.

Telephone News from the Northwest.

The Farmers' Telephone Company (formerly the Minnesota Valley Telephone Company) of Lake Crystal, Minn., has incorporated with a capital of $25,000. E. Upson of Judson is president and D. E. Bowen of Cambria, secretary.

The Union Telephone Company of Boscobel, Wis., has added a new switchboard of 100 drops.

The Minnesota Central Telephone Company will increase the long-distance facilities at New Paynesville, Minn., making it a district office.

The Wisconsin Telephone Company has arranged with the Monroe County Telephone Company at Sparta, Wis., to give long-distance connections. The latter will rebuild its exchange and will use the Bell instruments.

The Montrose (Minn.) Farmers' Telephone Company has been incorporated with $10,000 capital stock.

J. A. Peterson has a franchise at Wimbledon, N. D., for a telephone exchange, and will have work started in the early spring.

There is a strong sentiment at Lake City, Minn., in favor of municipal ownership of the telephone exchange.

A telephone company has been formed at New York Mills, Minn., to install a local exchange.

The Wisconsin Telephone Company, at Oshkosh, Wis., seeks to get a higher price for metallic-circuit instruments, which it urges in place of Blake transmitters. A canvass is being made to get subscribers to agree to the change.

The Pilot Telephone Company will build lines from Havelock, Iowa, to Mallard and Plover.

A telephone company was organized at Bartley, Neb., and will build a line from Indianola through Bartley to Cambridge.

The Schleswig (Iowa) Telephone Company will extend its lines about 30 miles this season.

R.

Ohio Telephone Notes.

Affairs of the Federal Telephone Company were discussed at a meeting of members of the Everett-Moore syndicate and the proposed trust committee which will take charge of its affairs. The committee consists of H. R. Newcomb, C. Morris and F. S. Dickson, president of the Cuyahoga and the United States Telephone Companies. President Dickson's plan of selling all the properties but the Cuyahoga and United States companies will probably be carried out within the year. This will largely clear up all the difficulties in the way of the syndicate so far as the telephone interests are concerned, but will leave the system much smaller than formerly.

Securities of the Cuyahoga and United States Telephone Companies will probably be listed on the Cleveland stock exchange within a short time.

F. P. Winn, J. W. Else, R. R. Painter and others have incorporated the Adamsville Telephone Company of Adamsville with a capital stock of $1,000.

The Springfield Township Rural Telephone Company of Brittain has been organized by Jacob Crumroy, J. H. Lepper and others to build country lines. Conferences have been held with representatives of the Bell interests and the Peoples' Telephone Company of Akron, but it has not been decided what connections will be made.

Representatives of Independent telephone companies are still working hard to secure franchises in Cincinnati. Four ordinances have been pigeonholed and the companies are endeavoring to revive one of these.

Plans have been formed for the installation of a private exchange in the Chamber of Commerce at Cincinnati. The switchboard will be located on the first floor of the building and an operator will be in charge. The exchange will have long-distance connections.

The Tri-county Telephone Company of Lake has been incorporated with a capital stock of $10,000 to build toll lines in Stark, Summit and Portage Counties. Albin F. Ness heads the list of incorporators.

The Independent exchange at Newark now has over 1,400 connections. Recently 70 new telephones have been installed and the company has orders for 25 or 30 more.

The Bell interests have planned to extend their line from Conneaut to Richmond Center. The patrons will be given free connections with the Conneaut exchange.

The new switchboard of the Cuyahoga Telephone Company at Cleveland is ready for use. The board is of the latest design produced by the Kellogg Switchboard and Supply Company of Chicago and has a total capacity of 36,000 telephones (single-circuit and party-line), or 18,000 circuits altogether. The present capacity is 15,000 telephones. The new board is of the lamp-signal multiple type and does away with the subscriber's button system that has been in use heretofore. J. H. Schmidt had charge of the installation for the Kellogg Switchboard and Supply Company. The company has arranged to put in new telephones for all subscribers. All the latest designs for wall and desk use have been adopted and will be installed as desired. New designs for branch exchanges have also been secured and will be used to improve the service in this respect. The prices adopted for business and residence telephones respectively are as follows: Unlimited service,-quarterly—Individual line, $18, $12; two-party, $13.50, $9; four-party, $9, $6. Measured service, 150 calls quarterly—Individual line, $15, $10.50; two-party, $11.25, $8.25; four-party, $7.50, $5.25. Where two or more individuals or firms use the same telephone the extra charge to each will be $10 a year. In case the subscribers to this service wish to have the nature of their business or firm names printed in the directory a charge of $3 each will be made. The Standard Protective Company will work in connection with the Cuyahoga company with its burglar-alarm system.

The financial statement of the United States Telephone Company for 1903 was the subject of discussion at the last annual meeting of the stockholders. The figures show total assets of $4,685,048.22 as compared with $4,065,425.73 the preceding year. A surplus of $15,972.18 was shown where there was a deficit of $21,138.32 the year before. The earnings are given as follows: Toll service, $361,457.48; line rentals, $19,260.87; telephone rentals, $443.99; miscellaneous, $482.71. The gross earnings after deducting discounts, toll tickets and certificates were $379,-235.10, a gain of $76,838.85 over the previous year. The percentage of expenses to earnings was 60.79, leaving net earnings of $139,056.65. The expenses in 1902 were somewhat smaller than last year, but through increased activity, resulting in greater earning capacity, the income more than balanced these expenses and leaves the property in much better shape than the year before. The directors elected at the meeting are Henry A. Everett, E. W. Moore, J. B. Hanna, C. W. Wason, Barney Mahler, J. W. Marsh, James B. Hoge, F. S. Dickson and James R. Sprankle. Mr. Hoge takes the place of Maxime Reber, resigned. The officers are: President, F. S. Dickson; vice-president, E. W. Moore; secretary, James B. Hoge; treasurer, R. W. Judd.

C.

Indianapolis Telephone Company Formed.

The officers of the New Telephone Company of Indianapolis have perfected plans to form a new company to be known as the Indianapolis Telephone Company, which will be incorporated for the purpose of leasing and operating the wires and property and carrying on the business of the New Telephone Company's exchange. The capitalization of the Indianapolis company will be $1,500,000, with an issue of $400,000 three per cent. common stock and the remainder six per cent. preferred stock. The dividends, interest, etc., of the New Telephone Company's stock and bonds will be guaranteed by the Indianapolis Telephone Company during the time of its lease, which will be 20 years. The general plans for the organization of the Indianapolis Telephone Company and for the lease of the property will be similar to the plan under which the Indianapolis Traction and Terminal Company and the Indiana Union Traction companies were organized. The company was launched on February 9th at the annual meeting of the stockholders.

The net income of the property last year was $110,000, and after deducting interest on bonds and dividends on stock the company had a surplus of over $50,000 from its operation. The Indianapolis company will realize, immediately after its incorporation, from sale of common stock to holders of the stock of the New Telephone Company, $200,000, with which it will begin making extensions and pushing forward the work of laying new cable lines to accommodate more than 3,000 telephones, 2,000 of which are now on the waiting list. This improvement will cost $100,000, but will increase the net income of the property at least $24,000 annually.

Mr. S. P. Sheerin, president; Louis Hollweg, vice-president and H. B. Sale, secretary, of the New Telephone Company, will hold similar offices in the Indianapolis Telephone Company.

Evansville Municipal Telephone Situation.

A fight is on among the stockholders of the Evansville Municipal Telephone Company. About a year ago, when the Cumberland Telephone Company was denied a franchise by the City Council, a move was started to form a municipal company, headed by Mayor Covert, City Attorney Funkhouser, and others. Stock has been subscribed to the extent of $78,000, and a call was issued nine months ago for a payment of 30 per cent. of it. According to the plans of the new company the stockholders were to receive an annual dividend of seven per cent., and all other surplus earnings were to go toward retiring the stock. It was figured that at the end of 20 years the city would own the plant.

A meeting of the subscribers was called recently by E. H. Meyer, a subscriber, who charged the directors with having accomplished nothing, and he said that he had cause to believe their intention was to turn the company into private hands. He demanded that the directors make an explanation, and if the explanation is unsatisfactory he would ask for a receiver for the company. There were many heated debates among the stockholders present. It was learned during the course of the meeting that the directors had concluded to place the matter in the hands of the Evansville Businessmen's Association with a view to giving the scheme support. A committee was then appointed to confer with the directors as to the best means of proceeding with the work of installing the plant.

Engineer Eversole was present and stated that $23,000 had been paid in and about $6,000 had been expended for making maps and plans for the plant and for other preliminary work. He said the company would not suffer by the delay, as the preliminary work would have to be done anyway, and the company can now buy the material needed for $11,000 less than it would have cost six months ago. The meeting was notable on account of the absence of Mayor Covert and all the directors. It is understood that nothing will be done pending the injunction suit now under advisement by Judge Robinson.

GENERAL TELEPHONE NEWS.

A telephone system is to be established at Eupora, Miss., by A. W. Carter of Grenada, Miss.

E. W. Ellison and associates are organizing a company for the construction of a telephone system at Chesterfield, N. J.

The Demopolis (Ala.) Telephone Company has been incorporated by E. B. McCarty, N. L. Lee and L. L. Lee. The capital stock is $15,000.

A 20-year franchise has been granted to the Skagit Valley Telephone Company of LaConner, Wash., for the construction and operation of a telephone system in Skagit County.

The exchange system of the Alma Heights (Mich.) Telephone Company, which was organized last summer, has been completed and put into operation. S. W. Boughton is the manager.

C. H. Shaft of the Southern Bell Telephone and Telegraph Company, visited Norfolk, Berkely, Portsmouth and Newport News, Va., recently to secure statistics of the telephone needs of that section.

Farmers of Lost Valley and Pleasant Hill, Ore., about 15 miles east of Eugene, have united to construct a telephone line to Goshan, a distance of about 11 miles. The funds have been subscribed and construction will commence at once. At Goshan the new line will connect with the Pacific States company's line.

The Washington and Idaho Telephone Company has been organized and will run a line to connect Lake Creek with Blackbird and Freeman. The line will be thoroughly up-to-date and replace the old barb-wire line. The following-named officers have been elected: President, Jesse Low; vice-president, T. J. Hunt; secretary, William Oliver; treasurer, Peter King.

The stockholders of the Strowger Automatic Telephone Company held their annual meeting last week and elected officers. It was evident that a better feeling exists between the factions in the company, so much so that the arrangements made by the court a year ago in settling the legal fight which resulted from the last annual election were set aside and Elmer Washburn and A. E. Campbell installed, respectively, by the court as president and secretary, were succeeded by J. L. Kesner and M. Sello. The full list of officers elected is: President, J. L. Kesner; vice-president, A. G. Wheeler, Jr.; treasurer, J. Siegel; secretary, M. Sello. No financial statement was made public, but President Washburn called attention to the improved financial condition of the company.

Notes on the Operation of Small Telephone Exchanges.

By Howard S. Knowlton.

A critical analysis of any particular electric plant or system almost always brings to light certain defects in construction, operation, maintenance or business methods which tend to produce inefficient service. These defects may be small in themselves, but their cumulative effect is capable of working great harm. It is therefore important to eliminate them wherever possible, by constant study of the changing conditions of service and the apparatus and personnel which keep the service in motion. The small telephone exchange is peculiarly liable to suffer from these "little rifts within the lute," for there is scarcely any type of plant which demands such constant attention in the way of maintenance and oversight as does this. At the risk of picking to pieces some familiar flaws in operation, the writer calls attention to some of the conditions which may be found in practice, hoping that they may suggest improvements in cases to which they are applicable.

In a small exchange it is of vital importance to keep down the operating expenses if the business is to show a reasonable profit at the end of each month. To this end the manager must not scorn to begin at the ash pile itself and assure himself that no fuel is being wasted. If the office is heated by a stove, it is emphatically worth while to see that the fire is skilfully managed. This would seem to be self-evident if it were not for the fact that it is possible to find a red-hot stove in more than one office, trying its best to enrich the coal dealer, roast out the operators, and incidentally set the building on fire. If the operators are to do their best work day after day, some sort of attention must be paid to questions of ventilation and temperature.

During office hours, when an operator is on duty, personal calls from friends should not be permitted unless the traffic is extremely light. Nor should visitors be allowed to stand directly behind the operators' positions for long periods of time. It is trying work properly to operate a telephone switchboard in even a small town, and the presence of visitors continuously at any single point does not add to the ease of the work.

Linemen and repair men should preferably be under the direction of the manager of the local exchange, rather than subordinate to some official at a distance, for daily instructions. The emergencies which arise locally can generally be best handled locally, and it is scarcely good operation when a local manager suddenly needs the services of a trouble man and finds he does not know where that particular individual is working—this being because earlier in the day the trouble man was sent out by a distant official, who failed to notify the manager as to the destination in view.

In small exchanges there is often occasion to use a horse and runabout wagon in maintaining the lines, putting in new telephones, repairing instruments already installed, replacing batteries, etc. The livery bills at the end of each month may easily become quite imposing. In such cases it is a good plan to do all the livery business with one stable, providing the service is satisfactory, thereby gaining a reduction in rates. In getting about the country in this way it is important to lay out the route so that the same ground will not be covered twice on the same trip. This is not always possible, but the writer recalls an instance where a drive of nine miles was saved in making an appraisal of a line by simply beginning work at the proper end and cutting through one mile between parallel roads at the other end of the lead. It is of no small advantage if the linemen ride and own bicycles, in country which is supplied with good roads and has not too many hills. In fact, it will often pay a company itself to furnish bicycles to linemen for use on light repairs or installation of new instruments. Until one has seen the amount of telephone paraphernalia that can be carried on a wheel it is difficult to realize what a saving in livery bills can be effected by this means.

A common fault of small exchanges, where skilled employes are few in number, is found in insufficient inspection of the subscribers' stations and aerial lines. The lines should not be allowed to lapse into slackness of appearance; poles which have been split by lightning so as to render them unsafe ought to be promptly replaced; insulators which have been pulled from their pins by the tautness of the wire should be put back in place; batteries which need recharging or replacement should not wait for repeated complaints on the part of subscribers before matters are righted, and when drop leads are attached so tightly to a house that the inhabitants cannot sleep at night on account of the humming of the wires in the wind, it should not take two or three weeks of complaint, with final threats to have the telephone removed, to remedy affairs.

When an exchange has grown from small beginnings to number its subscribers among the hundreds, it is almost always desirable that the superintendent, agent or manager—whatever his title may be—give his whole working time to its interests. The complexity of the business increases with the growth of traffic; questions arise that demand considerable time for proper weighing in mind; the demands of the public become more exacting; prominent citizens must be interviewed in regard to measures which the company wishes to adopt; collections become more onerous; records more extensive must be carefully kept, and it is not too much to say that the proper administration of all these affairs requires a manager's entire working day. Maintenance and new construction also become relatively more important. If the manager is a member of one or two fraternal orders, takes a prominent part in local club and social affairs, and is generally well acquainted with the influential residents of the town, it will do the telephone company no harm—perhaps much good. But a man who manages a growing telephone business properly must not have "too many irons in the fire" if he is to work most efficiently.

Coming now to central-office operation once more, there are a number of things to be said in the way of criticising defects. Sometimes complaints arise in the country districts because the lines desired are busy for long periods and the company is often unjustly blamed for this when in reality the subscribers themselves are at fault for extending their conversation to unreasonable length. It is the custom in such districts for a process of visiting by telephone to go on each evening, and it is not uncommon for conversations to last half or three-quarters of an hour, while one instance brought to the writer's attention covered nearly two hours of continuous cord-circuit connection. It would seem that after a certain time limit had elapsed, say 10 or 15 minutes, an agreement might be reached between the company and its subscribers to provide for a temporary interruption of the conversation between two parties in case a third party wished to use the busy line. No doubt serious difficulties would arise in connection with the keeping of this time, but it would seem that some such plan must be adopted if freer service is to be attained. The best plan possible would of course be to educate the subscribers to the habit of holding shorter conversations, but this is a staggering task to attempt. When a toll call comes in from a distant exchange, however, local connections should be made to give way before it, for every unoccupied minute means decided financial loss to the operating company. Toll lines are expensive property, and it is important that they earn money as much of the time as the best management can accomplish. Then, too, the party at the calling end must be considered. From almost ever point of view it is best that the toll call shall be treated with the same respect and rushed through the system in the same way that the lines of a steam railroad are cleared many miles in advance of a limited express train operating on a high-speed schedule.

Even in a small exchange subscribers should be taught to call one another by numbers instead of by names. The ideal method of giving operators purely routine work is here sought. As the exchange grows in capacity for business and as new subscribers are added, numbers changed, etc., it becomes harder for the operators to remember the names and numbers together; and the best foundation for future excellence of service includes this use of numbers as one of the important requirements. In offices that are not large it is often necessary for operators to be shifted with the traffic requirements from local to toll switchboard and back again. This is not troublesome unless the exchange grows rapidly to large dimensions. Always the point of giving each operator as little special work as possible must be kept in mind.

Delays in answering subscribers, unnecessary interruptions of conversations and mistakes in ringing are all so familiar to every telephone user that they need not be enlarged upon here. Suffice it to say that uniform courtesy should always be the rule in the operator's treatment of the public, no matter how discourteous the public may be, and in cases of mistaken ringing a polite apology for the inconvenience caused should invariably be tendered.

There should always be enough directories on hand at the central office to supply the subscribers' legitimate needs. As much excuse exists for an insufficient quantity as can be applied to a railway office which runs out of time tables.

Accurate records should be kept of the exact apparatus installed at each subscriber's station. Also, the pole lines ought to be carefully recorded, so that the entire cost of construction of any line or group of lines can be quickly determined. Here the card catalogue offers much help, particularly in relation to contracts with subscribers, rates, payments, changes in number, instruments, etc. It should be possible to determine the revenue and expenses each day of the exchange's life with a fair degree of accuracy.

Voltage Regulation of Rotary Converters.[1]

By P. M. Lincoln.

The regulation of a rotary converter differs from that of a direct-current generator in one essential—the actual increase in the voltage delivered by a rotary converter as the load increases depends not only upon its design but also upon the characteristics of other parts of the system to which it may be connected; compounding of a direct-current generator, however, depends entirely upon the design of the machine itself.

The external element upon which the actual compounding of a converter depends is the inductance of the supply circuit. To analyze the influence of inductance in the compounding of a converter it is necessary first to consider what happens if a converter be operated with a varying field current while a constant voltage is applied to the collector rings.

It is a well-known fact that there is a certain adjustment of rotary-converter field strength that gives a minimum alternating-current input for a given direct-current output, and that varying the field strength either way will increase this alternating-current input, while the direct-current output remains the same. In every case the alternating-current input may be considered as being made up of two components—one, the energy component in phase with the impressed electromotive force; the other, a wattless component, leading when the field strength is too great and lagging when the field strength is too small.

A constant alternating-current voltage across the collector rings has been assumed, and it is evident that the constancy of this applied voltage means the generation of practically a constant voltage by the rotation of the rotary converter armature. To generate this constant voltage in the converter armature (which runs at a definite speed) there must be a constant magnetic induction through the armature, and therefore a constant number of ampere turns to produce that induction.

In a rotary converter or other synchronous machine there are two sources of excitation—current in the field winding and current in the armature winding. To produce a constant voltage the sum of these two excitations must be a constant. If the ampere turns in the field winding are less than necessary a current circulates in the armature in such a manner as to assist the field in magnetizing the armature. Such a magnetizing current, though leading with respect to the electromotive force of the converter, regarded as a generator of electromotive force, is lagging with respect to the generator or supply system. On the other hand, if the ampere turns of the field winding are more than sufficient to produce the constant voltage we have assumed, a current circulates in the armature in such a manner as to oppose the field winding, and so reduce the magnetic induction to the required amount. This magnetizing current is leading with respect to the generator or supply system.

The actual current circulating in the armature may be regarded as being composed of the magnetizing current and the useful current, and the ratio of this useful component to the resultant of the useful and magnetizing components is known as the power factor of the circuit. It is measured by the ratio of the true input (recorded by a wattmeter) to the apparent input (recorded by an ammeter and voltmeter).

From the above analysis it is evident that the power factor of the alternating current taken by a rotary converter is intimately dependent on the amount of its armature magnetizing or demagnetizing current, and therefore dependent upon the field current of the converter. The limits of variation of power factor are from a very low power factor lagging to a very low power factor leading. The first occurs with a small load or no load when the field excitation is too low, and the second with a small load or no load when the field excitation is too high.

From this it will be seen that variations in field strength give lagging or leading current. It does not, however, affect the armature magnetization, and so a change in field strength alone cannot affect the direct-current voltage. This bears a fixed relation to the alternating-current voltage, so that the only way to raise the direct-current voltage is by raising the alternating-current voltage at the collector rings. Now the voltage at the collector rings of a converter is the resultant of two components: first, the voltage of the generator, and, second, the voltage needed to force the current taken by the converter through the inductance between itself and the generator. The resistance between the generator and the converter is also a modifying element, but we will assume this resistance to be negligible, and without

1 From the Electric Club Journal.

attempting at this point to give reasons, state the facts concerning the resultant of the two components.

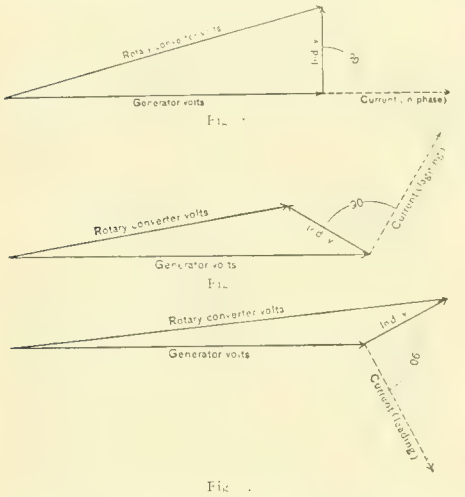
(1) As long as the current supplied to the converter is neither lagging nor leading, the inductance volts combine with the generator volts in such a manner that their resultant, the converter voltage, is practically the same as the generator voltage; that is, a noninductive load causes practically no drop over that due to the resistance of the line.

(2) If the converter current is lagging the two elements combine in such a way that their resultant is smaller than the generator volts; that is, the electromotive force of self-induction causes an increased drop over that due to line resistance.

(3) If the current is leading the result is greater than the generator volts; that is, the electromotive force of self-induction in this case adds to the generator volts.

It is evident therefore that if we can cause the current taken by the rotary converter to change from lagging at no load to leading at full load the voltage applied to the converter will change from an amount less than the generator voltage at no load to an amount greater than the generator voltage at full load, and this is exactly the function of the series field. It makes the field ampere turns increase with load, and therefore, as set forth above, causes the lagging component of the current supplied to the rotary converter to decrease and the leading component to increase, or both.

Now, to explain the reasons why the resultant



VOLTAGE REGULATION OF ROTARY CONVERTER.

of the two components which make up the converter voltage increase as the current changes from lagging to leading. The volts across an inductance (the electromotive force or self-induction) lag 90° behind the current causing them, the resistance being negligible. This lag remains fixed under all conditions. If, therefore, a rotary-converter current is neither lagging nor leading, the inductive volts caused by that current lag 90° behind the generator volts. This condition is shown on Fig. 1, where it is evident that the rotary converter volts are practically of the same value as the generator volts. Now, if the rotary converter current lags the inductance volts are thrown around into such a position that the resultant of them and the generator volts is smaller than the generator volts.

This condition is shown in Fig. 2. If, on the other hand, the rotary-converter current is leading, the resultant of the two elements is greater than the generator volts as shown in Fig. 3.

It will be noted that the amount of compounding depends upon two things:

(1) The variations from lagging to leading current between no load and full load, or, referring to the diagrams, upon the change in angle between the generator volts and inductance volts.

(2) Upon the drop across the inductance, or, referring to the diagrams, upon the length of the line representing inductance volts, compared to the length of the line representing generator volts.

The first condition depends upon the relative amount of series winding on the rotary converter, and this is covered by the design of the machine. The second, the inductance in circuit, depends, however, upon conditions entirely outside of the rotary converter.

In a rotary-converter plant there are usually three sources of inductive drop—the step-up transformers, the line, and the step-down transformers. In specific cases, however, any or all of these sources may be absent. For instance, where a rotary converter is operated directly from generators in the same building, there will be practically no inductance between the rotary converter and the generator. In order to obtain compounding in this case, it is necessary to insert inductance, usually choke coils, between the rotary converter and the generator.

The preceding discussion may be briefly recapitulated as follows:

(1) A series coil on a rotary converter has the effect of automatically changing the ampere-turns applied to the field.

(2) Varying the field ampere-turns means varying the magnetizing element of the alternating current delivered to the collector rings, causing the current to become leading when the ampere-turns are more than normal and lagging when the ampere-turns are less than normal.

(3) The voltage across any inductance in circuit tends to subtract from the generator voltage when the converter current lags and tends to add to the generator voltage when the converter current leads.

(4) The conditions for rotary-converter compounding are therefore:

(a) A series winding on the rotary converter connected so as to assist the shunt.

(b) Inductance between the generator and rotary converter.

The series field coils in a rotary converter do not increase the voltage directly, as in a direct-current generator, but indirectly, through co-operation with inductance in the supply circuit.

A Pole Order Curiously Filled.

E. A. Lindsley, secretary of the Lindsley Bros. Company, relates a peculiar incident in the history of his western business experience while establishing the company's now successful western business. While at Portland a pole order was received from a prosperous city in Arizona which rather baffled Mr. Lindsley. The order was for 1,200 six-inch 30-foot cedar poles. This size of pole was never produced in Oregon, but it happened the company had 400 undersized 30-foot poles in stock, which were immediately shipped. C. P. Lindsley, manager at Spokane, was then communicated with, who replied that it would be impossible to pick up more than 400, and these to come from undersized poles at different yards. These were dispatched, after a few days of rate manipulation. The last 400 absolutely baffled Mr. Lindsley until he telegraphed to G. L. Lindsley, manager of the eastern branch, with headquarters then at Menominee, Mich. A reply was soon received to the effect that a rate had been secured and that the remaining 400 would be forwarded post haste. This filled the order, with one-third from Oregon, one-third from Idaho and one-third from Michigan.

Mining of Rare Minerals in Texas Excites Conjecture.

Kingsland, Texas, March 3.—The publication of the fact that the Nernst Lamp Company of Pittsburg, Pa., is utilizing the products of the rare mineral known as gadolinite, which is found in abundant quantities near here, in the manufacture of its electric lamps has attracted wide attention from other lamp manufacturers and electrical manufacturers throughout the United States. The representatives of a number of these concerns have arrived in this locality recently, and a thorough scientific investigation is being made of the mineral resources that exist in this region. It is asserted that the Nernst Lamp Company utilizes, by some secret process, the radio-activity of the minerals which it is constantly shipping from here to its laboratory at Pittsburg. The company is said to be trying to purchase more land containing the earths and ores which it is utilizing, but the owners have raised the prices to almost prohibitive figures. However, it is said by representatives of the Nernst Lamp Company that the gadolinite which it is mining near here does not contain radium or radio-active properties. This statement, however, does not agree with the reports of disinterested scientists who have recently conducted tests and examinations of that mineral. A mining representative of the Nernst Lamp Company makes the following statement:

"The locality known as Barringer Hill, situated 11 miles from Kingsland, Texas, has become famous the world over within the last few weeks for its unprecedented yield of gadolinite and five other rare minerals, namely, yttrialite, rowlandite, nivenite, thoro-gummite and mackintoshite. It is the only place in the world that these minerals are mined for exclusively. At all other places where gadolinite is found it occurs as a bi-product in feldspar mining. The mining of this yttria ore on a rather large scale lately gave rise to the rumor that radium was being sought, instead of the first-mentioned substance. Gadolinite is now quoted at $1.50 per pound in 1,000-kilogram lots, or by the gross ton, and is found in Norway." H.

Clarence H. Mackay and others have organized the Mackay Companies under the Massachusetts laws to hold securities in the Commercial Cable Company and other corporations in which the late John W. Mackay was the leading spirit, and whose name it is designed to perpetuate. The trustees of the Mackay Companies are C. H. Mackay, John I. Waterbury, T. J. Coolidge and W. W. Cook. The $30,000,000 four per cent. cumulative preferred stock of the new concern and a like amount of common are offered in exchange for the $15,000,000 stock of the Commercial Cable Company.

CORRESPONDENCE.

Great Britain.

London, February 23.—Instances are continually arising which emphasize the need for legislative reform in Great Britain, especially in connection with electrical matters. It has already been pointed out that the London United Tramways Company has formed a connection with the District Railway Company, now dominated by Mr. Yerkes. In order to reap some practical benefit from the fusion of the two interests the Tramways company proposed this year to run its cars from the surface of the streets at Hammersmith to the level of the underground railway at that point, so that passengers upon the railway could continue their journey further west without coming up into the street. It was also proposed to connect the company's tramway systems north and south of the River Thames by means of a tunnel under the river, the company having been twice refused permission by Parliament to run its cars over the existing bridge. The majority of these proposed works would have been on private ground, and only a very small portion upon the public roadway. There appeared, therefore, some justification for the company to call these works "railways," and so obviate having to obtain the consent of the local authority, always a difficult and expensive matter. However, when the bill came before the examiners in the House of Commons the London County Council was successful upon a mere technicality, in arguing that the lines were tramways and that therefore the local consent should have been obtained. This view was accepted and the bill thrown out, as all measures of this character must be approved by the local authority. Thus a promising scheme is again put back purely owing to restrictive legislation.

The Board of Trade has caused a letter to be addressed to the Engineering Standards Committee intimating that his majesty's treasury has decided to make a grant in aid to the committee equal in amount to that subscribed by the supporting firms and institutions referred to in my last week's notes. The treasury has already granted the sum of $15,000.

A very undesirable feature in connection with municipal trading (and one which may be expected to occur frequently in the future) has revealed itself at West Ham (London). The local authority has gone in extensively for electric lighting and electric tramways. Quite recently it exercised its powers and purchased some horse lines from a company which is now busily engaged in converting all its lines to electric traction. But the local authority now finds itself with such heavy commitments for several years ahead that it has decided to postpone the electrification of the tramways just purchased. This is certainly an instance of municipal ownership retarding and not accelerating progress.

The annual exhibition of the Society of Motor Manufacturers and Traders has just closed, but once more it was essentially a "petrol" show. Only two or three electrical cars were shown, and nothing new was to be seen which would encourage a hope of any great progress in the industry in Great Britain in the near future. The biggest display of electrical goods was in the direction of ignition apparatus for petrol motors.

Considerable progress is now being made with the conversion of the system of the Metropolitan District Railway Company to electric traction. Particulars of one or two of the tenders have recently been given in these notes. The key of the whole position is the great power house at Lots Road, Chelsea, from which the complete system of the District company as well as four "tube" railways will be operated. Nearly 1,000 men are now at work upon this station, where the engine room is roofed in and the erection of machinery is being busily proceeded with. It is now definitely hoped to supply current by autumn. The foundations for the first of the Westinghouse-Parsons steam turbines are in position, and the turbine is due ere this. In addition, a large proportion of the high-tension cables have been laid, and contracts have been invited for the whole of the rolling stock. Sixty trains are expected to constitute the first order, and they will each comprise three motor cars and four trailer cars. Nothing used on these trains will be of an inflammable nature, the company having spent $1,500,000 in this direction out of a total of nearly $4,500,000. The work is proceeding by day and night, and upon a short length of electrically equipped track the motormen are being trained in their new duties. Other companies having branches running from the District company's lines are entering into agreements for the electrical equipment of these with a view to maintaining the existing services.

It is stated—with what truth I have been unable to ascertain—that a petition will be presented to Parliament shortly by the inhabitants of that part of Cornwall within reasonable proximity to the stations of the Marconi Wireless Telegraph Company, to suggest that the working of the huge wireless system is responsible for the execrable weather which has been experienced there of late. It is to be hoped that the deputation will be treated seriously.

G.

New York.

New York, March 5.—The campaign of the Metropolitan Street Railway Company to secure a tunnel franchise to compete with the Interborough system is advanced a step this week by the announcement that the Metropolitan company is prepared not only to construct the subway at its own expense but also to find the money without the issue of city bonds. The company insists, however, that its original route shall not be changed, and it is probably on the point of routes that all the coming discussion will turn, for the rapid transit commission has intimated its intention to map out such routes as it thinks best suited for public convenience and then assign the route to the highest bidder. To facilitate matters in any case the commissioners have asked for statutory powers to borrow an additional sum of $50,000,000; and for sundry rights as to changes of routes of tunnel schemes and the acquisition of property and easements. All this looks as though a very big move were in progress, designed to give the Metropolitan company all, or nearly all, the privileges that it desires, and the consequent rejection of the Belmont-Interborough plans for the West Broadway tunnel.

Elaborate preparations are being made for an experimental electric track for testing electric locomotives ordered by the New York Central Railroad. This special track is being laid at Schenectady, and the locomotives, 30 in number, of 2,200 horsepower each, are to be built by the General Electric Company.

Mayor McClellan is strenuously advocating a scheme for utilizing salt water as a fire extinguisher. The necessary pumps would be operated either by gas engines or electricity, and it is said that it would be cheaper to install electric motors than gas engines. Gas engines, such as are used for pumping salt water at Philadelphia, cost about $45 per horsepower, but electric motors of the same capacity with all necessary switchboards would cost perhaps $30 per horsepower. With gas at $1 a thousand and electrical current at five cents a kilowatt-hour, the gas engines would be cheaper to operate.

The agitation in favor of the establishment of a municipal-lighting plant for New York city is again to the fore. The suggestion has been under consideration in one form or another for many years, but a few months ago a misunderstanding regarding methods of payment arose between the lighting commissioner and the central-station companies, with the result that the tenders for the year commencing with the present month have been rejected both for gas and electricity on the ground of collusion between the competing companies.

A lively struggle is proceeding in this city as to the utilization of the telegraph and telephone for gambling purposes. The telegraph company has put up its rates for a race-track service from $17 to $25 a day, which has had the effect of closing not a few of the smaller poolrooms, and now it is found that it is cheaper to use the telephone even for race results from New Orleans.

The proposals of the Niagara, Lockport and Ontario Power Company are evoking a loud outcry about "the ruin of Niagara," and Governor Odell is being urged to kill the measure just passed at Albany. Action has been taken by the state reservation commissioners at Niagara protesting that the charters already affecting the Niagara River are estimated to utilize one-third of the total available waterpower. The Niagara, Lockport and Ontario people originally got their franchise in 1894 and were to supply Lockport with power and light on the understanding that its works should be begun before May 21, 1904. The new act allows them an additional two years and also increases the general scope of their operations.

There is not so much submarine cable manufactured in the United States that one can afford to ignore the shipment from Hoboken to Seattle of the last 43 miles of American-made cable for the government line from Seattle to Sitka, Alaska. This section of the cable weighed about 430 tons and was loaded upon five large freight cars. D. W. W.

New England.

Boston, March 5.—By a decision of the Supreme Court, just rendered, in a case wherein the Lexington and Boston Street Railway Company was made the defendant by a passenger, who sought to recover an extra five-cent fare paid by him, upon the plea that the company had violated one of the conditions of its franchise imposed by the towns of Concord and Bedford, whereby single five-cent fares for each town were determined upon by the selectmen, the street railways of Massachusetts are given a notable advantage. The court ruled that such conditions were not valid, since by the general railway statute of 1898 the directors have the primary right of fixing and regulating fares, subject to revision of the railroad commissioners, who are expected to act upon broad considerations of public policy.

The receivership which was denied the creditors of the Middleboro, Wareham and Buzzard's Bay Street Railway Company last month has at last been granted, and John T. Burnett and John L. Hall, named by Judge Hale of the United States Circuit Court, have taken charge. The liabilities of the road on September 30, 1903, were $572,967.48. The suit for a receiver was brought by the American Electric Works Company.

The Massachusetts Railroad Commission issued an order on March 1st which settled the Pittsfield muddle over the granting of locations to the street-railway company in that city by the aldermen of 1903 and the rescinding of the order therefor by the aldermen of 1904. The commission decides that "when a grant has been once formally made and the company has filed with the railroad commission its petition for a certificate, it is too late for the aldermen to rescind that action without the consent of the company." The grant by the 1903 aldermen is therefore approved subject to necessary formalities incidental to the locating of poles, etc., by the present board.

Capitalists in Springfield and points beyond, in Western Massachusetts, are taking steps to form a trolley express company to operate in that section, similar to the company planned for the suburban districts around Boston.

Anthony, Tucker, Anthony & Co., Boston capitalists who control railway properties in Hartford, Conn., and Springfield, Mass., have bought the franchise of the Windsor Locks and Rainbow Street Railway Company in order to carry out a scheme for a circuit line between the two cities. The intention is to have a line on the west side of the Connecticut River to supplement the one now in operation on the east side of the stream. The company which has just changed hands, possesses franchises for the building of about 10 miles of road that will be necessary to complete the round-trip circuit. It is capitalized for $100,000. The new owners have organized with the following officers: President, William A. Tucker; treasurer, S. Reed Anthony, Boston; secretary, Arthur Perkins, Hartford.

The New York, New Haven and Hartford Railroad corporation is to absorb another street-railway property in Connecticut, papers being reported as ready for transfer, which will give the steam-railroad company possession of the Fair Haven and Westville Street Railway Company of New Haven. The stock of the street-railway property is about $5,000,000, and its funded debt is $1,133,000. Its trackage is upward of 100 miles, comprising the trolley system centering in New Haven with its outlying branches to suburban points. The object of the steam-railroad company is to break up the plans for a long-distance trolley system, that has been trying to acquire the same property with a view to paralleling the steam road in the same section, between New York and Boston.

The General Electric Company has asked for bids from contractors for the construction of a four-story brick structure for factory purposes, to be erected on Federal Street, West Lynn, on land adjoining the present extensive plant. B.

Ohio.

Cleveland, March 5.—The City Council of Zanesville has passed an ordinance granting a franchise to the Columbus, Newark and Zanesville Railway Company, admitting it to the heart of the city.

An electric locomotive has been delivered to the Cincinnati, Georgetown and Portsmouth Railroad Company. It will be used for switching purposes in Cincinnati. Another that will be received within a short time will be put into service on the road for hauling freight trains. These are the first electric locomotives to be put into service in the state, and their operation will be watched with interest by managers.

The Peoples' Gas and Electric Company of Xenia has brought an injunction suit against the city to prevent the enforcement of an ordinance regulating the price of gas. The ordinance fixes the maximum price at $1.25 for illuminating purposes and $1 for heating and fuel, the latter figure to apply to all gas consumed for both purposes.

It is said that the Toledo and Indiana Electric Railroad Company has been financed by a Philadelphia syndicate and will be built through to Fort Wayne by way of Defiance. The suggestion is made that the same syndicate that purchased the Fort Wayne electric line is backing the Toledo and Indiana company.

The Miami, Bucyrus and Tiffin Railway and Light Company has been incorporated with a capital stock of $10,000 by M. B. Earnhart of Columbus, O. M. Bake of Hamilton, J. D. DeWitt and others.

The case of the county against the Appleyard syndicate to recover nine miles of track and the shops of the Bellaire, Zanesville and Cincinnati road, acquired some time ago by the syndicate, has been practically dismissed by the Common Pleas Court at Zanesville. The decision is based upon the fact that the commissioners had not declared the property forfeited under conditions which they claim brought it into their possession.

Shad Reed of Kenton spent the last week in New York looking after financing the Sandusky and Southwestern Interurban railway, which will build lines from Kenton to Wapakoneta and from Lima to Bellefontaine. The power house will be located at the junction of the lines. It is stated that he arranged for the sale of $2,000,000 bonds.

The management of the Fort Wayne and Springfield Electric Railway Company states that cars will be in operation by September. Contracts have been awarded for eight bridges to the New Castle Bridge Company of Indianapolis and the construction work is being pushed along as rapidly as the weather will allow.

It is said that steps will soon be taken to carry into effect plans for the consolidation of the Dayton, Springfield and Urbana and the Columbus, London and Springfield electric railways, both owned by the Appleyard syndicate. Richard Emory will continue to be general manager; E. B. Gunn, superintendent, and B. M. Brown, general passenger and traffic manager, succeeding G. H. Harrington. It is also said that the general offices will be moved to Springfield.

February earnings of the Northern Ohio electric roads show up about the same as one year ago. They did not make the expected increase on account of light travel, due to the extremely cold weather and the increased expense of operation. Recently high water has been severe in many parts of the state, especially about Fremont and in the Maumee valley, as well as in the vicinity of Steubenville, Canton, Massillon, Bucyrus and other points. Many of the roads were flooded and cars either did not run or were operated over only a portion of the lines. The damage done to the roadbeds and bridges is hard to estimate at this time, but it is safe to say that extensive repairs will be required on some of the lines.

The Interstate Traction Company has been incorporated in Indiana by J. D. Boroff and W. H. Reinz of Dayton, Ohio; E. R. Phillips of New Carlisle, Ohio, and B. A. Landis of Camden, Ohio. The capital stock is $50,000, and the articles state that the company will build a road from Dayton to Indianapolis.

The commissioners of Hamilton and Clermont Counties have granted the Cincinnati, Milford and Loveland and the Cincinnati and Columbus interurbans franchises to use the bridge across the Little Miami River at Milford. This settles a long dispute. O. M. C.

Michigan.

Detroit, March 5.—The first installment of a lot of new double-truck cars for the Detroit United Railway has been received and is the first of a lot of 50 built for the company by the J. G. Brill Company of Philadelphia and St. Louis. The motors are all new Westinghouse No. 56, of 65 horsepower, two to each car. The cars are roomy; the chief considerations in building them were strength and room. They are reinforced from end to end. Besides, the doors and aisles are made extra wide to provide easy entrance and exit. When the entire 50 are in commission the company will have 170 double-truck cars for city service, and they will be added to as fast as the single-truck cars wear out.

The projectors of the Detroit, Flint and Saginaw Electric railway have applied to the Common Council of Flint for a franchise to operate their line in that city. A franchise has been asked of the Clio Village Council and in a few days a franchise will be asked of the Mt. Morris Village Council. The company will then have the entire right-of-way through to Saginaw.

At a meeting of the Village Council of Brooklyn, Mich., a 30-year franchise was given to Hon. John O. Zabel of Petersburg, Mich., and F. M. Foster of Toledo for an electric railway to be built through the village within two years. The proposed road will extend from Petersburg through Brooklyn to Jackson by way of Tecumseh.

The Owosso and Corunna Electric Company, which operates the electric line from Owosso to Corunna and furnishes light for the city of Owosso, has been sold to a Pennsylvania syndicate which controls several lines around Allentown, Pa., and which also has the control of the public lighting in Flint. The company has secured an extension of the franchise in Owosso and Corunna and will extend the road to Durand.

The business men of Mt. Clemens have asked the Rapid Railway Company (electric) to put on a freight car which shall run between Detroit and that city only and which will make two trips a day.

The Lansing Street Car Company has introduced a metal box, into which passengers are requested to deposit their fare. The conductors naturally look upon this innovation with disfavor and some have thrown up their jobs.

The completion of the Detroit and Toledo Short Line electric railway is being held up pending action of the Springwells Township Board in regard to its suit against the Irvin & Pepper Company for the annulment of an old street-car franchise held by that company. The franchise, which was granted 15 years ago and has yet 15 years to run, is believed to have been acquired by the new company.

The American Engineering Company of Detroit has been advised from Washington that it has won its fourth suit for infringement of its patents covering the wireless-railroad signaling device by which engineers are warned of dangers ahead and of conditions at crossings and sidings before these are in sight. C. G. W.

Pacific Slope.

San Francisco, March 3.—The San Bernardino Gas and Electric Company is installing a large system of arc lamps at San Bernardino, Cal. The California Electrical Works has received an order for 90 of these lamps, of the series alternating type.

The National Electric Company has the contract for installing the electric plant, telephone and bell systems in a three-story residence being built for A. B. Hammond on Broadway near Fillmore Street. The cost is $3,000.

C. N. McGregor is to do the electric wiring for the residence of W. Y. Yore of Oakland, at a cost of $2,770.

The Independent Electrical Construction Company is to do the electrical work for a residence being

built for the Hayes-Chyoweth Company in Santa Clara County. The contract price is $4,000.

The United Railroads of San Francisco has announced its intention of changing the old steam road, extending from California Street to the Cliff House into a modern electric line. Plans have been filed with the board of supervisors showing the kind of apparatus to be installed.

D. W. and A. W. Coons have arrived in Los Angeles from the East and have opened a factory in West Fourteenth Street for the manufacture of dry cells. The demand for dry cells has increased of late years, justifying the establishment of an institution of the kind, which is now in operation.

Active work has been begun by the promoters of the Richmond Suburban electric railway at Point Richmond, Cal. The line will connect the industrial centers of the city.

The Scott Valley Creamery Company at Greenview, Cal., has decided to enter into negotiations with the Siskiyou Electric Power Company to establish a plant at the creamery. This will probably result in the electric lighting of the town also.

At a recent meeting of the council of Long Beach, Cal., the report of Charles Glass, giving an estimate on the construction of an electric-lighting plant for the city was adopted. It is the intention of the council to call an election for the purpose of issuing bonds for the work. The plant will cost $100,000.

The British Columbia Electric Railway Company, with headquarters at New Westminster, B. C., has secured the contract for furnishing the city with an electric-lighting system. The company will erect a $30,000 transforming station in the city at once.

A bond election is about to be held in Wasco, Ore., the proceeds to be used in the construction of a municipal electric power system and the construction of a water plant.

E. S. Babcock has petitioned the City Council of San Diego for a franchise to run a double-track electric railroad through the principal streets of the city, including in the plan lines to National City and Otay.

The Mendocino Electric Light and Power Company has been organized at Mendocino, Cal., and will have a capital stock of $25,000. Among the incorporators are J. Grindle and A. Brown.

The work of installing the new electric-lighting system in Santa Clara, Cal., has been commenced and the work of putting the new poles in place is well under way. It is expected that the linemen will commence the work of stretching the wires this week. The power will be furnished by the Standard Electric Company. A.

PERSONAL.

Mr. W. R. Mason, a well-known electrical man, is now connected with the Chicago branch of the Electric Vehicle Company, which deals in automobiles at 1413 Michigan Avenue.

Charles E. Krebs has been made superintendent of the Jewett Car Works at Newark, Ohio, to succeed Neil Paulson, resigned. Mr. Krebs has been assistant superintendent for some time.

The will of the late William C. Whitney, who had large electrical-traction interests in New York city, has been filled. The real estate is valued at $1,000,000 and the personal property at $10,000,000.

Professor M. E. Cooley has been made dean of the engineering department of the University of Michigan. Professor Cooley is professor of mechanical engineering and is one of the most popular instructors in the university.

James F. Nathan, who recently took charge of the Western Union Telegraph Company's office in State Street, Boston, has been promoted to be general inspector of the New York state district of the company. Mr. Nathan was connected with the Western Union Company in Chicago prior to accepting the Boston position.

Dr. E. C. Kilbourne, the pioneer electrical man of Seattle, Wash., has withdrawn from the Union Electric Company and will become a partner of the Kilbourne-Clark Company, one of the largest electrical supply concerns on the coast, doing business as far north as Nome, south to San Diego and east to Montana. Dr. Kilbourne was the first to apply electricity as a motive power in Seattle.

W. W. Wheatley, who was for a time superintendent of the trolley system of the Brooklyn Rapid Transit Company, has gone to Mexico, where he is to assume charge of the electric-railway system of the City of Mexico. Mr. Wheatley was with the Brooklyn Rapid Transit Company for two years. In 1903 he became general manager of the Public Service Corporation in New Jersey, but resigned recently.

Mr. B. C. Kenyon, who for six years has been general manager of the Diehl Manufacturing Company of Elizabethport, N. J., was elected president of that company on March 8th. This appointment is a high compliment to Mr. Kenyon's executive ability, to say nothing of its being further evidence of appreciation of his skill in the disposition of the large product of the Diehl factory. Mr. Kenyon has been connected with the electric-fan industry and with the Diehl company for a period extending over eight years. For two years he acted as manager of sales for the company, and then he was promoted to be general manager, and served in that capacity for six years. Mr. Kenyon's friends throughout the United States are many, and it is no exaggeration to say that he is one of the most popular and well-like men in the electrical business.

It is reported that General Manager Robert McCulloch of the Chicago City Railway Company has been tendered the office of superintendent of the St. Louis Transit Company. Mr. McCulloch was named as a director of the company at the recent annual meeting in St. Louis, and, it is said, was subsequently tendered the active direction of the Transit company's entire traction interests. Mr. McCulloch is well fitted for the position, having been vice-president and general manager of the St. Louis company previous to coming to Chicago. But he does not confirm the report or say that he will accept the offer at this time.

ELECTRIC LIGHTING.

The proposed issue of $50,000 in bonds for the construction of an electric-light plant and system of sewers in Anadarka, Okla. T., was approved by the citizens at a recent election.

The Chattanooga (Tenn.) Plow Works will install an electric-light and power plant to generate its own electricity. The factory will be greatly enlarged.

The Townsend Electric Company has been incorporated for the purpose of generating electricity in Baltimore, Md. M. J. Fitzsimmons and E. L. Ward of Baltimore head the incorporators.

A franchise has been awarded to Frank Sutter for the erection of an electric-light plant at Analusia, Ala. A system of waterworks and an ice factory will be established in connection.

The Milford Electric Light and Power Transmission Company has sold out, through the J. S. Maurer Company agency, to Mr. E. Lindner of Pecatonica, Ill., for a consideration of $15,000.

The Village Council of Garden, Mich., has granted a 20-year electric-lighting franchise to local men. The town is small, but enterprising, and sufficient lights have been ordered installed by the municipality and citizens to make the venture paying.

The Rand Central Electric Works reports that during the month of January last its plant at Johannesburg, South Africa, generated 776,940 kilowatt-hours, yielding a gross revenue of about $35,000, while for the corresponding period last year 677,860 kilowatt-hours were generated, yielding a gross revenue of about $25,000.

The Electric Company of Mitchell, S. D., is preparing to enlarge its system of arc and incandescent lighting in that city. The capacity of the incandescent system will be increased to 3,000 lights and the arc-lighting system will be entirely changed to the series-alternating system. Several other changes will also be made in the machinery at the plant.

The Chicago Edison Company has leased from L. Kiper & Son for a term of 10 years a lot 100 by 117 feet fronting on Peoria Street adjoining the Metropolitan elevated road. Under the terms of the transaction the lessors are to build a six-story brick building, with elevator, electric light, sprinkler system and steam heat, to be used by the Edison company for storage.

ELECTRIC RAILWAYS.

A franchise has been granted by the City Council of Ogden Utah, to the Ogden Rapid Transit Company to operate a street-railway system through some of the most important streets of the city.

The Boise (Idaho) Rapid Transit Company has been granted a franchise for a five-mile extension of its street-railway system and has ordered the necessary equipment.

The electric railway recently constructed from Warren, Pa., to Sugargrove, will be extended this summer to Lakewood, N. Y., where it will make connections with the Erie Railroad, the Jamestown street railway and the Chautauqua Traction Company.

The contract for building an extension of the Wheeling (W. Va.) Traction Company's electric railway from Pasco to Barton has been awarded to the Frank H. Blodgett Company of Wheeling. The line covers a distance of four miles and passes through a well-populated valley, which will make a valuable extension to the company's lines.

The Sheffield Company, which is building a tri-city electric railway between Tuscumbia, Sheffield and Florence, Ala., and in addition thereto an electric-light plant and waterworks system for the three cities, expects to have all the plants in operation soon. The power house is nearing completion and a number of cars have already arrived.

The Salt Lake and Brigham City Electric Railway Company has secured franchises for its line through Davis County, Utah, and the company is now ready to commence grading. The initial line will be built between Salt Lake and Ogden. This will traverse practically the same route as the proposed road of Simon Bamberger of Salt Lake, between the two cities.

Representatives of Ohio electric railways met recently at Dayton and organized the Ohio Interurban Railroad Association. The question of an interchangeable mileage system was favorably discussed and referred to a committee, to report on April 1st. Officers were elected as follows: President, H. P. Clegg, Dayton; vice-president, D. C. Spring, Dayton; secretary and treasurer, J. H. Merrill, Cleveland.

Although February was one day longer this year than last, the traffic gains of the elevated roads of Chicago for the month show but slight gains over February, 1903. The daily average of passengers carried by the different roads during February, in the years 1903 and 1904, is as follows: South Side Elevated—88,516 and 90,330; Northwestern Elevated—69,885 and 73,193; Metropolitan, 116,090 and 119,073.

The Lamb-Young interests of Clinton, Iowa, which already own the gas and electric-light plants in that city, have obtained the controlling interest in the State Electric Company, which operates the street-railway system. The electric railway is to be greatly improved and extended under a franchise granted the new owners, and several industrial and manufacturing institutions are to be started in Clinton by these capitalists.

The city of Chicago has begun suit against the Lake Street Elevated Railroad Company to compel the immediate payment of $50 a year license fee for each of its cars from May 1, 1903. It is contended that in accepting an ordinance passed October 1, 1884, when the company was given the right to build and operate its line between Market Street and Wabash Avenue, the company agreed to pay the fees now demanded.

A franchise has been granted to John F. Tuerk to construct the proposed Hornellsville and Branchport electric road through the town of Bath, N. Y. The franchise has now been secured for the entire route, and Mr. Tuerk states work will be commenced before April 1st. The line will be about 50 miles in length and will open up a rich agricultural and grape belt. The franchise in the town of Bath is void if work is not commenced in one year.

The Village Board of East Aurora, N. Y., has granted an exclusive franchise to John H. Boyle of Utica to build a trolley line into East Aurora, the tracks to be laid in Main Street. The exclusion clause of the franchise was opposed by R. F. Penton and Calvin S. Crosser, representing competing companies. It is expected the companies thus shut out will fight the board's action. The new company, to be known as the Buffalo and Southeastern, will have one year from next October 1st in which to build tracks in the corporation.

POWER TRANSMISSION.

Capitalists at Tonopah, Nev., are looking into the feasibility of securing electrical energy from the falls of the Owens River, about 90 miles distant from the mining district. It is estimated that 15,000 horsepower can be utilized and transmitted to the camp for use in operating the mining machinery. The company which will promote the enterprise is to be organized shortly.

Trustee Thomas J. Webb of the Sanitary District of Chicago recently introduced in the sanitary board a resolution offering the city of Chicago, for municipal electric lighting, the surplus power which will be developed at Lockport, Ill., by the waters of the sanitary canal "at a rental sufficient only to defray the necessary running expenses of the plant." The resolution was referred to the committee on municipal relations.

It has been definitely announced that the "Soo" properties shall be taken over by the reorganized Consolidated Lake Superior Company and the various plants put in operation within a month. A bill will be introduced in the Legislature by the Canadian government guaranteeing $2,000,000 to the company, which, with the amounts subscribed and the shareholders' contributions, together with the absorption of the creditors' claims, to which they have agreed, will bring the total sum available up to $9,000,000. The Speyer syndicate agrees to accept $5,500,000 in payment of its $5,050,000 loan and interest to date, and hand over the property.

SOCIETIES AND SCHOOLS.

The American Institute of Electrical Engineers on January 1, 1904, had 2,778 members. Of this number two are honorary members, 459 were full members and 2,317 were associate members. At the recent directors' meeting in New York Fred B. Corey and Albert H. Armstrong of Schenectady, N. Y., and Harry A. Mavor of Glasgow, Scotland, were transferred from associate to full membership.

At a recent special meeting of the American Society of Civil Engineers it was resolved that the present building of the society is adequate, and it was decided to reject the offer of Andrew Carnegie to build an engineering building at a cost of $1,000,000 or more for the engineering bodies of the country. The societies that have already voted in favor of the proposition are the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, and the Engineers' Club.

A comprehensive index of all the volumes of proceedings of the National Electric Light Association since its first convention is now in process of com-

pilation. This work has been undertaken by T. H. Creden, who is not only one of the best statisticians in the electric-lighting business, but is also a first-class constructing and operating electrical engineer, having served in both capacities with the Chicago Edison Company and with Stone & Webster. In giving his services for this work, Mr. Creden will deserve much gratitude from the members of the association and others interested in the reports, as it will make it an easy matter to find at once any topic or paper to which reference is desired.

PUBLICATIONS.

The Wilkinson Manufacturing Company of Bridgeport, Montgomery County, Pa., is issuing a small pamphlet containing comments upon the Wilkinson stoker by Edmund Mather, mechanical engineer, and also a partial list of the users of this make of stoker.

A folder expounding the merits of Dixon's Graphite Pipe Compound comes from the Joseph Dixon Crucible Company of Jersey City, N. J. This compound is put up in handy tubes for the pocket or tool-bag. Each tube contains about four ounces of the compound.

Alternating-current machinery is manufactured extensively by the National Electric Company of Milwaukee, and those desiring to familiarize themselves with this company's machines will do well to examine its catalogue No. 60. This catalogue is well prepared and handsomely illustrated and contains sufficient information concerning the machines to give the reader a good idea of what the company's products in this line are. The larger alternators are of the revolving-field type, with an output as high as 500 kilowatts.

Bullock type N motors are especially designed for direct connection to machine tools. These motors are described fully in a recent bulletin from the Bullock Electric Manufacturing Company of Cincinnati, a feature of which is the great number of illustrations which show the motor as applied to almost every type of machine tool, besides various other applications where severe service is demanded. These machines are made either open or enclosed, the latter type being dustproof, a desirable feature in woodworking plants. Another application of these motors is to exhaust fans, where they may be directly connected to the shaft of the fan.

TRADE NEWS.

The Trumbull Electric Manufacturing Company of Plainville, Conn., is bringing out a number of new specialties which it will place on the market soon, among them being a new panel cut-out with switch and enclosed fuses which will be used in a panel box, making a cheap and efficient box for panel-board work. The company is represented in Texas and Mexico at present by Frank Trumbull, who will later proceed to the Pacific Coast and the Northwest. George W. Edge, an eastern representative, is traveling in New England and Canada. The company reports a successful trade.

W. K. Palmer, consulting engineer of Kansas City, Mo., announces the removal of his engineering offices to the Lyceum Building, that city, where he has increased facilities for doing a general mechanical and electrical engineering business.

Bids will be received by the city clerk of Des Moines, Iowa, until March 31st for the furnishing of electrical and engineering supplies for the use of the city for the fiscal year beginning April 1st. Specifications will be on file after March 15th.

Consul George H. Jackson at La Rochelle, France, says there has been an inquiry at his office for prices of small electric motors. They should be of from one-twelfth to one-tenth horsepower, as compact as possible, and capable of running in two directions. Prices should be submitted for sample of one and in lots of 100 and 1,000.

The entire plant, buildings and land owned by the James Cooper Manufacturing Company at Rockfield, Que., have been sold to a syndicate to be known as the Canadian Engineering Company, composed, it is said, for the greater part, of shareholders of the Canadian Bullock Electric Manufacturing Company. The price paid is in the neighborhood of $200,000.

B. S. Rairden writes from Batavia, Java, stating that he believes there is a good opportunity for some enterprising American company interested in electrical material to make good connections in Batavia, although it must be prepared to fight German competitors, who are, it is asserted, largely interested in the electrical companies established in Batavia and other cities of Java.

In writing of the possibilities of Italy as a field for American trade and capital, Hector de Castro, consul-general at Rome, states that "there is room for the importation of American electrical machinery, in spite of the many existing local shops and of the competition of Switzerland. The United States, being, however, far ahead of any other country in the matter of inventions and labor-saving machinery, our machine manufacturers would undoubtedly be able to create a market in this country for their products, especially in the line of machinery in connection with the utilization of the great waterpower of Italy. Electrical traction is being developed considerably in all the provinces of Italy, as well as electric light, the use of which is constantly increasing."

BUSINESS.

The Plume & Atwood Manufacturing Company of Chicago reports having met with great success with its brass drill rods, and is recommending its Snow brand rods for special work in free turning and drilling. The company says that it will be glad to send catalogues of its various products in brass goods on request.

The Marinette Iron Works Manufacturing Company of Marinette, Wis., manufacturer of the Walrath gas engine, recently changed its name to the Marinette Gas Engine Company and moved its plant to Chicago Heights, Ill. The Walrath engine is said to be especially adapted for electric-lighting purposes and is extensively used in isolated and other plants. The Marinette company is now most advantageously located in an excellently equipped new factory at Chicago Heights and will therefore be in a better position to meet the demand for its product than ever before.

At a meeting of the creditors of the Michigan Electric Company in Detroit the Union Trust Company of Detroit, whose appointment as receiver of the electric company was noted by the Michigan correspondent of the Western Electrician last week, reported that it had completed an inventory of the stock of the company, and in a statement of assets and liabilities showed the former to be $51,831.37 and the latter $59,667.12. Before deciding upon a course to pursue it was voted to have the assets appraised, for which purpose a committee was appointed, composed of W. P. Bowman of Cleveland, representing John A. Roebling's Sons Company; H. H. Sanger of the Commercial National Bank of Detroit, and Frank C. Teal of Detroit, representing the National Conduit and Cable Company and other creditors. The receiver was authorized to continue the business to keep it intact until the further action of the creditors.

The Electric Storage Battery Company of Philadelphia will supply to the Union Electric Light and Power Company, St. Louis, Mo., a battery having a capacity of 462 kilowatt-hours for its exciter substation. The St. Louis Transit Company will have installed 55 cells of Chloride accumulators in its new sub-station for the purpose of operating time switches. The World's Fair Automobile Transit Company has given an order for 100 sets of Exide batteries, each set consisting of 44 cells, to be used for the operation of the bus line, which will be in service at the fair. The Consolidated Railway, Electric Light and Equipment Company has contracted for a large number of batteries for car lighting, and the Herreshoff Manufacturing Company will install on Mr. Herreshoff's private yacht a complete lighting and power battery for operating the searchlights, ventilating fans, and electric light throughout the boat. Several smaller installations have also been made.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) March 1, 1904

753,226. Igniting Device for Explosive Engines. Boris Botkowski, New York, N. Y., assignor to the De La Vergne Refrigerating Machine Company, New York, N. Y. Application filed December 24, 1902. Renewed August 1, 1903.

The electrodes are carried into the combustion chamber through an insulating plug.

753,240. Electric Alarm Clock. Leslie H. Cushman, Lakewood, N. J. Application filed February 17, 1903.

When the clock mechanism has turned to a predetermined point a lever is raised, throwing a switch and connecting an alarm bell and small electric lamp with the battery.

753,243. Velocity Meter. Georg Dettmar, Frankfort-on-the-Main, Germany, assignor to the Society of Electricitäts Actien-Gesellschaft, Frankfort-on-the-Main, Germany. Application filed September 12, 1902.

A circuit-varying device is included in the circuit and adapted to move in any definite ratio to the movements of the body, the movements of which are to be measured. A self-induction device is included in the circuit and an electromagnetic measuring instrument operatively associated with the circuit.

753,252. Telephone Repeater. Merritt Gally, Brooklyn, N. Y. Application filed March 18, 1903.

The receiving magnet has two cores placed on one side of a receiving diaphragm, two wires being wound on each core. Connections for two main-line circuits for separately energizing the magnet to vibrate the diaphragm are supplied.

753,258. Electric Switch. Gerald W. Hart, Hartford, Conn., assignor to the Hart Manufacturing Company, Hartford, Conn. Application filed November 23, 1903.

Insulating material is located between the bushing bearing the current-carrying plate or blade and its support.

753,276. Lamp Socket and Plug. Daniel A. Kimbark, Chicago, Ill., assignor to the Electric Specialty Company, Chicago, Ill. Application filed May 21, 1902.

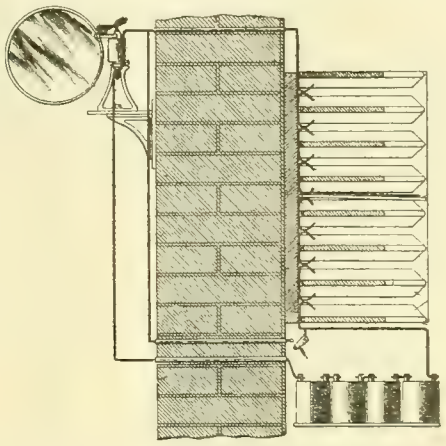
A socket comprising two insulated contacts is supplied with a plug containing a spring-actuated plunger adapted to connect with one of the contacts and a contact adapted to slide over and connect with the other of the contacts. Conductors connect with the contacts and plug respectively. The insulated contacts are arranged successively in the line of movement of the plug whereby the contact of the plug will slide over one of them while approaching the other.

753,278. Winding for Electrical Machines. Frederick J. Lindeman, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed April 11, 1903.

A winding for electrical machines comprises bars having slots in their ends which are located nearer to one side of the bars than the other. Strap-connectors project into the slots and partially surround the thicker adjacent portions.

753,284. Electrically Propelled Vehicle. Hiram P. Maxim, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed April 4, 1903.

A pair of driving wheels on the vehicle are driven by a pair of electric motors suspended from the vehicle body at opposite sides and adjacent to opposite ends of the



NO. 753,387.—TRAIN-ORDER AND SIGNALING DEVICE.

axle by means of gearing between each of the motors and the corresponding wheel. The wheels, motors and gear members are movable on horizontal axes only.

753,321. Lamp Socket. Duny A. Schutt, Peru, Ind. Application filed April 7, 1903.

An insulting base bears a yoke provided with an outer and an inner stem-bearing and an outer wire-attaching terminal.

753,345. Automatic Releasing Device for Safety Trolleys. Andrew C. Wolfe, Pittsburg, Pa. Application filed July 6, 1903.

A catch upon the trolley base holds the pole in a lowered position. When the catch is released the pole is thrown up by means of springs.

753,356. Brush Holder. Charles O. Bulock, Milwaukee, Wis., assignor to the National Electric Company, Milwaukee, Wis. Application filed August 21, 1903.

The brush is movable endwise in a sleeve provided at its outer end with an overhanging slotted plate. A spiral spring is attached at one end to a part of the holder and is adapted to be engaged with the plate between different turns of the spiral to vary the tension on the brush.

753,365. Electromagnetic Signal. William U. Colthar, Springfield, Ohio, assignor to John C. Gleason and James B. Von Schriltz, Springfield, Ohio. Application filed July 21, 1903.

Combined with a vertical electromagnet having laterally extending pole pieces is a rolling armature supported so as to move over the pole pieces, the signal being carried by the armature.

753,383. Process of Preparing Electrodes for Storage-battery Cells. Oskar Frank, Detroit, Mich., assignor to Levi J. Lennox and the Michigan Storage Battery Company, Detroit, Mich. Application filed May 2, 1903.

Treating battery plates or grids by this process consists in first immersing [illegible] passing a current of one-ampere strength through the plates for about 50 hours at a temperature of about 20° C.; then removing the plates and placing them in a weak solution of $H_2SO_4+H_2O$ and using the positive for the negative plates and lead sheets for the positive plates; then connecting them up and charging with a current of two-ampere strength for about 50 hours, and then removing, washing and drying them at a temperature of about 300°C.

753,387. Electric Train-order and Signaling System. John C. Gleason, Springfield, Ohio, assignor of one-half to James B. Von Schriltz, Springfield, Ohio. Application filed July 24, 1903.

An electrically operated semaphore signal is located in a battery circuit and acts to indicate safety when the circuit is closed and danger when the circuit is open. Normally open contact terminals in the circuit are in operative relation [illegible] order board. A removable train-order board also supported by the device is adapted when placed in position to close the circuit and set the signal to safety. (See cut.)

753,391. Casing for Telephone [illegible] Paul Hardegen, Berlin, Germany. Application filed September 3, 1902.

The electromagnet and coils are located in a bell-shaped casing of steel [illegible] magnet, a bi-polar magnet.

753,398. Cleat for Electric Wiring. Emory C. Hunt, Belle Plaine, Iowa, assignor of one-half to Charles W. E. Snyder, Benton County, Iowa. Application filed November 8, 1902.

The cleat for wiring comprises a perforated base and a perforated cap, the perforations registering with each other and standing at a right angle to the plane of contact between the base and the cap but at an inclination to the rear face of the base.

753,399. Combination Bracket and Knob for Electric Conductors. Emory C. Hunt, Belle Plaine, Iowa, assignor of one-half to Charles W. E. Snyder, Benton County, Iowa. Application filed November 8, 1902.

The device comprises a bracket portion and a knob portion, the bracket portion having an oblique bore, the knob portion having a transverse bore and several grooves substantially parallel with the transverse bore.

753,411. Telephone Toll Apparatus. George A. Long, Hartford, Conn., assignor to the Gray Telephone Pay Station Company, Hartford, Conn. Application filed April 15, 1902.

Preventing the movement of the switch-hook lever is a lock. A trip lever with a part projecting into a coin channel bears a trip, thrown by the coin, arranged to operate the lock.

753,412. Telephone Toll Apparatus. George A. Long, Hartford, Conn., assignor to the Gray Telephone Pay Station Company, Hartford, Conn. Application filed November 8, 1902.

The toll telephone is connected upon the insertion of a proper coin in a carrier. When the coin has passed through the carrier it is ejected with force against a bell, warning the speaker that the allowed time is up.

753,422. Armature Winding. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company, Albany, N. Y. Application filed November 11, 1902.

Two coils in series are placed respectively at points on the armature giving different electromotive forces at the same time and connected in parallel with two coils correspondingly situated on the armature. The sets of coils are in series with another and are similarly arranged.

753,429. Electrodynamic Generator. George M. Pelton, Chagrin Falls, Ohio. Application filed September 29, 1902.

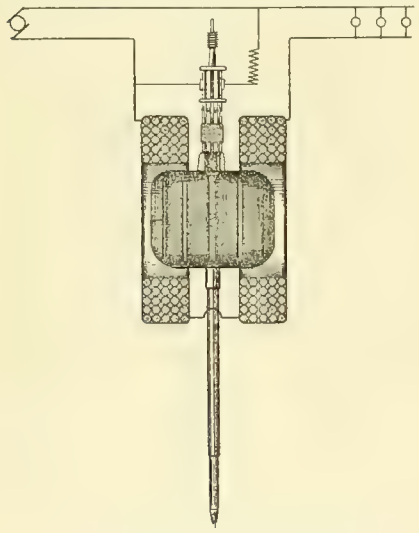
Several armature coils are connected to two commutators, each consisting of segments equal in number to the coils. Connections are established between the coils and the commutators in such a manner that coils may be put in series or in multiple relation.

753,461. Electrical Conductor and Coil. James C. Anderson, Jersey City, N. J., assignor to the Varley Duplex Magnet Company. Application filed April 30, 1903.

A winding of flat wire is covered with insulating material in the form of a strip applied longitudinally to the wire and having its lateral edges bent or hemmed over the edges of the wire and forming a longitudinal seam along one face of the wire, the seam occurring on the convex side of the convolutions of the coil.

753,509. Electrotherapeutic Device. Charles K. Munns, Corning, Iowa. Application filed October 24, 1903.

All the accessories for electrotherapeutic treatment, such as generators, batteries, vibrators, etc., are contained in a neat case along with the switches and other controlling apparatus.



NO. 753,556 ELECTRIC METER.

753,511. Sparking Device for Gas Engines. George J. Murdock, Newark, N. J. Original application filed February 11, 1903. Divided and this application filed March 21, 1903.

A rotary, toothed, grounded electrode is contained in the combustion chamber.

753,533. Rheostat. John C. Barclay, New York, N. Y. Application filed September 9, 1903.

Surrounding a core of insulating material are collars. Conductors are wound about the core between the collars, the latter electrically connected to the conductors to form terminals therefor and likewise forming stops for the windings of the conductors.

753,536. Contact Device for Electrically Propelled Railways. Henri Berthoud, Neuchatel, Switzerland. Application filed July 10, 1902.

A contact rail above each car extends the whole length of the car, the ends overhanging. The overhanging ends are so arranged as to be spaced apart from the overhanging ends of the contact rails on the adjacent cars. The contact rails are insulated from the cars, and contact devices with which the contact rails come into electrical connection to form momentary contact with the ends of adjacent rails insure continuity of current.

753,542. Trolley. Alexander C. Calderwood, Gloversville, N. Y. Application filed August 6, 1903.

The trolley replacer is normally held out of action against a force tending to throw it into a working position. A trip device actuated by contact with the line wire effects a release of the replacer, whereby it assumes an operative position and effects automatic return of the trolley to the line wire.

753,552. Trolley for Electric Cars. William A. Daggett, Vineland, N. J. Application filed September 3, 1903.

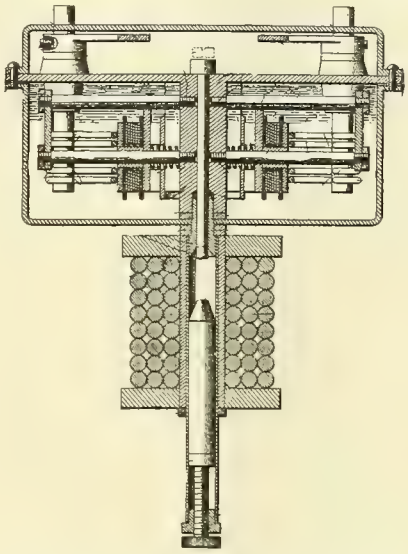
Prongs set at an angle on the trolley wheel forks serve to guide the wire to the wheel groove.

753,554. Trolley. Arthur S. Deem, Reading, Pa. Application filed August 8, 1903.

Details are described.

753,556. Electric Meter. Thomas Duncan, Lafayette, Ind. Application filed December 29, 1903.

The rotating winding of the meter is subdivided into armature coils having terminals substantially fixed with respect to the armature and forming one set of contacts, the armature with its terminals being together slidable longitudinally of the armature shaft to effect connection and disconnection. A commutator has segments forming another set of contacts, the sets of armature-coil contacts and commutator-segment contacts being relatively slidable longitudinally of the armature shaft to effect connection and disconnection of the armature and permit physical separation of armature and commutator. (See cut.)



NO. 753,704. —AUTOMATIC MAGNETIC CIRCUIT BREAKER

753,563. Portaable or Table Telephone Instrument. Lars M. Ericsson, Stockholm, Sweden, assignor to Aktiebolaget L. M. Ericsson & Co., Stockholm, Sweden. Application filed September 30, 1902.

An ornamental design for a table telephone stand is described.

753,595. Insulated Pipe Joint. Waldo A. Learned, Watertown, Mass. Application filed September 8, 1903.

Insulating compound fills the space between the bell and spigot.

753,617. Trolley Replacer. Francis A. Nolan, St. Paul, Minn. Application filed January 16, 1902.

The trolley cord is fastened at one end of a prolonged lever which is pivoted at the trolley-wheel axle. Upon pulling down on the cord, as when it is in the act of replacing the trolley, the prongs are directed upwardly to guide the wheel to the wire.

753,666. Railway Signal. Tony Brück, New York, N. Y. Application filed January 26, 1903.

An electromagnet and armature operate a series of levers which throw the signals one way or the other.

753,690. Electric-telegraph Apparatus. Agazio Falcone, Florence, Italy. Application filed May 6, 1903.

Combined with a permanent magnet is an armature located between the poles of the magnet. A Morse transmitting key is connected with the armature with means whereby the rocking of the key about its pivot directly imparts to the armature an angular movement in opposite directions.

753,704. Automatic Magnetic Circuit-breaker. Frank O. Hartman, Mansfield, Ohio. Application filed April 10, 1902.

Slidingly mounted insulated contacts are adapted to engage contact blocks mounted in a casing. Means carried by revoluble shafts force the contacts against the blocks, and pivoted latches are engaged by the free ends of arms carried by the shaft, the latches being adapted to normally retain the arms. The latches are tripped by a solenoid. (See cut.)

753,716. Carbon Resistance and Method of Producing and Adjusting Same. George I. Leonard, Pasadena, Cal. Application filed February 3, 1903.

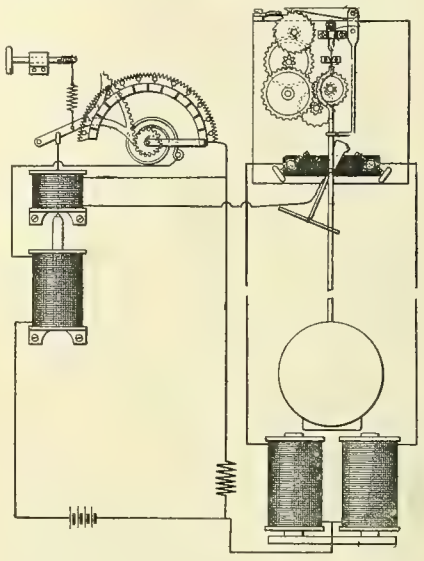
The method of adjusting the resistance of graphite or similar material consists in subjecting it to a frictional pressure until the resistance is reduced to the required amount.

753,757. Self-winding Electric Clock. Frank T. Talcott and Benjamin F. Kerr, Ashtabula, Ohio. Application filed March 11, 1903.

Electromagnets actuate a pendulum and a switch controlled by the pendulum is connected to the magnets. An arm connected to the switchplate and engaging the pendulum acts to rock the plate beyond the perpendicular in opposite directions alternately. (See cut.)

753,795. Electric Sparking Igniter for Explosive Engines. William J. Hart, Mt. Vernon, N. Y., assignor of one-half to Charles F. Splitdorf, New York, N. Y. Application filed May 28, 1903.

A thimble adapted to contain the sparking plug is screwed into the wall of the combustion chamber.



NO. 753 757.—SELF-WINDING ELECTRIC CLOCK

753,802. Combined Third and Traction Rail for Electric Railways and Switching Systems Embodying Same. Edmund C. Morgan, Chicago, Ill., assignor to the Morgan Electric Machine Company of West Virginia, Chicago, Ill. Application filed August 27, 1902.

Main and branch-track rails, switching-track rails and a combined third and traction rail for each pair of track rails are contained in the system. The combined third and traction rails are each made in sections, one section being movable.

753,803. Combined Third and Traction Rail for Electric Railways. Edmund C. Morgan, Chicago, Ill., assignor to the Morgan Electric Machine Company, East Chicago, Ind. Original application filed August 27, 1902. Divided and this application filed December 3, 1903.

A combined third and traction rail comprises plates or bars arranged end to end and having suitably spaced openings. Plates are lapped over the joint at the abutting ends of the plates or bars and secured thereto.

753,809. Automatic Playing Apparatus for Musical Instruments. Timothy B. Powers and Major R. Jewell, New York, N. Y., assignors to the Imperial Corporation, New York, N. Y. Application filed August 14, 1901.

Electrically operated keys of a piano are in circuit with a contact finger and a nonrotating metal guide. An electric conductor movable in the guide transversely of the finger is in electrical contact with the guide. Means for making and breaking the contact between the fingers and bar are provided.

753,819. Electrode. George J. Atkins, Tottenham, England. Application filed April 8, 1903.

An electrode for electrolytic or the like apparatus consists of a sheet-metal conductor, a carbon or other analogous electrode proper and a conducting but waterproof substratum interposed between the conductor and the electrode for the purpose of isolating the conductor from the electrolyte while establishing and maintaining electric connection between the conductor and the electrode.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on March 8, 1904:

358,854. Self-signaling and Self-recording Electromagnetic Thermoscope, Henry J. Haight, New York, N. Y.
358,864. Fire Alarm. Frank G. Lyon, Jersey City, N. J.
358,890. Telegraphy. Charles Selden, Baltimore, Md.
358,939. Telephone and Telegraph. Noyes F. Palmer, Jamaica, N. Y.
358,941. Telephone Transmitter. Noyes F. Palmer, Jamaica, N. Y.
358,975. Electric Bolt-releasing Device. George L. Henzel, San Francisco, Cal.
359,040. Electric Railway Signal. Charles D. Tisdale, Boston, Mass.
359,050. Electric Railway. Edward M. Bentley, Brooklyn, N. Y.
359,053. Electric Gas-lighting Apparatus. Charles B. Bosworth, Everett, Mass.
359,063. Galvanic Battery. Lucien A. W. Desruelles, Paris, France.
359,067. Electric Switch Register. Charles Fearon, Philadelphia, Pa.
359,072. Secondary Battery. William G. Griscom, Philadelphia, Pa.
359,085. Electromagnetic Ore Separator. George W. Mansfield, Jersey City, N. J.
359,101. Electric Regulator. Oliver B. Shallenberger, Rochester, Pa.
359,188. Telephone Transmitter. Joseph F. Tabony, New Orleans, La.
359,204. Stand for Flatirons. Robert Crommer and Adelbert H. Phillips, Philadelphia, Pa.
359,210. Electromagnetic Transmitting and Distributing Thermoscope. Henry J. Haight, New York, N. Y.
359,221. Electric Arc Lamp. Henry C. McDill and James E. Gaston, Fort Worth, Tex.
358,910. Electric Bell. Edward A. Wildt, Long Island City, N. Y.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, MARCH 19, 1904 No. 12

Fayet-Chamonix Electric Railway.

The third-rail electric railway connecting the village of Chamonix with Fayet over a picturesque route in the Mont Blanc region of France presents some interesting features. The accompanying illustration shows the track construction, with conducting third rail, motor cars and Chamonix railway station of the road. The line was constructed by the Paris-Lyons-Mediterranean Railway Company and connects at Fayet with the steam railroad.

The electric road is nearly 20 kilometers in length and has a maximum grade of nearly 10 per cent. for a considerable distance, most of the road having grades less than two per cent. The third rail is employed for supplying the necessary current to the motors, and this rail is guarded at the stations and switches in the manner shown in the illustration. The gauge is 1,000 millimeters, and the rails which have a T-section are in 12-meter lengths and weigh 35 kilograms to the meter. The third rail is practically the same as the working rails in section and weight and is mounted on insulating blocks located about 3½ feet from the center of the track. The top of the third rail is somewhat higher than the track level and the rails are bonded by Brown plastic bonds. Trains are operated by the multiple-unit-control system and from three to eight passenger trains and one to two freight trains are operated each way daily, according to the season of the year. The motor cars weigh about 40,000 pounds each and are supplied with two 65-horsepower electric motors. A number of the motor cars are arranged with baggage compartments, while some of them are arranged with passenger compartments in addition to the motorman's compartment. The current is supplied at a pressure of 550 volts, the maximum current used by the motor being 200 amperes, with a speed of 275 revolutions a minute. The motor cars were electrically equipped by the Societe d'Electricite Alioth of Muenchenstein-Bale. The cars are electrically heated and are lighted with 10 incandescent lamps of 16 candlepower each. Christensen air brakes are used, and an electrically operated compressor is provided for supplying the necessary compressed air. The trains operate at a speed of from 12 to 40 kilometers an hour, according to whether they are operating on heavy grades or on a level.

FAYET-CHAMONIX ELECTRIC RAILWAY.—VIEWS SHOWING ROLLING STOCK AND TRACK CONSTRUCTION.

The Fayet-Chamonix railway is supplied with current from two generating stations at the present time, located, respectively, at Servoz and Chavants. The line is to be extended a number of miles to the Swiss border, and the Chavants power plant, which has a capacity of more than 10,000 horsepower, will supply the necessary current. High-tension alternating current of a frequency of 25 cycles, it is stated, will be employed, the pressure on the transmission line being reduced from 10,000 volts or more by step-down transformers located at substations at various points along the line. It is stated that 1,200-horsepower turbines and generators will be employed and several hundred storage-battery cells will be utilized at the sub-stations in connection with the rotary converters. The Chavants power station is located somewhat less than 10 kilometers from the station at Fayet St. Gervais, while the Servoz station is located about seven kilometers from Fayet.

These hydro-electric stations are supplied with water from the River Arve. The effective fall at the Servoz station is about 40 meters, and the water is utilized after leaving this station by the power plant of the Chedde Electrochemical Works, the remaining fall being about 140 meters. The Servoz station has a minimum output of more than 2,000 horsepower and a maximum output of over 4,500 horsepower. At the Chavants station there is an effective head of 94 meters and a normal flow of over 10 cubic meters during the summer, while about half of this flow of water is available in the winter. The electrical pressure is maintained nearly constant by electrical methods, as the turbines are not provided with governors.

The turbines are designed to run at a speed of 615 revolutions a minute at no load and at 450 revolutions a minute at full load, the generators regulating by compounding. The pressure at the terminals of the generator is about 550 volts, with a speed of 600 revolutions a minute at no load, while at full load, with a current of about 300 amperes and a speed of 450 revolutions a minute, the pressure is 680 volts, the additional pressure being required to take care of the loss in the feeders. It is said that the new turbines to be installed at the Chavants power station, which are to drive alternating-current generators, will be provided with governors to regulate the speed very closely. P.

California Power Companies Consolidate.

One of the largest transactions in the history of the electric power business on the Pacific Slope was effected on March 1st, when the Standard Electric Company and the United Gas and Electric Company turned over their large and profitable plants to the California Gas and Electric Corporation. The larger of these two concerns is the Standard, which in itself is a big corporation, having been for the last two or three years absorbing the smaller plants in its particular field. This company's plant at Electra, on the Mokelumne River, generates 13,000 horsepower, which is used in many of the large mines and towns of Amador and Calaveras Counties and is transmitted to Stockton, San Jose, San Francisco and Oakland. The United Gas and Electric Company is a distributor of power, with a plant at San Jose and a sub-plant at Redwood City. It owns the Electric Improvement Company and the San Jose Light and Power Company.

This consolidation makes the California Gas and Electric Corporation one of the largest of its kind in the West. It now embraces at least 29 different companies, some of very large size, distributes power to 20 counties, and operates over 1,100 miles of main-transmission lines. At the present time 45,000 horsepower is being developed, and when the plants now in course of construction are finished the total will be raised to 78,000 horsepower. In addition to this, the company owns water rights and the necessary reservoir sites for developing 65,000 additional horsepower whenever business requirements warrant it. The officers and directors of the California Gas and Electric Corporation are: President, E. J. de Sabia; vice-president, John Martin; second-vice-president, John C. Coleman; general manager, John A. Britton; treasurer, Richard M. Hotaling; additional directors, E. W. Hopkins, J. Henry Meyer, Frank D. Anderson, N. D. Rideout, Fred W. Zeile and Frank G. Drum.

The Standard company has a capitalization of $5,000,000 authorized stock and $5,000,000 in bonds, all issued and outstanding. The United company was capitalized at $2,500,000 in authorized stock, of which $2,286,000 is outstanding, and $2,000,000 in authorized bonds, of which $1,100,000 is outstanding. The purchase price has not been made public, but is said to be high. This vast accumulation of electric power means that nearly all the convertible steam power in and adjacent to San Francisco could be supplanted by electricity generated by the streams of the Sierra Nevada Mountains and brought over transmission wires for 200 miles.

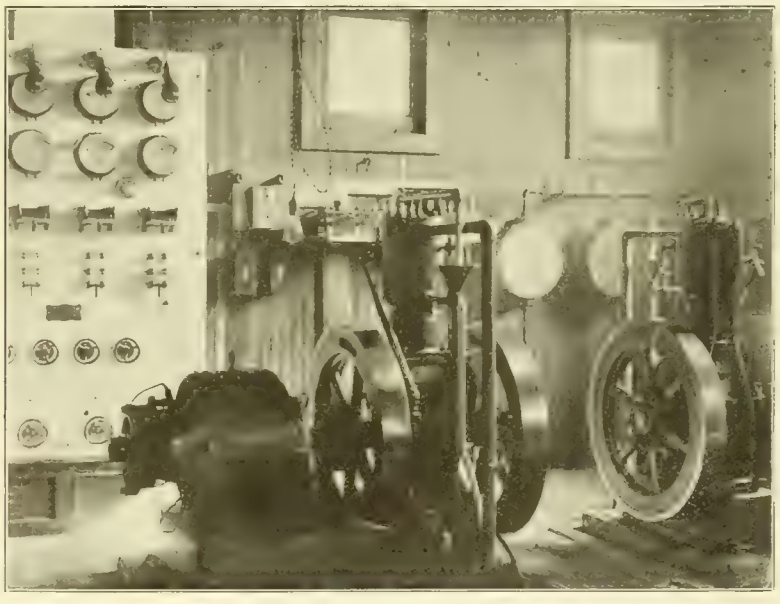
Private Automobile Charging Plant.

Perhaps one of the largest private automobile-charging plants in the West is the one owned by George R. Thorne and located at 90 East Forty-seventh Street, Chicago. Mr. Thorne owns three electric automobiles at present, though the plant has facilities for charging four machines simultaneously.

The generating plant consists of two units, as shown in the accompanying illustration, which are automatic in action, being arranged to shut down automatically when the battery is fully charged. Each unit consists of a six-horsepower gas engine direct-connected to a four-kilowatt generator wound for 140 volts, which is the pressure used in all the automobile batteries, therefore no current-changing apparatus is necessary. The engines are self-starting, requiring no strenuous manipulation of the flywheel on the part of the attendant. Ordinary illuminating gas is used. Flexible couplings connect the engine and generator in each case, which are mounted on a common base.

The gas is supplied to the engines through the two gas bags shown on the wall in the rear of the engines. The walls of the bags are flexible and the charge of gas for each explosion, being drawn through the bags, which contain much more than the required amount for one charge, the flow of gas from the mains is made practically constant. Without the intervention of the bags each charge, if drawn directly from the main, would tend to cause a vacuum in the pipe and therefore an intermittent and unreliable flow of gas would result. Jump-spark ignition is used on each of the engines.

A neat switchboard is mounted back of the generators, as shown, and contains all the necessary switches and plugging facilities for charging four machines at a time, as already stated. An underload circuit-breaker insures safety from current reverses, and should a reverse occur the breaker instantly opens the circuit and at the same time automatically shuts off the fuel and cooling water from the engines. The automatic character of the plant makes necessary very little attendance, and so simple are the operations of starting that an unskilled person may readily acquire sufficient knowledge to operate it with success. Quiet running is also another feature of the plant, which is situated in a quiet residential district, where any noise from the exhaust would immediately arouse the ire of those in the neighborhood. The exhaust is practically noiseless and no trouble has been encountered from this source.



PRIVATE AUTOMOBILE-CHARGING PLANT.

The contractors who installed the apparatus are Henry Newgard & Co. of Chicago.

The United States Civil Service Commission announces an examination on April 6th and 7th at the principal cities throughout the states and territories of the United States, to secure eligibles from which to make certification to fill vacancies in the position of assistant electrical engineer in the signal service at large, Washington, D. C., at $1,400 a year, and other similar vacancies as they may occur. The examination will consist of theoretical and practical questions in electrical engineering and technical training and experience. The age limit is 20 years or over, and applicants should have a good general knowledge of electrical science and should be thoroughly familiar with telephone, telegraph and cable engineering.

Westinghouse Vertical Steam Turbine.

As the steam turbine becomes more and more generally applied to electrical purposes, inventors of note are seeking with increasing efforts to bring it to a higher state of perfection and to make for it, among the prime movers in large installations, a place which shall be pre-eminent. One of the mooted questions in the construction of steam turbines has been the position of the turbine shaft, whether horizontal or vertical, and as to which style the more readily adapts itself to balancing of the rotating parts. Units of great size have been built and operated successfully, representing both these classes. Therefore, in making a study of the two types, it will be of interest to give consideration to a new vertical turbine recently patented by George Westinghouse of Pittsburg and assigned to the Westinghouse Machine Company. By examining the accompanying illustrations, which are, respectively, a vertical section of the turbine with the generator mounted on the upper end of the shaft (Fig. 1), and a cross-section (Fig. 2), a clear understanding of its construction may be obtained.

The frame of the turbine is provided near its lower end with one or more steam chests (2), into which the steam is introduced from a boiler at a pressure suitable for operating the engine. As shown in Fig. 2, a single steam chest or box is provided which extends nearly around the casing and the steam is introduced through an inlet pipe (3). From the steam chamber expansion nozzles (4) lead to the interior of the casing (1), in which is located a drum (5). This drum is composed of three parts, the lower part (6) and middle part (7) being fastened together by means of bolts, and the upper part or cap being fastened to the main or middle part by means of suitable tap bolts or screws.

In order to avoid all tendency to unbalancing the rotary member of the turbine by means of the impact of the steam upon the steam-using parts, steam is introduced through three groups of nozzles 120 degrees apart, as indicated in Fig. 2.

The upper part or cap (Fig. 1) is provided with a hub, which is forced under heavy pressure upon a sleeve (12) and the bottom part (6) is provided with a similar hub, which is also forced under heavy pressure upon the lower end of the sleeve, the lower part (6) being further held securely in position by means of a ring (14), which is shrunk upon the extreme lower end of the sleeve.

Seated in the lower end of the sleeve is the hollow upper end of a shaft (16), which is forced into position under heavy pressure and receives the reduced lower end of the dynamo shaft (17). The shaft (16), in which the lower end of the dynamo shaft is seated, is solid and extends below the drum (5) and is provided with a flange, which rests against the lower end of the sleeve (12). Fastened to the lower side of this flange is a wearing plate (23). The construction above is employed because it lends itself to convenience of manufacture and is described merely as one of a variety of suitable structures.

Seated in the bearing housing (24) below the plate (23) and rigidly fastened is a ring (25), the interior of which is provided with a screw thread to engage a corresponding thread in a cylinder (26), which surrounds the shaft and between which and the shaft is a considerable circumferential space. The upper end of the cylinder (26) is extended to form a horizontal flange, the upper face of which normally makes a close fit with the lower face of the wearing plate. This cylinder is provided near its lower end with a worm wheel (28a), and mounted in suitable bearings in the bearing housing is a worm pinion (29), which meshes with the worm wheel, and when rotated serves to turn the cylinder, and thus raise or lower it, provision being thus made for any desired adjustment for taking up of wear or for any other purpose. The cylinder is also provided with a small passage (30), which communicates at its upper end with oil-distributing grooves in the upper face of the cylinder and its flange. The lower end of the passage is connected by an annular passage (32) to a horizontal passage (33), to which oil is supplied through a pipe (34), the waste oil being discharged through a pipe (35).

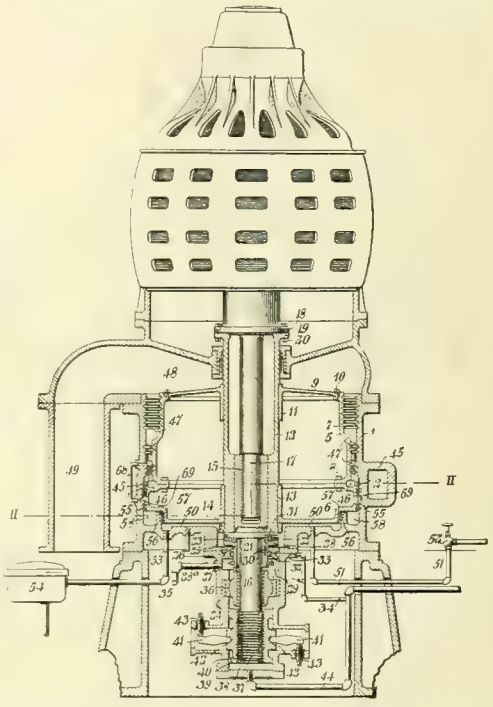


FIG. 1. WESTINGHOUSE STEAM TURBINE.—VERTICAL SECTION OF TURBINE WITH GENERATOR MOUNTED ON TOP.

A suitable ball-and-socket bearing is provided between the bearing housing (24) and the shaft in order to take care of any flexure of the shaft which may occur in operation. The lower end of the shaft is also provided with a series of grooves and annular flanges, which co-operate with corresponding rings (39) on a longitudinally adjustable cylindrical head, levers (41) being provided, in such position that their inner ends engage with suitable sockets (42) in the cylindrical head, and also screws for engaging with the outer ends of the levers, so as to adjust the head in the one direction or the other in order to take up wear and secure the packing engagement between the annular flanges (38) and the rings (39) that may be desired in practice.

Located above the annular chamber (46) is a series of steam-using devices (47). After the steam passes the upper or last set of steam-using devices it exhausts into a chamber (48), which communicates with suitable condensing apparatus, so that when the turbine is in operation as a condensing engine a considerable degree of vacuum will be maintained in the upper end of the casing above the rotary parts. By reason of this vacuum atmospheric pressure in the space (50) between the lower end of the drum and the lower end of the casing will serve to either partially or wholly support the drum, depending upon the degree of vacuum and the area of that portion of the drum which is subjected to this pressure. The air may be introduced to the space through any suitable small inlet provided with a suitable valve. A drain pipe (53), having an ordinary trap for conducting away any water which may result from condensed steam that may leak into the space (50) is also provided.

In case atmospheric pressure is not sufficient to support the rotary member of the turbine and the rotary member of the dynamo, the fluid pressure introduced into the space (50) from a pump or compressed-air reservoir through the pipe (51) may be increased to the desired degree by adjusting the valve (52). In case the air pressure in the space becomes more than is necessary to float the moving parts, the wearing plate (23) will be lifted an almost inappreciable degree from the flange (28) of the

cylinder (26), but sufficiently to relieve the pressure in the space to the necessary extent.

In order to prevent so far as possible the leakage of steam into the space, suitable packing rings (55) are supplied near the lower end of the drum at its maximum diameter, and also an annular flange (56), between which and the corresponding portion of the drum is another set of packing rings (57). The space or chamber (58) between these two sets of packing rings is connected to a port of a valve casing. The opposite port, which is normally closed by the valve, connects with an exhaust passage. The stem of the valve extends loosely through a partition wall

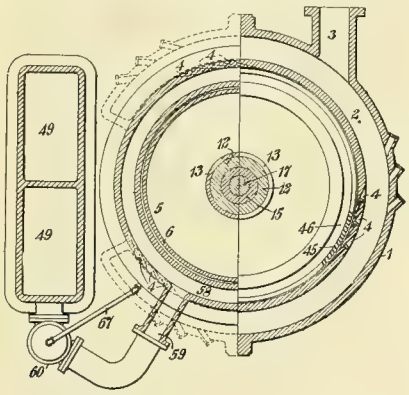


FIG. 2. WESTINGHOUSE VERTICAL STEAM TURBINE.—CROSS-SECTION THROUGH TURBINE.

and is connected to the middle of a flexible diaphragm. The valve is normally held to its seat by means of a coil spring, supplemented by fluid pressure, the space above the diaphragm being connected, by means of a pipe, to the space (50) in order to provide the fluid pressure. It follows from this construction that if leakage steam accumulates in the chamber (58) it will pass into the lower part of the valve casing and through the space around the valve stem into the space above and below the flexible diaphragm. The air pressure in the space (50), which is also exerted above the diaphragm by reason of the pipe connection between the two spaces, in conjunction with the spring, will normally hold the valve closed; but if the leakage steam increases sufficiently so that its pressure actuates the diaphragm the valve will be opened and the steam will be exhausted from the chamber or space (58) to the exhaust passage, the arrangement being such that any desired predetermined pressure in excess of that in the chamber (50) may be maintained in chamber (58). A further safeguard is provided against the leakage of steam in the form of a pipe, which connects an annular space (69) above the packing rings (55) with the steam-using devices at a workable point above the annular chamber (46).

In case the vacuum should fail from any cause sufficient air pressure may be supplied to the space (50) through the pipe (51) to float the moving parts, as will be readily understood.

Street-railway Passenger Traffic in Berlin.

Nearly all the city street-car lines of Berlin are the property of the Grosse Berliner Strassenbahn Gesellschaft, which carried last year a total of 316,000,000 passengers, an increase of 18,000,000 over the traffic of the previous year. For this service the company received as fares 28,903,833 marks ($6,879,722), an average—including commutation and all other tickets—of 2.17 cents a fare. Within the city limits of Berlin the uniform fare for any distance is 10 pfennigs (2.5 cents), but there are no transfer tickets and the same fare must be paid on each line traversed by the passenger. Tickets from the central portions of the city to the outlying suburbs cost 2.5, four and five cents, according to distance, but all these are subject to slight reductions for commutation tickets. The importance of the Grosse Berliner as a factor in the transportation system of the city may be inferred from the fact that out of a total city and suburban population of 2,500,000 its lines carry an average of 865,000 passengers a day. The electric elevated and underground railway carried 29,473,355 passengers, for which the company received as fares 3,557,785 marks ($846,752), or an average of three cents for each person. The heaviest traffic of the year was during the month of December, when 2,870,653 persons were carried; next came March, with 2,700,000, and last, July, with 2,093,000 passengers.

The City Council of Garfield, Wash., has refused to grant the franchise for an electric-light plant which was asked for by C. A. Magney.

Zanesvilles' Up-to-date Central-station Plant.

As an example of engineering resourcefulness and the adaptation of ways to means the new hydro-electric turbo-generator plant of the Zanesville Railway, Light and Power Company at Zanesville, Ohio, is worthy of careful consideration. The power is generated by waterwheels and steam turbines, supplemented by a large storage battery, and it is supplied to a street-railway system, an arc-light system and both alternating and direct-current incandescent circuits, besides a considerable motor load. So that in this unique plant there are probably exemplified as many phases of electric power generation and distribution as were ever combined in a single installation.

The power house is situated upon the banks of the Muskingum River and is located almost in the exact center of distribution of both the lighting and railway loads. The building is entirely of concrete up to the high-water line, the superstructure being of brick, with pressed-brick facing. A view of the river side of the structure is shown in Fig. 1.

The interior space is divided into three portions, a boiler room 65 by 40 feet, a wheel room 57 by 70 feet and a generator or engine room with an available space of 58 by 57 feet. This part of the work is entirely completed, as is also the installation of the generating machinery, with the exception of one of the two turbo-generators, which is, however, rapidly nearing completion, and one rotary converter, which will be added in a short time.

In general the equipment of the plant consists of two alternators driven by waterwheels, two turbo-generators, four rotary converters, a storage battery and a motor-generator for charging the battery. The scheme of operation is to carry the railway load from the alternators by means of one of the rotaries. The remaining two rotaries supply the direct-current lighting load. The turbo-generators are only brought into requisition during times of insufficient water supply. The battery is used only for carrying the fluctuations of the load. At night, when the load is lightest, the current developed by the waterpower is utilized for charging the battery, which, during the day, when the peaks of the railway load occur, and during the early hours of the evening, when the peak of the lighting load is reached, in turn relieves the hydraulic plant. Taken the year around, it is calculated that the waterpower will be sufficient for about one-half the kilowatt output of the plant.

The head of water available at Zanesville is about 13 feet on the average. This head is utilized by five 51-inch cylinder-gate Stilwell-Bierce waterwheels of 275 horsepower each, when running at the most efficient head. An open flume is used, as is usual with such low heads. All five wheels are geared to a single horizontal shaft (Fig. 2) six inches in diameter and divided into three sections by two clutches, one on each side of the middle waterwheel. Directly connected on the ends of this shaft are the two alternators. One of these alternators is to be seen in the extreme end of the generator room (Fig. 3). The other alternator is mounted on the opposite end of the shaft in the wheelhouse beyond the partition. By such an arrangement of the shafting it is possible to divide the wheels into two groups, the two wheels at each end of the shaft forming a group, while the wheel in the middle may be connected to either group by releasing one clutch and closing the other. Thus, when water is scarce, either one of the groups may be operated driving one generator and when water is plentiful the whole shaft may be connected as a unit and both alternators driven at once. Each group of wheels is provided with a Lombard governor, but when all five wheels are operated at once, one governor may be connected to perform the duty for all.

The two alternating-current generators are each of 375-kilowatt capacity and generate three-phase current at 2,300 volts, 60 cycles, running at 200 revolutions per minute, and are of the General Electric make. The speed of the waterwheels is 90 revolutions per minute, the increase being effected in the gearing. These generators supply the alternating-current lighting direct to the lighting transformers about the city. They also take care of the normal railway load during the day by means of a 300-kilowatt rotary converter. Referring to the picture of the generator room (Fig. 3), the three rotaries, including the two for direct-current lighting, are shown in the foreground. Just in front of the alternator at the end of the room is the battery-charging set. To the left, in the rear, is to be seen the top of one of the turbo-generators, while the switchboard at the right is for direct-current purposes, the alternating-current board being situated in a gallery, not shown.

As seen in the picture, the direct-current board contains one railway rotary panel and two storage-battery panels (for main and battery booster). Three emergency panels permit of the splitting up of the battery into two three-wire sections. Next in order come one railway panel, two feeder panels, two 240-volt rotary panels and one three-wire main panel. The alternating-current board, which is mounted in the gallery, contains four generator panels, four alternating-current feeder panels and three rotary panels, with space on either side to add further panels. Double-throw oil switches are installed on this board together with the necessary ammeters, wattmeters and a power-factor indicator. The waterwheel governors, which are operated by small motors, are also controlled from this board by push buttons. Both the alternating-current and direct-current switchboards are of blue Vermont marble.

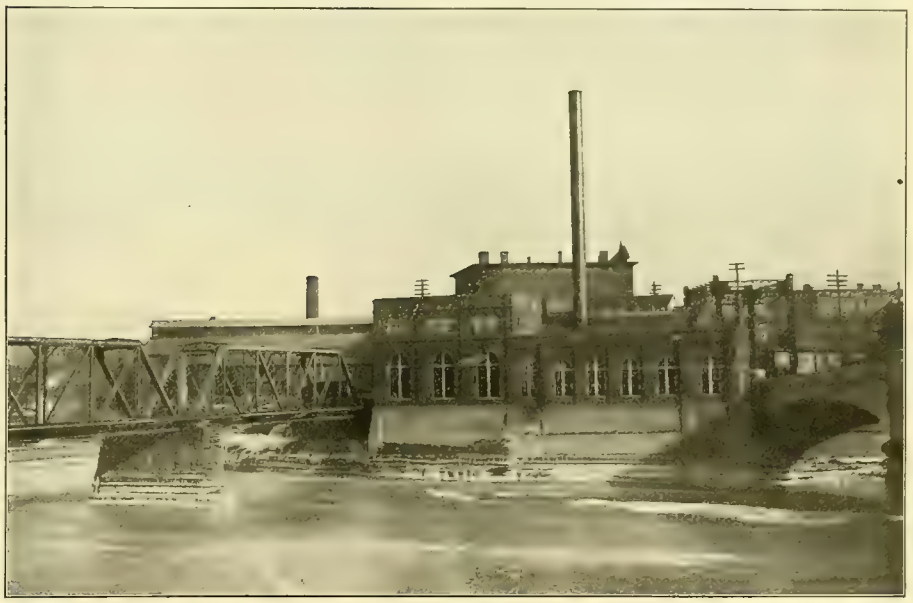


FIG. 1. ZANESVILLE POWER HOUSE AS SEEN FROM THE RIVER

Fig. 4 is a longitudinal section of the power house showing the location of the waterwheels and the generating machinery. By consulting this drawing it will be seen that the steam turbines are installed with their lower parts and also their condensers in a basement beneath the generator room.

A dimensional drawing of one of the turbines and its condenser is shown in Fig. 5, which also shows the location of the unit relatively to the floor line of the generator room.

The turbo-generators are of the vertical type built by the General Electric Company, a Curtis two-stage steam turbine driving a revolving-field, 2,300-volt alternator developing 500 kilowatts. The frequency at the speed of 1,800 revolutions per minute is the same as that of the two alternators driven by the waterwheels, so that the turbo-generators may be

ZANESVILLE'S UP-TO-DATE CENTRAL-STATION PLANT.

used to supplement, when necessary, the alternators driven by the waterwheels, the bus connections being arranged to permit of any combination desired. The total weight of each unit is approximately 20 tons.

Steam for the turbines is obtained from two 350-horsepower Heine water-tube boilers, developing a pressure of 200 pounds. Steam-driven duplex-feed pumps feed the boilers, while ample draft is secured by a steel stack 143 feet high and 68 inches in diameter. This stack has been found in practice to be entirely adequate, since the steam-developing powers of the boilers are at no time taxed to a great extent, owing to the smoothing out the peaks of the load curve by the storage battery. Fig. 6 is a section through the boiler room.

Fig. 2 Waterwheel Shaft

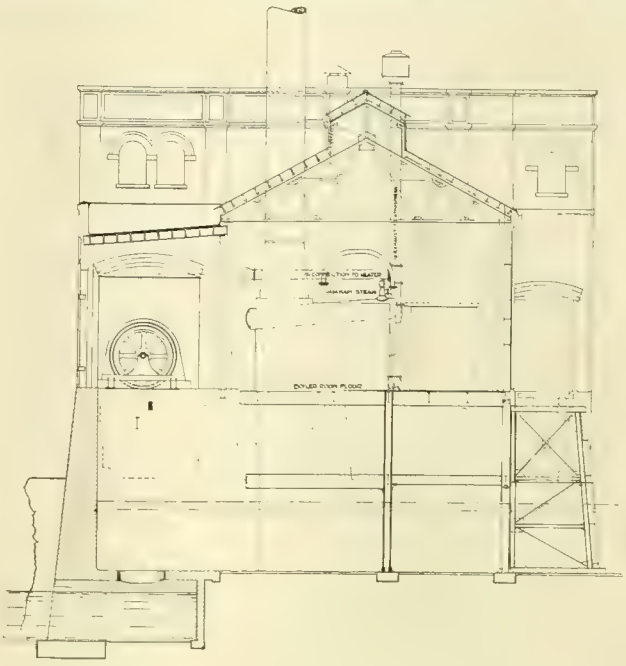


Fig. 6. Section of Power House Through Boiler Room.

The storage battery is one of the most important parts of the plant, and to it is due a large part of the efficiency of operation which has been attained. The battery consists of 256 cells of Chloride accumulators manufactured by the Electric Storage Battery Company and known as type G17. The electromotive force developed is 550 volts and the capacity at present is a 650-ampere discharge for one hour. The cells are located in a battery room above the generator room, the floor of which is of reinforced concrete construction. The batteries are charged by the motor-generator set shown just in front of the alternator in Fig. 3. As already stated, in connection with the direct-current switchboard, the battery, in case of accident to either of the direct-current lighting rotaries, may be split up into two three-wire batteries and thrown upon the lighting circuit.

Current from the battery, besides taking care of the fluctuations in load, is utilized for the momentary excitation of the alternator fields. When the plant is in operation the field coils are switched to one limb of the three-wire circuit.

By proper connections at the switchboards either one or both of the alternators driven by the waterwheels may be made to carry the alternating-current load, the railway load and all the Edison load simultaneously. By the aid of the storage battery to assist at the peak of the load it is possible at times to shut down the turbo-generators entirely, which would be impossible if the battery were not installed.

As an example of the importance of the storage battery in this plant, the operation for the month of last December may be cited. During this period the railway load was the heaviest experienced since November 6th of last year, when the plant was first put in operation. During December also the water supply was the most meager, being on the average only about one-third that necessary for running the five waterwheels. The maximum railway load was 660 kilowatts and the average 250 kilowatts. The difference between the two, or 410 kilowatts, was carried by the storage battery, which, by receiving its charge during slack periods of the day and night, permitted the waterpower to take care of the whole of the railway load.

Current developed by the plant, as already stated, is used for several different purposes. Probably the first in importance of these is the street-railway system. The traffic is all within the city, the lines radiating from the central business portion with no loops. The character of the surface is extremely hilly, making necessary quite a number of 10 per cent. grades. Altogether, there are now 16 miles of track, all of which has been supplied with new rails since the building of the new power plant, several miles of extensions having also been built since that time. Seventy-pound rails are used throughout.

The cars are 18 in number and were furnished by the J. G. Brill Company. Each is supplied with four 25-horsepower motors. In appearance the cars are up-to-date and comfortable. The seats run longitudinally and are upholstered in plush. A 10-minute headway is maintained, the cars being geared to 12 miles an hour. In the central portion of the city a No. 0 trolley wire is used, supported by steel poles, but in the outskirts a No. 0000 wire is found necessary and is suspended from wooden poles.

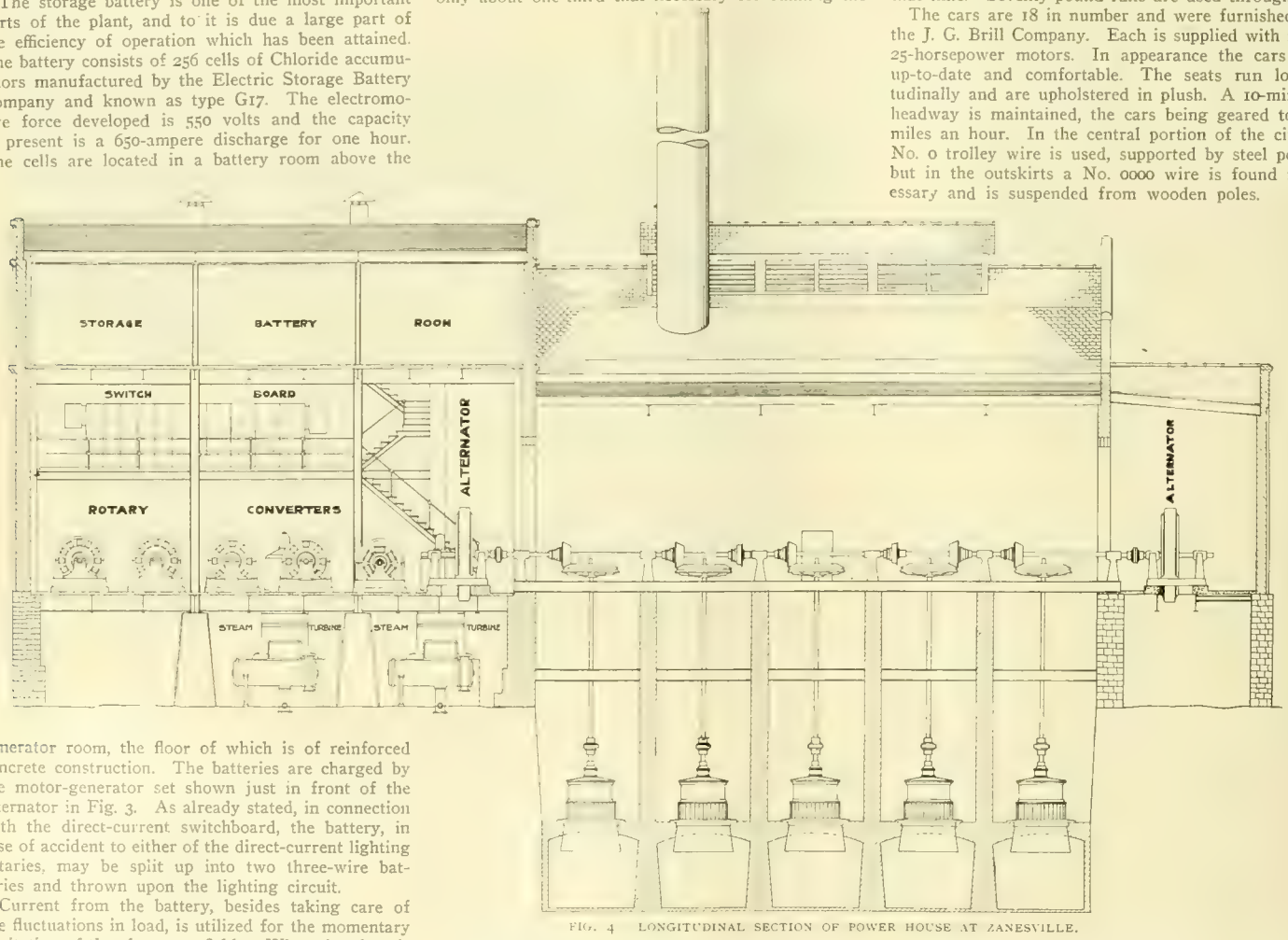


FIG. 4 LONGITUDINAL SECTION OF POWER HOUSE AT ZANESVILLE.

The peak of the railway and light loads combined is 1,000 kilowatts, of which the lighting peak is about 550 kilowatts. Approximately 25 per cent. of the lighting load is alternating current, supplied from the 2,300-volt alternators, and is composed of incandescent lamps, and an arc-light system. The method of distribution is the usual one for the alternating-current incandescent lamps, the current being trans-

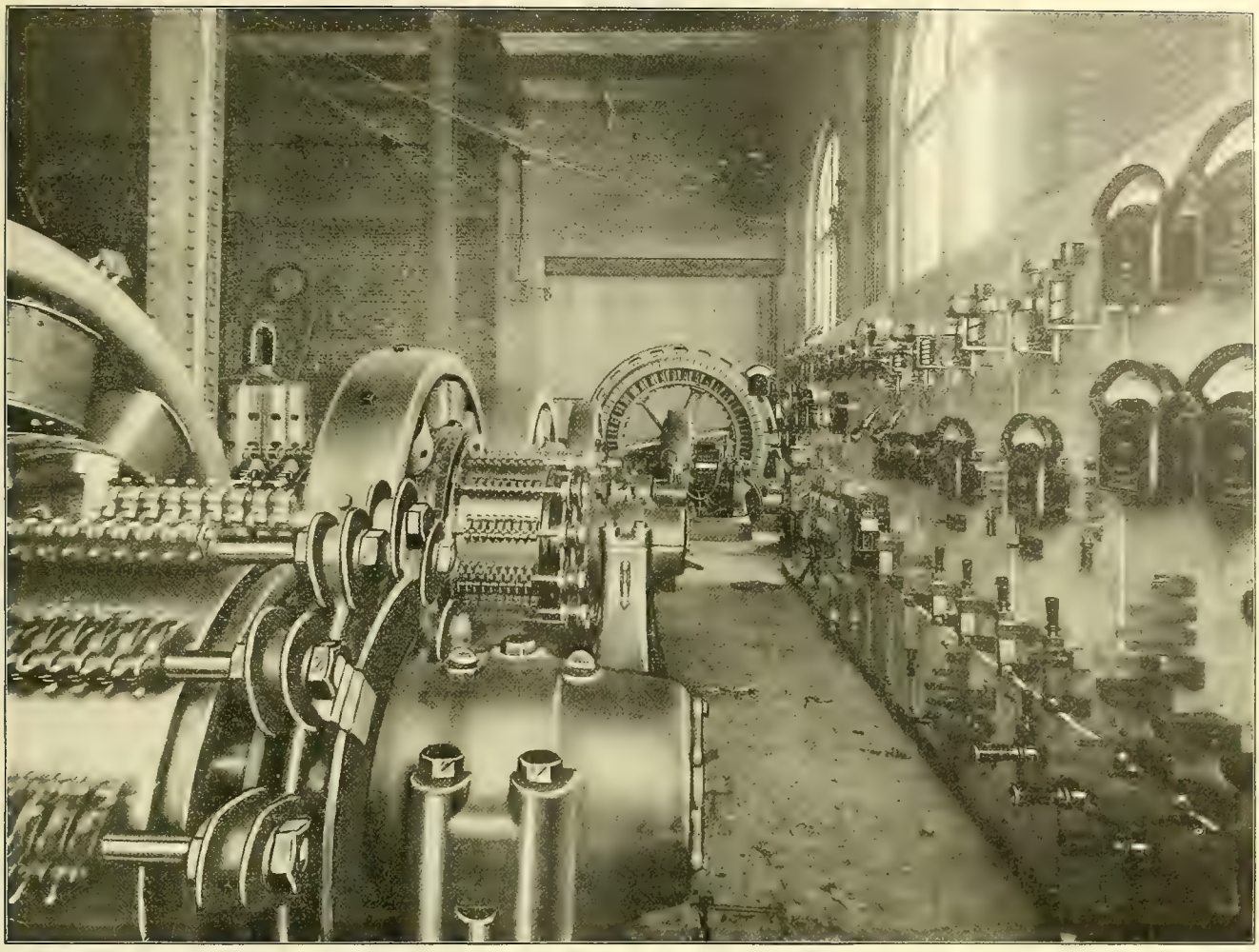


FIG. 3. VIEW OF GENERATOR ROOM OF ZANESVILLE RAILWAY, LIGHT AND POWER COMPANY.

mitted at 2,300 volts to pole transformers about town and from there distributed to the various circuits. The remainder of the alternating-current lighting load is taken up by the arc-light system, which is of the series alternating enclosed type and consists of five circuits of 250 lights, each supplied with automatic regulators at the station. The current for each circuit is 6.6 amperes.

The remaining 75 per cent. of the total lighting load is direct current, supplied to a three-wire system from the two rotaries already referred to in the description of the station equipment.

Marked economy in the cost of fuel and operation is shown in the present installation over that of the old plant previously in operation. In the old plant the consumption of coal at the switchboard was from 10 to 12 pounds a kilowatt-hour. In the new plant, taking into consideration the waterpower, the coal consumption is but 1¼ pounds at the switchboard a kilowatt-hour.

The present plant is the outgrowth of an old and inefficient steam plant. Rudolph Kleybolte & Co., bankers of Cincinnati, New York and Chicago, undertook the reorganization of the properties now merged in the Zanesville Railway, Light and Power Company, in September, 1902, their contract providing for not only the reorganization of the securities of these properties, but also for their complete physical and operating reconstruction. This company in turn contracted with H. M. Byllesby & Co. of Chicago for all the engineering work connected with the rebuilding of the property, the designing of the new power house and its contents. The latter company, in connection with Kleybolte & Co., also had charge of the reorganization of the operation of the properties. Under the reorganization, all the former operating officials were retained, namely: President, F. A. Durban of Zanesville; vice-president and engineer, H. M. Byllesby of Chicago; general manager and assistant treasurer, W. A. Gibbs; secretary and treasurer, W. D. Breed. Mr. Gibbs had been in charge of the properties under the former management for several years, and he had a prominent part in the reorganization of the operating condition and in the reconstruction of the properties. Mr. Gibbs, together with E. C. Braun, one of the engineers of H. M. Byllesby & Co., had charge on the spot of the reconstruction of the property.

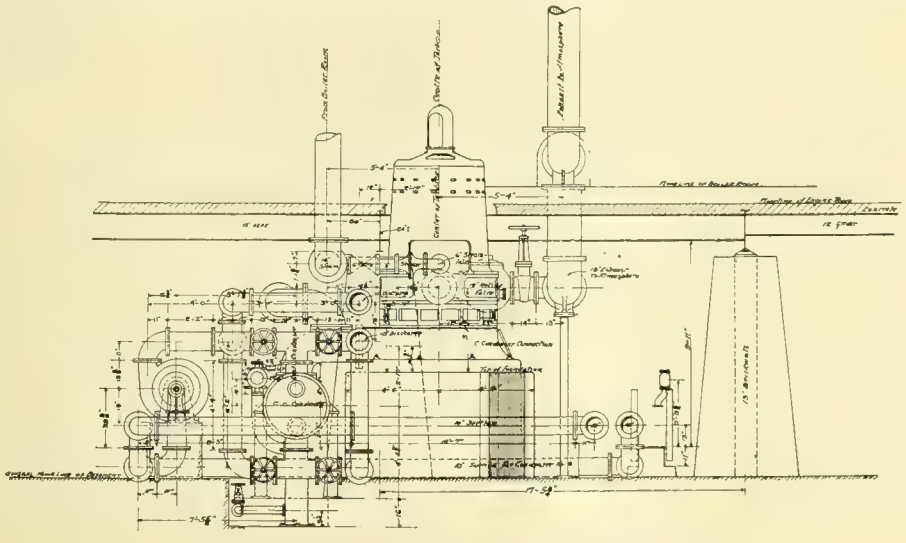


FIG. 5. DETAIL DRAWING OF STEAM TURBINE IN ZANESVILLE PLANT.

American Electrochemical Society to Meet in Washington.

The fifth general meeting of the American Electrochemical Society will be held in Washington, D. C., on April 7th, 8th and 9th at Columbian University. The headquarters will be opposite the university in the Shoreham hotel. Thursday and Friday afternoons will be devoted to visits to scientific laboratories, government institutions and various points of interest in and about Washington. On Thursday evening the presidential address will be delivered and will be followed by a complimentary smoker. Friday evening there will be a subscription banquet at the Shoreham.

The following papers will be read at the meeting: "The Composition and Resolution of Voltages," by Dr. J. W. Richards; "Notes on the Industrial Electrolysis of Water," by W. S. Landis; "Standard Cells," by Dr. F. A. Wolff; "Electric Smelting Experiments for the Manufacture of Ferro-nickel from Pyrrhotite," by Ernst A. Sjostedt; "A Contribution to the Study of the Electric Arc," by Dr. William S. Weedon; "The Energy of Ions," by Dr. L. A. Parsons; "Some Experiences in Copper Precipitation," by Hermann Poole; "A New Electrolytic Separation of Gold and Silver," by Hermann Poole; "The Preparation of Materials for Clark and Weston Standard Cell," by Dr. H. S. Carhart and Dr. G. A. Hulett; "The Determination of 'H,' at Annisquam, Mass., by Tangent Galvanometer," by Barry MacNutt; "The Economic Balance in Electrolytic Copper Refining," by Lawrence Addicks; "Single Potentials of the Halogen Elements," by W. R. Mott; "Observations on the Preparation of Electrolytic White Lead," by C. F. Carrier, Jr., A. C.; "Electrolytic Iron," by C. F. Burgess and Carl Hambuechen; "A Relative Decimal Index for Electrochemical Interests," by Adolph L. Voege. It is expected that other papers besides the above will be read.

The local committee consists of Colonel Samuel Reber and C. P. Townsend. Dr. N. M. Hopkins, Dr. E. A. Byrnes and W. O. Snelling are upon the entertainment committee.

The Official Journal of France has published a decree which places the space-telegraph system established by the Department of Marine at the service of the general public.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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DATES AHEAD.

American Electrochemical Society (annual business meeting), Washington, D. C., April 7th, 8th and 9th.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

THE recent—or shall we say the present?—severe winter has directed renewed attention to the possibilities of electric heating in thawing out frozen water pipes. We have been somewhat amused to observe that several of our contemporaries have spoken of the electrical process as though it were some new discovery or application. As a matter of fact, it has been in use, more or less, for several years. In the Western Electrician of March 4, 1899, we published an article on "Thawing Ice in Buried Pipes by Electric Heat." That article described, with a diagram, the plan adopted by Mr. Francis H. Soden of Chicago, a well-known electrical engineer, who at that time laid claim to being the first to give practical demonstration of the success of the system. In the same article it was stated that Professor R. W. Wood and Professor D. C. Jackson of the University of Wisconsin appeared to have accomplished the same result at Madison as Mr. Soden had in Chicago without knowing of his work.

Mr. Soden employed alternating current. He cut the service pipe leading into a building and attached one wire of the secondary main of a transformer to the street end of the severed pipe, the other wire of the circuit being connected to any convenient point of the water-pipe system exposed on the street, such as a fire hydrant. In the article in question the details of the system are given, with a drawing. We have received some inquiry this winter on the electrical method of thawing ice in water pipes and have referred all applicants to this article, printed five years ago, as we are not aware that anything better on the subject has been published since. If the present weather continues, we may have to republish the article in full.

IN CONSIDERING the relative merits of steam and electric railways the problem of acceleration occupies a prominent place. It is generally accepted that a stationary power house equipped with all modern economizing methods must be less expensive in the supply of energy than where the same demands are provided by a great number of single steam units scattered about a given section of a railway. The greater flexibility of the electrically driven train, the simplification of switching operations at terminal stations, and the increased speed due to higher acceleration, help to produce a balance in favor of electric traction when viewed from an economical point of view. In a recent comparison in an English journal by Messrs. d'Alton and Mannheim, who consider typical London suburban roads, the authors remark: "If it were possible to coast a train to a standstill, and not to brake at all, then no energy would be lost, and the total of energy applied during the acceleration period would be equal to the amount of energy necessary under all conditions to make the run in that time. But the conditions laid down do not allow such an ideal run to be made. The speed, and consequently the kinetic energy stored to make the run in the specified time, is too great to get rid of this kinetic energy simply by coasting. While it is not possible to utilize the total amount of kinetic energy necessary for acceleration, it is evident that enormous differences in the amount of energy to be applied will occur according to the manner in which the run is performed." Some comparative examples dealing with ideal runs made by electric motor cars and steam locomotives under precisely similar conditions are given, and in every case the figures favor the electrical equipment. This is hardly surprising, but it is gratifying none the less, although it is to be remembered that the calculation is on an assumed basis and not founded on a record of practical tests.

THE action of the American Society of Civil Engineers in deciding by the emphatic vote of 1,139 to 662 not to participate in the union-engineering-building project made possible by the generous offer of Andrew Carnegie is of much importance. It means that the plan to erect a building to house the four great engineering societies in New York—the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society of Civil Engineers—must be considerably modified or possibly abandoned altogether. The American Society of Civil Engineers has, no doubt, a proper appreciation of its own prestige and dignity. It is the oldest of the societies named and has a fine building of its own. It is not strange that it concluded not to take part in an undertaking by which, in some measure, it might lose its distinctive individuality. Perhaps, too, the society rather resented the idea of being patronized, even by such a man as Mr. Carnegie. But when all is said it would appear that the Civils took the narrow rather than the broad view of the situation. We believe that Mr. Carnegie's offer was made in the best possible spirit, with a sincere desire to advance without any preference or discrimination the art of engineering in the United States. Unquestionably, too, a union engineering building, such as the one planned, would have enhanced the standing of the engineering profession in this country. Such being the case, could not even such an important body as the American Society of Civil Engineers have sacrificed something of its pride, of its independence, perhaps, for the good of engineering as a whole?

[Since the foregoing comment on the action of the American Society of Civil Engineers was written a press dispatch from New York, dated March 15th, announces that Mr. Carnegie has placed at the disposal of the other societies named and the Engineers' Club $1,500,000 to provide funds for a union engineering building. The electrical, mechanical and mining engineers have accepted Mr. Carnegie's benevolent proposal and he has, it appears, increased his original proffer by 50 per cent. Thus the project will be carried out, although it is still to be regretted that the civil engineers have elected to plow a lonely furrow. It is said that the new building will be 12 stories high, construction to be begun this year.]

NATURE lovers and industrial promoters are again at loggerheads over the diversion of the water of Niagara Falls for power purposes. Recently the president of the Board of Commissioners of the State Reservation at Niagara appeared before a committee of the New York state Senate to protest against a bill to amend the charter of one of the power companies, giving it the right to divert water from Niagara River, above the falls, in unlimited volume. The president of the commission, Mr. Charles M. Dow, made out a strong case. He asserted that the diversion of 20 per cent. of the water of Niagara River would be sufficient to render the American Falls dry. Charters have been granted to seven corporations to take water from Niagara River. Some of these corporations are limited in the amount of water which they can divert. More are unlimited. One limited American company alone is authorized to develop 200,000 horsepower, requiring six per cent. of the volume of the river. With a similar development by its corresponding company on the Canadian side the flow of the river will be diminished, according to Mr. Dow, about one-eighth. A similar development by all of the companies now in existence would rob Niagara of one-third of its volume and insure the obliteration of the American Falls. There appears to be no limit, said Mr. Dow, to the amount of water which the two Canadian corporations are authorized to use. A single section of the wheelpit of the Canadian Niagara Falls Power Company, now under construction, will develop 50,000 horsepower, and it is said that the contracts are being made to increase the development to 110,000 horsepower.

One cannot help a sympathetic feeling toward the attitude assumed by the protagonists of the scenic attractions of the Falls, however advantageous may be the utilization of the power for industrial development. It is a case where one's reason inclines one way and one's sentiment the other. Even electrical men are not wholly unsympathetic when they are appealed to to preserve the grandeur and beauty of Nature, although one of the greatest of their number —Lord Kelvin—did say that it would be better for humanity if every drop of Niagara went through waterwheels to drive the motors of industry instead of pouring over a cliff in untamed majesty. But this is an extreme view. Perhaps the State Reservation people take the other extreme. We hope the future is not as dark as they have painted it. We cannot eat our cake and have it too at Niagara; but considerable water can still be diverted and yet leave enough for a wonderful waterfall.

Renshaw on the Alternating-current Motor.

A brief account of the proceedings of the Chicago branch of the American Institute of Electrical Engineers, held on March 8th, was given in the Western Electrician last week, as was also the paper read at that meeting by W. A. Blanck. Another who read an interesting and valuable paper upon the alternating-current motor for street-railway work was Clarence Renshaw of Chicago.

The real source of economy in using alternating-current motors for street-railway work, as stated by Mr. Renshaw in his introduction, lies not so much in the efficiency of the alternating-current motor and its cost, which are mere details, as in the fact that through their agency alternating current may be used for traction purposes. By the use of alternating current no moving machinery is necessary for transformation; great ease of transmission is another factor and also the absence of electrolysis in city work is not to be overlooked. Constant attendance at points where the transmission voltage is reduced to that of the trolley, as is necessary in systems using alternating-current transmission with direct-current distribution, is made unnecessary by the alternating-current motor. At the same time, these advantages may be derived from a properly constructed alternating-current motor, which may also be made to embody the characteristics of a direct-current series motor, so long thought to be the only one possible for street-railway work.

Generally speaking, alternating-current motors for traction work may be divided into two classes, the straight series motor and the transformer series motor. The latter type may again be divided into two distinct types, in one of which the transformer is entirely outside of the motor and in the other combined with the motor. This last type is known as the repulsion motor. In the straight series motor the sum of the voltage across the field plus the voltage across the armature is greater than the terminal voltage. Since the power factor is represented principally by the armature volts, to obtain a high power factor a high armature voltage should be used in connection with a low field voltage.

The armature voltage depends upon three factors —the speed, the number of armature conductors in series, and the inductance through the armature. With a given inductance, therefore, a lower voltage is obtained by decreasing the number of turns on the armature.

In the transformer type of motor the field volts are at an angle of 90 degrees from the transformer pressure, while the armature electromotive force is in phase with the field flux. Therefore the transformer voltage opposes the voltage generated by rotation, which is the proper condition, the flux at starting then being at a minimum in the transformer and at a maximum in the field.

In the repulsion type of motor, with a given input the torque is not as great as in the straight series motor because the inductance in the transformer, one member of which is in the rotating part of the motor and the other in the stationary part, is greater.

In the building of alternating-current motors for street-railway work and also their location under the car especial care should be taken that the insulation of the fields be as near perfect as possible, since there is a voltage at the field terminals due to the transformer action of the field coils under the influence of the alternating current. For this reason, too, the voltage at the motor should be as low as possible.

Mr. Renshaw in his discussion rather favored the straight series type of alternating-current motor as compared to the repulsion type. In his summary he gave as the three principal reasons for this stand that, first, the weight is less; second, there is less short-circuiting current in the armature, and, third, the series type may be wound for lower voltage.

In the discussion which followed the paper Mr. Summers brought up the question of the possibility of returning current to the line by the use of the alternating-current motor. Mr. Renshaw said this was possible, but not commercially practicable. The complications which arise in the building of a motor to accomplish this more than offset the small amount of power to be saved. In Switzerland, where the grades are exceptionally steep, power is actually returned to the line at a profit, but nowhere else do the conditions warrant the design of apparatus for this purpose.

The eighth annual meeting of the National Fire Protection Association will be held in the rooms of the New York Board of Fire Underwriters, No. 32 Nassau Street, New York, on May 24th, 25th and 26th.

Chicago Street-railway Situation.

Pending final disposition of the franchise suit involving the city of Chicago and the Chicago City Railway Company, the ordinances of the company have been extended until January 1, 1905. This action was taken at the last meeting of the City Council. The suit was begun before Judge Grosscup two weeks ago with a hearing on the claims of both sides concerning the much-discussed 99-year act. When Judge Grosscup gives his decision the case will be appealed for final hearing. The ordinance provides for an extension of the Indiana Avenue trolley line to a downtown loop, and the company agrees to pay a license fee of $100 per car for the period. The extension permit is revocable at the will of the council. This action postpones consideration of the company's extension ordinance until a new council is elected.

A considerable change in the management of the Chicago City Company is anticipated as a result of the announcement by General Manager McCulloch of his acceptance of the offer to go to St. Louis. Mr. McCulloch will probably leave within 30 days.

The Union Traction Company is undergoing an examination before Master in Chancery Bishop on behalf of the city on the allegation by certain stockholders that the receivership proceedings were collusive between the street-car company and the Guarantee Trust Company of New York. Several of the company's attorneys have been closely questioned as to how the proceedings by which the company was placed in receiver's hands were conducted.

Improvements and extensions are also under way by the Union Traction Company. Beginning next Monday through service between the North Side limits barns and Bowmanville will be inaugurated. By this change residents of the northwest section of the city will be able to ride to the downtown district without transferring to and from the cross-town lines. Receiver John C. Fetzer is now working on a plan to run the North State Street trolley cars in Lake Street to Dearborn and to obtain the right to wire Dearborn Street from Randolph to Van Buren so that the horse cars to Polk Street can be abandoned.

The Union Traction Company suffered severely this week from a fire which destroyed the large car barns at Nineteenth and Leavitt Streets, together with 250 cars. The direct effect will not be felt by the public, however, until summer, as all but eight were open cars. With the unsettled condition of franchise matters and the possible reconstruction of the entire system, it is a matter of doubt as to what will be done to handle the summer traffic with a shortage of 250 cars.

Arrangements for the National Electric Light Convention.

Arrangements for the twenty-seventh convention of the National Electric Light Association to be held in Boston on May 24th to 27th are gradually rounding into shape and indications already are bright for a successful meeting. President Edgar spent several days in New York recently looking after association affairs. Mr. Edgar was accompanied by past-President James I. Ayer, whom he has been fortunate enough to induce to act as chairman of the entertainment committee. This committee among its other duties will have charge of the assigning of rooms at the Vendome, which is to be the headquarters of the association; particulars regarding rates, etc., will be issued soon. As many delegates prefer to stop at a smaller or quieter hotel than that selected for convention headquarters, arrangements will be made by which they also can secure, through the committee, such accommodations as they prefer. In fact, hotel arrangements promise to be more systematic and satisfactory than they have ever been before.

A preliminary list of questions for the Question Box is being sent out by Secretary Davis. There are already 326 questions, which makes a list nearly twice as large as the complete list for last year's convention. The questions have been classified in sections covering the following subjects: Central-station buildings, waterwheels, waterpower, etc.; feed water, purifying compounds, etc.; fuel, boilers; forced draft, blowers, stacks, etc.; engines; piping; heaters and heating systems; pumps, condensers; dynamos and motors; storage batteries; switchboard instruments and station wiring; belts and shafting; oil and waste; pole lines and conduit systems; arc lamps; incandescent lamps; transformers; meters; management; miscellaneous.

Institute Meeting in New York.

The next meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club in New York city on March 25th. Several interesting papers will be read and discussed. The titles of the papers and the names of their respective authors follow: "The Relative Risk of Oil and Air-blast Transformers," by E. W. Rice, Jr., Schenectady, N. Y.; "Use of Group Switches in Large Power Plants," by Louis B. Stillwell, New York city; "Oil Switches for High Voltages," by E. M. Hewlett, Schenectady, N. Y.; "Terminals and Bushings for High-pressure Transformers," by Walter S. Moody, Schenectady, N. Y. The secretary of the Institute is Ralph W. Pope, 95 Liberty Street, New York.

Death of John B. O'Hara.

Many hearts will be saddened, many eyes will be moistened, by the news that John O'Hara is dead. For he was a man who made friends and kept them. He had a singularly winning nature; he was kind; he was considerate; he delighted in making others happy; he probably had not an enemy in the world. In mental equipment he was strong, clear, well balanced; in physical organism, alas! he was not so well gifted. His body was not equal to the task of sustaining the fine, active mind through a long career. He had had a weak heart for years, and it was a valvular disease of that organ that caused his death, after much suffering, at the untimely age of 38. Coming just four weeks after the death of his wife, to whom he was devoted, Mr. O'Hara's death is particularly pathetic.

JOHN B. O'HARA.

John B. O'Hara was born in Rochester, N. Y., December 10, 1865. He died in that city March 13, 1904. He was a bright, precocious boy, the delight and admiration of his teachers. In the academy which he attended he published a little paper; the boy was father of the man. After leaving school his first ventures were in mercantile pursuits, but he continued to study. It was not long before he gravitated to the calling for which he was pre-eminently fitted—journalism. He became a daily-newspaper reporter and was speedily recognized as one of the best in Rochester. His industry, intelligence, unfailing good humor, wide acquaintance and ability to keep a secret—O'Hara never betrayed any man's confidence—made him successful. Politicians trusted him; public officials could rely on his discretion; everybody liked him.

In December, 1888, at the suggestion of the late John W. Dickerson, Mr. O'Hara removed to Chicago and became associate editor of the Western Electrician. The transition from general to technical journalism is not always a success, but in Mr. O'Hara's case it was entirely so. The young newspaper man had the habits of a student; he was a keen observer; he was interested in machinery; he had good sense and good judgment. He not only became a writer of strength on subjects of electrical interest—not only a specialist in the dissemination of useful information on the science of electricity and the arts affected thereby—but he himself contributed valuable ideas to the development of inventions about which he was consulted.

The readers of the Western Electrician had the benefit of Mr. O'Hara's talents for a period of nearly 11 years, or until July 15, 1899. In that time he had been advanced from the position of associate editor to that of managing editor, which he held when, with the good wishes of his associates, he resigned from this journal. During this time he married Miss Margaret Hickey of Rochester—a witty, sprightly, light-hearted girl, who became a tender and loyal wife. Mrs. O'Hara died on February 14th last, less than a month before her husband. By these two deaths the only surviving child of this marriage—a charming boy of eight years—becomes an orphan.

Having assumed the entire management of a monthly magazine in Chicago, Mr. O'Hara threw himself into the task with his accustomed sincerity and earnestness. He undertoook too much, however, and his health broke down under the strain. In the spring of 1901 he was forced to lay aside all business cares by an attack of nervous prostration, and he spent the summer and early autumn of the year at eastern seaside resorts recuperating his health. Late in that year he accepted a position as representative of the Westinghouse Companies' Publishing Department in New York city. He established his family in that city and something less than two years ago became associate editor of the Street Railway Journal—a position he held at the time of his death.

Mrs. O'Hara's death was a great shock to her husband. His own health had been unsatisfactory for some time. He accompanied the body to Rochester, but was too ill to attend the funeral. He took to his bed and failed steadily until the end came. Mr. O'Hara had every care, but he suffered greatly in the complications which accompanied his disorder. But although pain extorted groans of agony from his lips, he looked death bravely in the face, and went down with colors flying—like the fine fellow and true man that he was.

Mr. O'Hara was a member of the Knights of Columbus and an associate member of the American Institute of Electrical Engineers. He was buried in Rochester. The accompanying portrait is a reproduction of a photograph taken several years ago.

Rectifiers.[1]

By Charles F. Burgess.

To correct or redress an alternating current so that it may serve certain purposes, such as charging storage batteries, is the function of the so-called alternating-current rectifier. The perfection of these devices has occupied the attention of various engineers and scientists during recent years, and the progress made has been such as to bring the subject to a state of practical importance to the central-station operators.

A rectified current, properly speaking, is that derived from an alternating source of pressure in which both halves of the complete alternating cycle are utilized. The ideal rectified curve would be produced by inverting the lower half of the alternating curve, the resultant being a curve of unidirectional, pulsating nature. The term, however, is sometimes improperly applied to the interrupted pulsating current produced by suppressing one-half of each cycle, but the newest and most improved rectifiers utilize the complete cycle.

Rectifiers may be divided into three general types—mechanical, vapor and electrolytic.

Omitting the rotary converter, which is essentially a direct-current dynamo driven by an alternating-current motor, and is not a rectifier, in the commonly accepted meaning of the term, the mechanical rectifiers include the synchronously driven rotating reversing switch, and the vibrating reverser in which the contact maker is maintained in synchronous vibration by energy derived from the alternating circuit. The destructive sparking, which it is almost impossible to suppress, and the tendency of the storage battery or other translating device to discharge when its pressure is greater than the instantaneous values of the pulsating rectified pressure, have prevented these devices from being extensively adopted, in spite of their low cost as compared with the rotary converter. A vibrating rectifier was advertised not long ago by an English manufacturer, but the inertia of the moving part, together with the objections referred to, undoubtedly will prevent this from being of value except for the smallest capacities.

Certain materials have been discovered which have a low resistance when the current flows in one direction and an extremely high value when the direction of the current flow is reversed. Conductors possessing this property have been designated "asymmetric" conductors. It is this property that the vapor and electrolytic types of rectifiers utilize.

The electric arc playing between carbon terminals has for a long time been known to possess the property of asymmetry, but not in sufficient degree to warrant its practical application. In the discovery of the so-called "Edison effect" some 20 years ago it was shown that a rectified current could be obtained from an alternating current by means of an extra electrode inserted in an incandescent lamp. Various other vapors have been found to possess this property, the most pronounced results being those recently pointed out by Mr. Cooper Hewitt in his remarkable work on the conductivity of mercury vapor. In this Mr. Cooper Hewitt has demonstrated the possibility of utilizing the mercury-vapor conductor in the construction of a rectifier or converter having an efficiency of 98 per cent. and above. His apparatus is remarkable in its large amount of energy converted per unit of weight and volume and also for the high efficiency, which can scarcely be approached by any other form of electrical converting apparatus. At present these converters are apparently in the development and experimental stage, but hold out great promise as a successful rectifier for various classes of service.

Though for the last 20 years it has occupied a prominent place in scientific and technical literature, the third class, or the electrolytic rectifier, has only recently been placed upon the market in this country. This form of rectifier is sometimes designated as an electrolytic valve, and, as such, has an analogy in the hydraulic check-valve, which automatically allows water to flow freely through a pipe in one direction, but prevents its passage in the opposite direction. The discovery upon which the electrolytic rectifier of to-day is based was made a half century ago, when it was found that aluminum, in certain solutions, possesses the property of opposing in a high degree the passage of the current from it to an electrolyte, and of freely allowing its passage in the opposite direction.

It will be evident that the efficiency of such an electric valve must depend upon the rapidity with which it acts, upon the completeness with which it stops the flow of current in the one direction, and upon the high conductivity which it allows for the passage in the reverse direction. With the commercial frequencies now employed, of from 25 to over 100 per second, it is evident that this valve must act with great rapidity. Without going into details as to this factor, or the method of determining it, I may state that an investigation of this question in our laboratory has shown that an aluminum plate immersed in a sodium-nitrate electrolyte required about one eleven-hundredth of a second for closing the "electrical valve" at each reversal of pressure.

There are many solutions which, in contact with aluminum, allow this electrolytic-valve action to become manifest. Some solutions are naturally more efficient than are others, and it is to the study of the relative behavior of different materials that most attention has been given during the last few years.

Although extravagant claims have been made from time to time as regards efficiency, durability and other factors, these claims have almost invariably failed of realization under practical conditions, and it is only recently that improvements have brought the working efficiency of the apparatus up to a point where it can be used commercially. It is not yet all that may be desired, but for certain classes of work, such as charging small storage-battery equipments, it offers decided advantages.

Among these advantages which have made the electrolytic rectifier an attractive problem for study and investigation are the following: In possessing no moving parts, it is a close approximation to the static alternating-current transformer, requiring little or no attention during operation. The materials of which it is constructed are cheap and the total cost should be lower than that of the ordinary transformer for equivalent outputs. The electrolytic rectifier has a high power factor. It requires little or no abnormal rush of starting current. It has in its present condition an efficiency in the neighborhood of 50 per cent., and, what makes it especially desirable for a certain class of work, is, that it can be made in small sizes at such a cost as will permit its general use where small storage batteries are to be charged from alternating-current circuits. Where direct-current circuits are available, and two or three or more storage cells are to be charged from them, the common, though wasteful method, is to connect the batteries in series with a suitable resistance. With the electrolytic rectifier, advantage may be made of pressure transformation rather than rheostatic control, thus effecting a large saving in the power consumption.

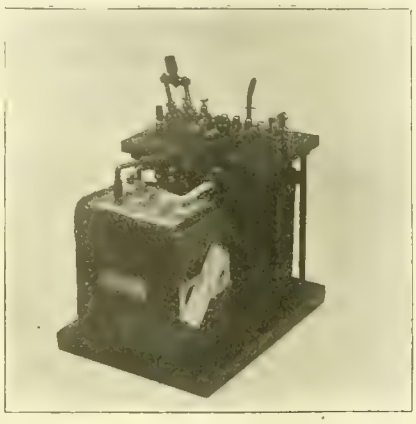


FIG. 1. SINGLE-CELL ELECTROLYTIC RECTIFIER, 10 AMPERES AT 30 VOLTS.

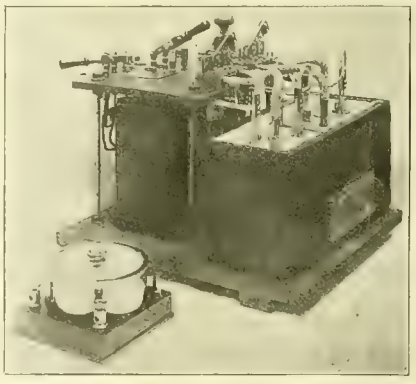


FIG. 2. DOUBLE-CELL ELECTROLYTIC RECTIFIER, 50 AMPERES AT 50 VOLTS.

The electrolytic rectifier has certain limitations, one of which is that, for a single cell a pressure much greater than 50 or 60 volts cannot be maintained at a high efficiency; and where higher pressures are necessary, two or more cells must be operated in series.

Tests which have been made in our laboratories on the efficiency of a large number of electrolytic rectifiers of various types have shown that the best of them operate, under practical working conditions, at an efficiency between 50 and 60 per cent. Tests on various sizes of a certain type of rectifier have shown that this efficiency is practically constant, regardless of size, and in this respect the rectifier differs materially from most types of electrical apparatus, where the efficiency usually increases in value as the size of the outfit is increased. While the efficiency of the rectifier is such as to enable it to compete very satisfactorily with a motor-dynamo or similar form of charging device, when small outputs are required, for larger equipments of, say, five to 10 kilowatts, the advantage of efficiency is in favor of the latter device.

The electrolytic rectifier will not operate indefinitely without attention, for there is a tendency to electrolytic decomposition; for the liquid to evaporate, and for the electrodes themselves to undergo a certain corrosion which requires their replacement after certain intervals. With certain forms of cells, however, this corrosion and the amount of attention made necessary may be rendered so small as to offer little ground for practical objection. In some extensive tests on a form of rectifier devised in our laboratory we have found that the total cost of maintaining the apparatus in working condition may be covered by a small fraction of a cent a kilowatt-hour, and the amount of attention is limited to a few minutes once in each 10 hours of continual operation.

Another limitation of the rectifier is due to the pulsating nature of the rectified current. Pulsations of the current, while interfering in no way with its use for charging batteries or for other electrolytic work, may produce a humming sound and heating, due to eddy current, in motors which are operated by this current. There is also produced a very undesirable humming sound in telephone lines which are operated from batteries simultaneously under charge by this pulsating current.

In measuring the efficiency and investigating the properties of this new type of apparatus certain peculiarities become manifest. On attempting to measure the output of these rectifiers by the use of direct-current ammeters and voltmeters, and multiplying the readings thus produced to give the watts, a value considerably at variance with the true value may be obtained, on account of the failure of the ordinary type of instruments to properly record the current having this peculiar pulsating nature. The wattmeter, however, will give more nearly correct indications, and the efficiency should be properly determined by wattmeter readings on each side of the rectifier outfit. It might, at first sight, seem rather startling, after measuring the rectified pressure by means of a direct-current voltmeter and obtaining a reading of, say, 25 volts, to find that, when connecting a 28 or 30-volt storage battery to the terminals, a charging current will flow. This, of course, is due to the fact that the voltmeter indicates only average values of current, while at certain portions of the current wave, the pressure considerably exceeds this value. It is while the pressure is at the maximum that the storage battery in the above instance will be charged.

Electrolytic rectifiers may properly be subdivided into two classes, one in which an aqueous solution is employed, and another in which use is made of the non-aqueous or fused electrolyte. It has been found that certain soluble phosphates, borates, tartrates, sulphates and various other materials, when placed in water to a suitable density, will cause aluminum to develop the valve action. It has also been found that in most of these solutions if the temperature is allowed to rise beyond 30° or 40° C., a marked decrease in efficiency results, and it is, therefore, necessary in cells of any considerable size to use a cooling device in which the cell is kept at a low temperature, either by flowing water or circulating air.

Mr. Carl Hambuechen of the University of Wisconsin has discovered that aluminum acts most efficiently as an asymmetric conductor when placed in molten sodium nitrate, or certain other similar salts. Upon this discovery is based the second class of electrolytic conductors, or those which employ the fused electrolyte. An average efficiency of from 10 to 30 per cent. higher than that of the aqueous type may be maintained with the fused salt, on account of the more efficient valve action of the aluminum and the lower resistance of the electrolyte. It has a further advantage in that the development of heat is utilized, inasmuch as it tends to keep the material in a condition of fusion and at a high degree of conductivity, while, with the aqueous type, the elevation of temperature beyond 30° or 40° C. causes such a rapid decrease in efficiency that artificial means are necessary for dissipating the heat.

With the fused salt the temperature of operation is limited to the degree of heat at which evaporation and decomposition of the electrolyte begins, and this point being over 350° C., allows a fairly high rate of radiation by simply exposing the cell to the air. This fact, together with the high conductivity of the fused salt, enables a large output per unit of weight and volume of the cell to be attained.

The essential parts of this rectifier [see Figs. 1 and 2] consist in a specially wound transformer or auto-transformer, which allows connection to a 110-volt or other convenient source of alternating supply. This transformer has various terminals by means of which the ratio of transformation and, consequently, the pressure of the rectified current may be regulated, thus avoiding rheostat control. Connections are made also from the windings of the transformer to two aluminum electrodes and an iron electrode. The electrodes are contained in an aluminum case surrounded by an asbestos cover, passing through and being held in place by a stone top.

When the rectifier is not in use, the electrolyte is perfectly solid and non-conductive, but by passing a low-voltage and high-volume alternating current lengthwise through the iron electrodes for four or five minutes, the cell is brought into working condition, after which the heating current is switched off and the cell is maintained at the desired work-

1. A paper read before the Northwestern Electrical Association at Milwaukee January 21, 1904. The author is professor of electrical engineering at the University of Wisconsin.

ing condition by the natural heat losses when operating within 25 per cent. of the normal load.

With aluminum electrodes two by one by one-eighth inches the normal load is 10 amperes, at a rectified pressure of 25 to 30 volts. The current may be several hundred per cent. higher than this value for a short time without detriment, and a 50 per cent. overload causes excessive heating and vaporization of the salt only after several hours' run. The total weight of an outfit of this capacity is about 30 pounds, most of which is in the transformer.

All the attention which the device requires is the addition, once in each day of operation, of a small amount of salt in the form of sticks, which are introduced through an opening in a stone cover. This salt is added for the purpose of supplying electrolyte losses by vaporization, and neutralizing the tendency of the electrolyte to become alkaline by the decomposition effect of the current.

By thus maintaining the salt in working condition, aluminum electrodes have been operated for over 800 hours without excessive corrosion, and the iron electrodes last a considerably longer time. Estimates of the cost of the additional salt and the renewal of electrodes place the figure at below three-tenths of a cent a kilowatt-hour.

The electrolytic rectifier, in its present stage of development, is an apparatus of interest and value to the central-station manager as well as to the large number of customers who desire to obtain from existing alternating-current systems current for their electric automobiles or for storage batteries used for other purposes.

If it comes into extensive use, some interesting problems will be presented to the central-station manager. The customer who connects his rectifier to the regular lighting circuits pays a high price for his power. It is doubtful whether, even at this rate, such a load is a desirable one from the station standpoint, on account of its intermittent nature, and its interference with the regular lighting service. The management, however, could well afford to encourage the use of the rectifiers in the daytime to the extent of giving reduced rates for that portion of the day when the tax on the lighting circuits is at the minimum.

The improvements in quality and price of storage cells, and the many new uses for them, tend to increase the importance of any device which will enable them to be charged from alternating circuits, and the rectifier may serve not only to add to the accommodation which can be offered to the customers, but also to afford an additional market for the central-station product.

DISCUSSION (IN ABSTRACT.)

George Cutter, Chicago: I have a transformer in my house, giving me 110 volts on a 60-cycle circuit, and I wish to charge a small storage battery, and would like to know if I do not use the device more than once a week or two, if I would still have to attend to it every day; or if it merely needs attention once in so many hours of service, and then can stand idle for a long while without attention? And also, can I connect onto my lighting circuit just inside of my meter?

Professor Burgess: Where the cell is not in operation, of course, no change or deterioration can take place in it. So the addition of this salt, in the form of sticks, is made after every 10 hours of continual operation. This particular device was designed to connect on to any lighting outfit; it would be placed inside of the meter.

George W. Colles, Milwaukee: I would like to ask if Professor Burgess can tell us something about what has been actually done in this country toward introducing rectifiers, or whether anything has been done at all in putting them into use on a reasonably large scale to take the place of rotary converters or motor-generators; and whether, on the other hand, anything has been done on a small scale?

Professor Burgess: As far as the electrolytic rectifier is concerned, I do not look for any great success in sizes beyond one kilowatt, as the efficiency is against them.

As far as the future of the rectifier is concerned, it seems to me that this work of Cooper Hewitt is the most promising. He has demonstrated that you can get an efficiency as high as 98 per cent. by methods which do not seem to allow of any dispute. I have seen one of his outfits in operation, and it certainly showed remarkable efficiency and economy. But it is not yet on the market as a converter, and I do not know that they are making any promises as to when it will be on the market. From an experimental standpoint it is a very satisfactory device.

Mr. Cutter: Am I to understand that this electrolytic rectifier works by sifting out half of the current, that is, does it let through that which goes one way and sift out that which would go the other way—is that the idea?

Professor Burgess: Not exactly. One electrode sifts out one half and the other electrode the other half, and then they join them together.

Mr. Cutter: I wanted to say that while I am not familiar with operating central stations, I believe that there is a great future, from the central-station standpoint, for an apparatus of this sort. I am a firm believer in the wide use of small electric automobiles, little runabouts for professional men and ladies. In my case, for instance, I bought a little electric runabout. Our lighting current is 60-cycle alternating, so I bought a little motor-generator set to charge the storage battery of my automobile. I had a capacity of 60 volts, with maximum of 10 amperes. The usual charging current was about 30 to 35 volts. The device cost me, installed, about $250, and weighed 700 or 800 pounds, and was quite a good deal of apparatus to take care of. We had not run it long before we got out of oil in one of the bearings, and had to send it to the machine shop for repairs. When I compare that device with this I am struck with the simplicity and superiority of the rectifier in question. The other one was so cumbersome as to prohibit its use in my automobile for pleasure, and I sold it. This rectifier would have enabled me to keep my little electric runabout for the madame to use around home, and I believe that the central-station people would do well to keep thoroughly in touch with those devices for that purpose, if for nothing else, and I think they can add very materially to their revenue by it.

V. R. Lansingh, Chicago: Would the weight of that apparatus be so great as to prohibit its use in the automobile itself? Could it not be put in the machine itself, so that the batteries could be charged almost anywhere from an alternating current?

Professor Burgess: That is one of the points which seems to be in favor of this type of rectifier. The weight of this outfit is 28 pounds for a 300-watt apparatus. I made one that delivered 50 amperes at 60 volts, for charging an electric launch, which weighed about 90 pounds. Now, the principal part of the weight is in the transformer, and, of course, for short charging service you can make a transformer a good deal lighter than it is ordinarily made, because you do not care if you do heat it up some. So, it seems to me, it is entirely feasible to construct a device which can be carried around with your automobile. I do not know if it has been done as yet, but it seems to me entirely practicable.

F. W. Bowen, Kenosha, Wis.: It looks to me as though any proposition of this kind necessarily must be viewed from the commercial side, and I want to ask the professor a question. I heard him mention a moment ago an efficiency of about 50 per cent. Now, from that should I be led to understand that you could get the necessary direct current out of double the price you paid for your alternating current per kilowatt?

Professor Burgess: Yes, sir.

Mr. Cutter: That little motor-generator set which I bought gave me about 60 per cent—the manufacturers only claimed that much—but what I got I don't know. What do I care for the difference between 60 and 50 per cent., for my automobile charging?

Allis-Chalmers-Bullock Combination.

Further details of the Allis-Chalmers-Bullock combination are to the effect that the Allis-Chalmers Company of Chicago has entered into an agreement with the Bullock Electric Manufacturing Company of Cincinnati, whereby the business of the two companies will hereafter be carried on as that of a single interest. The business of the Bullock company will be conducted as heretofore by its present management under the form of a new Bullock Electric Manufacturing Company, organized under the laws of the state of Ohio, with George Bullock as president and Joseph S. Neave as vice-president and all the present officers of the Bullock Electric Manufacturing Company of New Jersey.

In addition to its well-known line of electrical machinery the Bullock company has also developed a full line of street-railway motors. Extensive additions to its shops are now being contracted for. These will add another shop to the already large number of shops at East Norwood, Ohio. The new building will contain about 40,000 square feet of space.

The Allis-Chalmers-Bullock combination of industries will enable either company to bid upon complete power plants, whether driven by steam, water-power or gas, and supply not only the prime movers but a complete outfit of electrical apparatus from generators to motors either for factory, street car, or interurban work, as well as large electrical locomotives, which will take the place of the present steam locomotives on the steam roads.

The capital stock issue of the Allis-Chalmers Company is $36,250,000 and of the Bullock company $3,600,000, making a combined capital of $39,850,000. The total number of employes of the combined companies amounts to over 8,700 men. Under the terms of the agreement the payment of the six per cent. interest on the Bullock company's preferred stock is guaranteed.

New Surface-contact Railway System in Indiana.

The new Wabash and Rochester interurban line now being constructed in Indiana will make use of a system of surface-contact which has not as yet received practical trial, although the device has been patented for some time. The feed wires are to be buried beneath the ground beside the track. At intervals of 18 feet the feed wire is tapped with short copper wires working in sockets, the upper ends of which are fitted with a hinge cap. The place of the ordinary trolley pole is taken by a long magnetized steel bar beneath the car. As this bar extends over the short copper wires the caps are drawn open by the magnetic pull of the bar and the wires drawn up, forming a circuit with the bar and, consequently, with the motors in the car.

Portable Voltage and Series Transformers.

In checking and testing electrical instruments with the use of the ordinary appliances the standards often introduce sources of error and make it impossible to certify absolutely to the accuracy of the results obtained. In fact, the greater number of the errors and discrepancies in tests can be traced directly to lack of legibility of standards and to variations in the different instruments.

Manifestly the ideal instrument either for taking measurements or for making comparisons with other measuring devices is one which will combine a great degree of legibility with a capacity for all ranges in which readings are to be taken, and any means by which these characteristics can be imparted to the instruments now in service is of practical value.

The best method for accomplishing the desired result is by the use of transformers which will adapt the voltage or current to be measured to the capacity of the instrument to be used, adopting a ratio which will permit readings to be taken from the most legible portions of the scale. By this means any difficulty in readings is obviated, uniform accuracy at all capacities is assured, and a single voltmeter, ammeter and wattmeter will fulfill all the requirements of the most exacting service.

Portable series and voltage transformers made by the Westinghouse Electric and Manufacturing Company are especially designed for this work and are admirably adapted for the purpose. They are carefully made, the ample insulation and generous amount of iron and copper used reducing to a minimum the error of transformation. They are designed to give accurate ratios at the load which will normally be imposed on the secondary by the ordinary type of portable instruments, the output of the voltage transformer being about .15 ampere and the maximum voltage across the secondary of the series transformer being about three volts.

The series transformer is made in two types. One is designed for primary currents up to 100 amperes, the ratio being changed by plugs, somewhat as in the Wheatstone bridge. In the other type, which is designed for larger capacities, there is a circular opening through the transformer, and the conductor is passed through this opening, forming the primary. In this type the ratio is changed by the number of turns made by the conductor, passing it through the aperture once, giving a ratio of 400 to 5, twice a ratio of 200 to 5, and four times a ratio of 100 to 5.

These voltage transformers are furnished in various capacities up to 750 volts primary, the standard secondary voltage at the maximum primary voltage being 150 volts. The terminals on the primary are arranged so that a number of primary voltages may be obtained, although they are not usually required in a great range of capacities, as is the case with series transformers. The transformers are mounted in finely finished mahogany cases with carrying handles. The terminals of the voltage transformers and the plug contacts of the series transformers are protected by a cover, which for convenience in use is made removable.

Hydro-electric Developments in Austria.

The British consul at Triest reports that the Kerka (Dalmatia) electricity works, developing 20,000 horsepower, will be opened soon. A great part of the power generated will be transmitted to Sebenico, where a calcium carbide works has been erected. The transmission line will be 7½ miles long. The central station at Jaruga contains two 3,500-horsepower sets, and it is anticipated that the annual production of carbide will be 5,000 tons. The consul states further that the company formed for the utilization of waterpower of Dalmatia, under the name of the Società Romana, has also commenced operations on the Manoilovac waterfall, from which it is hoped that 25,000 horsepower will be obtained. There will be altogether 30,000 horsepower from the four Kerka falls, and the annual production of calcium carbide will be 30,000 tons. The electric works will when completed absorb a capital expenditure of about $750,000.

BOOK TABLE.

THE UNIVERSAL ELECTRICAL DIRECTORY (J. A. Berly's). London: H. Alabaster, Gatehouse & Co. 1904. Pp. (six by 9½ inches), 1,446. Price (to America) $3.75.

Berly's Universal Electrical Directory has again made its appearance, this time with a grand total of 32,090 names. The book contains the names and addresses of members of the electrical and allied trades and professions throughout the world. It is divided into four sections, as follows: British, with 11,560 names; Continental, with 9,420 names; United States, with 7,500 names; Colonial, with 3,610 names. Each of these sections is again divided into alphabetical and classified sections, and in the case of the British section a geographical subdivision is also given. The entire book is carefully revised each year, and the financial information and central-station particulars are brought up to date as far as possible. The 1904 edition is bound in cloth similarly to the previous editions, and is supplied with a thumb index. A preface by the publishers gives a brief resumé of the progress of the electrical industries of the United Kingdom during 1903.

Iowa Telephone Association.

The eighth annual meeting of the Iowa Telephone Association was called to order Tuesday afternoon, March 8th, in the Savery Ordinary, Des Moines, by Vice-president J. C. Sullivan. The meeting was adjourned until Tuesday evening. After the appointment of the committee on credentials at the session Tuesday evening the annual address of the president was given. Mr. Herr's topic was "Combinations and Their Necessity in the Telephone Business in Iowa." The subject of long-distance lines was taken up by P. C. Holdeogel of Rockwell City.

At the session Wednesday morning the farm-line proposition was discussed in many of its details and phases. The subject seemed to be an interesting one to most of those present, as it evoked a great deal of discussion. Papers presented at this session were "Jealousy Among Independent Telephone Men" by H. E. Ralston of Maitland, Mo.; "Operating a Telephone Plant as a Side Line" by J. C. Thorne; "Our Business Relations" by Paul H. Patton of Waterloo, and "Our Loyalty to the Principles of the Association" by H. A. Kinney of Woodbine.

A special session was called for Wednesday afternoon to discuss the papers of D. M. Griswold of Des Moines, on "Necessity of Uniformity in Toll-line Service and Rates," and "Shall We Establish a Clearing House?" by J. M. Plaister of Ft. Dodge. The discussion brought out the fact, long realized by many, that there is urgent need for a clearing house or similar office, but was somewhat divided as to the scope of a plan and the details to be arranged.

On Wednesday evening about 200 of the members of the association and their friends sat down to a six-course dinner served at Our Circle Hall. Following the banquet U. S. Alderman, acting as toastmaster, called on Governor A. B. Cummins for an address, which was largely in the nature of a welcome. The Hon. Lafayette Young spoke on the subject, "A Long-distance Hot Wire." Mr. Young was in a very happy vein and thoroughly entertained his hearers. A. L. Urick of the State Federation of Labor spoke on the "Relation of Employer and Employe," and was listened to with great interest. Judge Nichols responded to the toast "Service" with a very fine address.

At the last session, which was held Thursday morning, E. H. Martin of Webster City had for his topic, "How Can We Promote Better Feeling Among Toll Operators, Inducing Harmony, Improving Our Service, and Thus Reducing the Lost Call Record?"

The following named were elected to office for the ensuing year:

President—J. C. Sullivan of Creston.

Vice-president—S. S. Lichty of Vinton,

Secretary and treasurer—Charles C. Deering of Des Moines.

Executive committee—J. S. Bellamy of Knoxville, J. C. Thorne of Fairfield, P. C. Holdeogel of Rockwell City, and U. S. Alderman of Nevada.

Following is a partial list of those present together with the name of the company represented:

McCartney, H., Fremont County Tel. Co.....Thurman
Sullivan, J. C., Creston Mutual Tel. Co.....Creston
Atkinson, Geo. E., Creston Mutual Tel. Co.....Creston
Deering, Chas. C., Mutual Tel. Co.....Des Moines
Bandy, Geo. N., Hawkeye Tel. Co.....Des Moines
Bellamy, J. S., Knoxville Electric Co.....Knoxville
Norwalk Tel. Co.....Norwalk
Buxton, B. C.....Buxton
Johnson County Tel. Co.....Iowa City
Redman, R. S., Jasper County Tel. Co.....Newton
Clarkson, Coker F.....Des Moines
Rogers, Oscar .....Des Moines
National Carbon Co.....Cleveland
Lichty, S. S., Vinton and Benton County Tel. Co...Vinton
Thorne, J. C., Jefferson County Tel Co.....Fairfield
Patton, Paul H., United States Tel. and Teleg. Co..Waterloo
Plaister, J. M., Fort Dodge Tel. Co.....Fort Dodge
Bygel, G. F., Dayton Tel. Co.....Dayton
Berger, M. L., Vought-Berger Co.....La Crosse
Lundgren, G. O., Vought-Berger Co.....La Crosse
Dirsmore, S. A., Electric Apoliance Co.....Chicago
McGillen, F. L., Valentine Clark Co.....Chicago
Swaney, W. B., Anderson County Tel. Co.....Audubon
Martin, E. H., E. H. Martin Tel. Co.....Webster City
Doolittle, W. E., Sterling Electric Co.....La Fayette
Keelyn, J. E., Western Tel. Mfg. Co.....Chicago
Overshiner, E. B., Swedish-American Tel. Co.....Chicago
Musson, F. C., Musson Bros. Co.....Atlantic
Hind, W. R., Kellogg Switchboard and Supply Co...Chicago
Trimm, W. H., Monarch Tel. Mfg. Co.....Chicago
Carter, A. J., Monarch Tel. Mfg. Co.....Chicago
Bowen, Wm., Stromberg-Carlson Tel. Mfg. Co.....Chicago
Walthauer, Fred, Stromberg-Carlson Tel. Mfg. Co..Chicago
Jones, H. A., Stromberg-Carlson Tel. Mfg. Co.....Chicago
Arnold, W. S., Wittenberg Cedar Co.....Wittenberg, Wis.
Boardman, F. M., Nevada Mutual Tel. Co.....Nevada
Harvey, N. G., Illinois Electric Co.....Chicago
McNeill, M., Illinois Electric Co.....Chicago
Eubanks, P. L., American Electric Tel. Co.....Chicago
Blackledge, H. P., American Electric Tel. Co.....Chicago
Hauptman, W. R., American Electric Tel. Co.....Chicago
Bryan, W. O., New Sharon, Ind., Tel. Co...New Sharon
[illegible] Automatic Electric Co.....Chicago
Pietzcher, E. J., Standard Underground Cable Co..Chicago
Crawford, W. J., Ino. A. Roehlings Sons Co.....Chicago
Carney, B. J., Mitchellville Tel. Co.....Mitchellville
Plummer, A. L., Mitchellville Tel. Co.....Mitchellville
Kelster, [illegible] Mitchellville Tel Co.....Mitchellville
Whittle, A. T., Harlan and Avoca Tel. Co.....Harlan
Holdoegel, P. C., Central Mutual Tel. Co...Rockwell City
Brady, J. H., Central Mutual Tel Co.....Rockwell City
Anderson, Claus, Madrid Ice and Tel. Co.....Madrid
Anderson, Francis, Madrid Ice and Tel. Co.....Madrid
Cochran, O. C., Farmers' and Traders' Tel. Co.....Wright
Afton Mutual Tel. Co.....Afton
Guthrie Center and Northwestern Tel. Co...Guthrie Center
Repass, O. A., Farmers' Tel. Co.....Dallas Center
Kinney, H. A., Woodbine Tel. Co.....Woodbine
Bell, H. L., Delta Tel. Co.....Delta
Ralston, H. E., Hanams Tel. Co.....Burlington Junction
Jones, F. H., Boone County Tel. Co.....Boone
Brown, J. W., Olds Tel. Co.....Olds
Anderson, H. U., Gravity Tel. Co.....Bedford
Bowlin, L. L., Hedrick Tel. Co.....Hedrick
Brooks, Senator, Hedrick Tel. Co.....Hedrick
Greaves, G. W., Spencer Tel. Co.....Spencer
Brown, J. A., Chariton Tel. Co.....Chariton
Kirk, Chas. R., Chariton Tel. Co. and Newburn Tel. Co.....Chariton
Shipley, Mr., Central Iowa Tel. Co.....Iowa Falls
Brooksmith, Mr., Central Iowa Tel. Co.....Iowa Falls
Herr, H. H., Ottumwa Tel. Co.....Ottumwa
Dupee, F. E., People's Tel. Co.....Sigourney
Wells, W. O., Wells Tel. Co.....Woodward
Lindquist, F. W., Gowrie Tel. Co.....Gowrie
Weitzel, S. E., Gowrie Tel. Co.....Gowrie
Dunsmore, W. D., Oskaloosa Home Tel. Co.....Oskaloosa

Telephone Rates in the District of Columbia.

The District of Columbia appropriation bill as it was passed by the House of Representatives provides among other things a reduction in telephone rates. The rates provided are as follows: Fifty dollars a year for the use of a telephone on a single wire; $40 a year on a two-party wire; $30 a year on a three-party wire, and $25 a year on a four-party wire. Any violation of this provision is declared to work a forfeiture of all rights to conduct a telephone business within the district. This arbitrary action on the part of the House of Representatives has prompted U. N. Bethel, president of the Chesapeake and Potomac Telephone Company, to send an open letter to Representative Babcock, chairman of the House committee on the District of Columbia, in which he says that the Chesapeake and Potomac Telephone Company is the only company affected by this legislation and that this company has had no opportunity whatever to place before the House of Representatives reasons why such legislation should not be enacted. Mr. Bethel calls attention to the fact that in 1901 the company entered upon a general plan of improvement. In the following year Congress passed a law authorizing the extension of the underground conduit system in Washington, and in that year 75 miles, and in 1903 57 miles of underground ducts were constructed. In all subways space for the fire and police wires of the District of Columbia are provided free of charge. A building costing, including site, about $200,000, was erected at Fourteenth and R Streets northwest, and upon its completion a modern central-office equipment was installed therein. Another new building, to cost about $22,000, on Twelfth Street, near G Street northwest, is nearing completion, in which a new and complete exchange equipment will be installed at an early date. The work is now under way and will be completed in the early part of this summer. On the whole, in enlarging and improving the telephone plant in Washington approximately $1,500,000 of new money has already been invested. The plans for construction and reconstruction work in 1904 alone call for an outlay of approximately $750,000.

The purpose of the management, says Mr. Bethel, has been and is to provide in Washington a telephone system that for comprehensiveness and completeness shall not be surpassed. He admits that during the general reconstruction work that has been going on, the service has not been up to the high standard of efficiency which the company hopes soon to be able to maintain. The company has practically been replacing an old telephone plant with a new one and at the same time being compelled to keep the old one in constant operation.

In conclusion President Bethel says: "If the provisions in question are enacted into law development will be arrested, the efforts of the company to provide an adequate plant and render efficient service will be seriously interfered with, and consequently the existing investment will, to a large extent, be destroyed."

EXTENSIONS AND IMPROVEMENTS.

The Diamond A Cattle Company is building a private telephone line from Whitewater, New Mexico, to the headquarters of the company at its ranch.

A telephone line running south from Rockford, Wash., to connect with the Fairfield and Rockford Valley lines, is being contemplated by Rockford citizens and farmers in the vicinity.

The New Westminster and Burrard Inlet Telephone Company, which operated through the province, has just installed a new system in Victoria, B. C. The new plant has been installed on three floors in the Bank of Montreal Building and represents an outlay of $75,000. In the basement is situated the power plant and the main distributing rack. This is where the cables enter and where the storage batteries are situated. The cables pass up through a chute to the first floor, where the intermediate distributing rack and relay rack are situated. The switchboard is of the visual-signal type and is a vast improvement over the old one. The change also improves the long-distance service. W. H. Kent is the general superintendent of the company.

The Bedford (Mass.) local paper of recent date says that the commencement of a movement toward the extension of the automatic-telephone system throughout Massachusetts and Rhode Island is signalized by the incorporation of a new company, designated as the Automatic Telephone Equipment Company. The new organization is distinct from the company which operates the lines in this city and Fall River, but is not intended to infringe on the privileges of the present company. The license of the Automatic Telephone Equipment Company will enable it to establish lines throughout the state and Rhode Island, this territory being the extent to which it is at present limited. The list of incorporators contains the names of some well-known business men and capitalists.

Ohio Telephone Notes.

Independent telephone companies in this state are making a good start for the year. Both the Cuyahoga and United States companies show a good increase for January over the corresponding month a year ago. The outlook for Independent business in Ohio is better than it has been since the Everett-Moore embarrassment, which for the time retarded all movements in that line.

Cleveland and Ohio telephone men in general are much interested in the decision of the Supreme Court of Missouri to the effect that a franchise fixing telephone rates is not valid. The court held, as in cases decided in Ohio within the last year, that the manner of setting poles, stringing wires and other things of that kind are subjects of limitation by franchise, but that no municipality has a right to set a price for telephone service. Independent companies over the Central West have for some time been advancing rates slightly, as they found they could not operate on prices first made, and in some cases they have had to stand suit to test their rights to do so, but the courts have always sustained them, and the decision of the Missouri Supreme Court only adds to the conviction that they were correct in their views of the law.

Improvements will be made by the Cleveland Telephone Company that will just about double the capacity for long-distance work. A new toll board will be installed which will require the services of eight recording toll operators and 36 line operators. It will carry 160 long-distance lines out of Cleveland to all parts of the country. The company now has three recording operators and 19 line operators. Six years ago four operators could handle all the business easily, but it is with difficulty that the present force is able to look after the work. The new board will be installed by the Western Electric Company and will probably be ready for operation about April 15th.

A company has been formed to install a telephone system at LeRoy and it will be connected up with the system at Painesville. The officers are: President, W. M. Baker; secretary and treasurer, Ford Booth; manager, G. H. Sohl.

The Norwood Citizens' Telephone Company of Norwood, near Cincinnati, has been granted a 25-year franchise. It is said, however, that the mayor is not in favor of the company and may veto the ordinance. W. Gilbert Townsend, a prominent Independent telephone man of Lebanon, is interested in the company, though Patrick H. Shortall is the nominal head.

The Farmers' Telephone Exchange Company of Caldwell has been incorporated by E. W. Spannagel, J. M. Harding, H. W. Kuntz, L. W. Wheeler and F. G. Okey. The capital stock is fixed at $10,000. Plans have been completed to construct lines from Caldwell to Cambridge, with terminals at Zanesville, Marietta, McConnellsville and Woodfield.

The North Benton-Deerfield Telephone Company of North Benton has notified the secretary of state of an increase of capital stock from $1,000 to $15,000. D. J. Miller is the president of the company.

The capital stock of the Bryan Telephone Company of Bryan has been increased from $40,000 to $75,000. W. W. Morrison is the president.

The Getaway Telephone Company has been organized at the little town of Getaway in Lawrence County with a capital stock of $5,000. J. E. Schneider, J. W. Gerlach, W. W. Poindexter, W. T. Cox and G. W. Thader are the incorporators.

The Tri-county Telephone Company, lately incorporated with a capital of $10,000, is preparing to build lines in Stark, Summit and Portage Counties. The principal office will be at Lake, Stark County.

C.

Telephone News from the Northwest.

Steps are being taken at Cottage Grove, Minn., to organize a telephone company.

The Chicago, Milwaukee and St. Paul railway has inaugurated the telephone at all offices between Madison and Portage, Wis., except one. This is said to be the outcome of a demand by telegraph operators for an increase in salary.

C. L. Parkin and L. F. Meyer have bought the local telephone exchange at Goodhue, Minn.

The Tri-state Telephone and Telegraph Company has poles set for a long-distance line from Hastings to Wabasha, Minn.

A company is being formed at Brandt, S. D., to build telephone lines in that vicinity.

The Rock and Minnehaha Telephone Company has been organized at Booge, S. D., to build rural lines.

The Thompson, Caldwell and Wilson Rural Telephone Company has been organized in Brookings, S. D., to build telephone lines through the rural districts.

The Menno-Wittenberg Telephone Company has been incorporated to build a telephone line from Menno to Wittenberg, S. D.

Farmers have formed the Lake Andrew and Dovre Telephone Company near Willmar, Minn.

Farmers near LaDelle, S. D., contemplate building a telephone line to Doland.

The Dakota Central Telephone Company will extend a line from Volga, S. D., to Wentworth, giving connection with the southern part of the state.

A local telephone exchange is to be installed for Bowbells, N. D., by G. L. Bickford, Ralph Andrews and Dr. Limburg.

The Western Electric Telephone Company has a difference of opinion with the Emmons (Minn.)

Telephone Company, which has resulted in severing connection with the Emmons line at Albert Lea, Minn. The local exchange at Albert Lea has also been induced to sever its connections with the Emmons line.

A rural telephone system is planned by residents of Hanska, Minn.

Farmers of Swiss have formed an organization to build a telephone line from Gordon to Grantsburg, Wis.

A telephone line is planned from Lawton to Linstad, N. D.

Plans have been finally completed and the money secured for rebuilding the exchange building of the Mutual Telephone Company at Des Moines, Iowa. The total capital of the reorganized company is $450,000.

C. W. Smith has sold an interest in the Tama (Iowa) telephone exchange to Crittenden Bros. R.

Indiana Telephone Items.

At a meeting of the stockholders of the New Telephone Company of Indianapolis on February 11th the following-named directors were elected: Louis C. Walker, B. E. Parrott, John W. Bowlus, F. L. Holweg and J. D. Wiest. Louis C. Walker was elected president and J. W. Bowlus vice-president, to succeed S. P. Sheerin and Louis Holweg, who retired to become president and vice-president, respectively, of the Indianapolis Telephone Company. The lease of the properties of the New Telephone Company to the Indianapolis Telephone Company was authorized by the directors. The rapid growth of the business of the New Telephone Company made it necessary to raise additional capital in order to meet all the demand for service. The treasurer made a report to the stockholders which shows that the gross earnings of the New Telephone Company for the year ended with February were $227,196, an increase over the previous year, after deducting operating expenses, depreciation, fixed charges and dividends, amounting to $177,410, of $49,786, which increased the company's surplus to $130,223. A striking feature of the local stock market during the week was the advance in New telephone stock to 90, and sales of 80 shares at that figure. This stock is exchangeable for stock in the Indianapolis company.

A novel warfare has been declared between the merchants of Jonesboro and the Bell Telephone Company. Both the Bell and an Independent company have franchises to operate in Jonesboro. The merchants, weary of paying for dual telephones, organized an association pledging the members to remove from their business houses and homes the Bell telephones. The Bell company now proposes to enter the mercantile business and has sent an agent to procure a room in which to establish a large department store.

The New Palestine Telephone Company, which operates a system in the southern part of Hancock County, is arranging to extend its lines into the northern part of Shelby County. A new metallic circuit will be put in and a new switchboard installed in the exchange. The toll charges have been increased from $1.20 to $3.

Representatives of Independent telephone exchanges in Western Indiana and Eastern Illinois, with a total of 14,000 telephones, held a meeting in Terre Haute on March 2d and adopted a schedule of uniform long-distance rates. A secretary will be employed to give his entire attention and service to the matter of unifying distances and tolls.

The Warren telephone plant has been sold by W. R. Lowe to a company of local capitalists. George Griffith and Frank Canaday are the leading stockholders in the new company. The plant has been in operation in Warren for five years. The new management will take charge on April 1st and announce that the plant will be greatly improved and the lines extended.

The farmers of Union Township, Vanderburg County, have organized a mutual telephone company. The exchange will be built in the village of Cypress. After the system is built an effort will be made to obtain connection with the Cumberland company in Evansville.

The following-named telephone companies have been incorporated recently in Indiana. The name of one person interested is given: Salamonia Telephone Company, capital $2,500, Salamonia and in Jay County, H. E. Barting; Morning Star Telephone Company, capital $5,000, Ethel and in Crawford and adjacent counties, J. R. Allen; Terhune Co-operative Telephone Company, capital $2,000, Terhune and in Boone County, Louis A. King; Elberfeld and Millersburg Telephone Company, capital $4,500, Elberfeld and in Warrick and adjacent counties, L. Brown; Warren Telephone Company, capital $25,000, to take over the property of the Warren Home Telephone Company, G. W. Griffith; Farmers' Co-operative Telephone Company, Danville and in Hendricks County, J. F. Hardwick; Citizens' Mutual Telephone Company, capital $6,000, Dana and in Vermilion County, D. C. Kerrese; Indianapolis Telephone Company, capital $1,300,000, Indianapolis and throughout the state of Indiana, S. P. Sheerin.

The Wabash Home Telephone Company, operating an exchange in Monroe City, has increased its capital stock to $25,000 and will make extensive improvements this summer.

The farming community east of Summittville, Boone County, is to have a new telephone system. Robert W. Inglis of Summittville has been granted a franchise by the county commissioners.

The Delaware and Madison Counties Telephone Company will build an exchange in Daleville and connect the local lines to be put up with its large system. The farmers attempted to organize a company at Daleville, but failed. F.

Southwestern Telephone Progress.

The Independent Commercial Telephone Company has applied to the City Council of New Braunfels, Texas, for a franchise to install a local telephone exchange there. The application was referred to a special committee of the council.

Frank C. Smith of San Antonio, Texas, president of the Commercial Telephone Company, announces that he has just purchased for his company the Independent telephone exchanges at Austin, Taylor, Temple and Belton, and that he has leased from the Beaumont Northwestern Telephone Company the long-distance lines and local exchanges belonging to that corporation. Mr. Smith denies the published report that he was acting for H. E. Huntington of California in making these purchases. He says that extensive improvements will be made to the acquired properties.

A new telephone exchange is to be established at Durant, Ind. Ter., by the Bokschito Telephone Company. Dr. W. W. Steadley is manager.

The government of the state of Vera Cruz, Mexico, has granted a concession to A. Espinosa of the city of Vera Cruz for the establishment of a complete telephone system there. It is stipulated in the concession that the service shall be first class in every respect and that prices shall be lower than are charged by the company now doing business in Vera Cruz.

The department of communications and public works of the Mexican government has ordered the construction of an extensive system of telephone lines in the Yaqui district, state of Sonora, Mexico. It is proposed to connect every town and hamlet in that district by telephone. This action is taken in order that the movement of troops in pursuit of Yaqui Indian outlaws may be expedited, and also to help in the settlement and development of that region.

The Sonora Telephone Company of Guaymas, Mexico, is installing a new and complete telephone exchange at that place.

S. G. McMeen, engineer in charge of the work of mapping out the City of Mexico for the numerous extensions of the lines of the Mexican Telephone Company, has returned to his headquarters at Chicago, where he will finish up his work. Mr. McMeen is quoted as saying prior to his departure from the City of Mexico that when the contemplated improvements and extensions are completed, that city will have one of the finest and most complete telephone systems of any city on the American continent. H.

Southeastern Telephone Developments.

The new telephone law in South Carolina just passed by the state Legislature places all telephone companies under the supervision of the Corporation Commission. It is stated that there are conflicting clauses in the bill. The commission has already applied to the attorney-general for an interpretation of the measure.

The Southern Bell Telephone Company has applied for a new franchise at Lynchburg, Va., and a warm fight is expected. A minority report of the council committees has been made, asking for lower rates. The Southern Bell company is also putting in long-distance connections at the well-known resort at Pinehurst, N. C.

At Asheville, N. C., recently, a number of citizens signed contracts to use only the service of the Asheville Telephone Company, now sold out, and the question has arisen as to who is responsible for the low rates. The attorney of the new merger company holds that if anybody is responsible, it is the stockholders of the old company.

The Raleigh (N. C.) Telephone Company recently re-elected the old board of directors. The rumor of the sale of the company is denied. There are three companies in Raleigh.

As the Bell Telephone Company has been granted a perpetual franchise at Anderson, S. C., the City Council has offered a like franchise to the Anderson Telephone Company.

An interesting fight is now on in Greensboro, N. C., over the attempt of the Southern Bell company to raise rates to "standard," which the company claims is allowed by the State Corporation Commission. L.

Michigan Telephone Matters.

The Port Huron Merchants' and Manufacturers' Association has taken action against the increased telephone rates which are scheduled to go into effect on April 1st. According to the plan decided upon the association will not confine itself to local matters alone, but will inaugurate a movement throughout the state and have for its purpose the establishment of state regulation of telephone companies, with an adjustment of rates according to earnings.

The city of Detroit has obtained judgment in the Supreme Court against the People's Telephone Company for $1,529, with interest, for certain inspection charges made in connection with the construction of the telephone system in Detroit. The claim was not disputed, but the telephone company sought to recover $5,000 and interest from the city for a deposit made with the city comptroller under the terms of the franchise. The circuit judge refused to allow the telephone company to establish the claim to this deposit, and gave the city a judgment for its claim, and this decision has been again affirmed. W.

Underground Cables in Baltimore Fire.

The Baltimore fire was the means of settling several disputed points for the engineers of this country. One of these was the great advantage of using underground cables for electrical transmission of power in the business districts of cities. The Standard Underground Cable Company has installed in Baltimore during the last few years many miles of underground cable in the municipal subway for the Western Union and Baltimore and Ohio telegraph companies, the Maryland Telephone Company, the city fire and police departments and the United Railway and Electric Company. The main conduit lines run the entire length of the burned district, and the manhole covers were in many cases covered with piles of hot brick and stone to a depth of 20 feet. In spite of the intense heat there is so far as is known not a single instance of trouble in the cables in manholes or subway, except where exposed ends of cables were destroyed by the fire, and the cable system is in perfect condition to-day. Two three-conductor cables installed for the United Railway and Electric Company over a year ago and which terminated in the new and unburned portion of the Pratt Street power house extended the entire length of the burned district, and were carrying current to the sub-station at 13,000 volts the second day after the fire without any interruption to service. This record, compared with the ruin of overhead construction, which was universal, certainly gives food for thought to all users of wire.

GENERAL TELEPHONE NEWS.

The Jalisco Telephone Company is making many improvements to its telephone system at Chapala, Mexico.

President F. P. Fish of the American Telephone and Telegraph Company of Boston is on the Pacific Coast inspecting the various telephone systems there.

The Troy Telephone Company, capitalized at $10,000, has been incorporated to construct and operate a telephone system at Troy, Ill. J. H. Steinhaus, J. W. Gornet and Christ Busse are the incorporators.

T. G. Monderbeck, one of the Chicago Telephone Company's linemen, in attempting to recover a tool which fell from his hand while working on a cross-arm of a telephone pole recently, slipped and fell to the pavement and was instantly killed.

Sam Byrus and S. Nichols of DeSoto, Mo., are investigating the Independent telephone situation at El Paso, Texas, with the view of acquiring the uncompleted plant of the local system, which was started by Mrs. Brett. If the consent of the city authorities can be obtained, this system will probably be rehabilitated and completed.

The Chesapeake and Potomac Telephone Company has let a contract for the construction of an exchange building for East Baltimore. The structure will be three stories high, 48 by 89 feet, of brick, stone and steel, and will cost $65,000. The company is also considering general plans for rebuilding its central exchange in Baltimore, destroyed by the recent fire.

The County Board of Cook County, Ill., has refused to concur in the recommendation of the public-service committee that 13 automatic telephones be installed in the County Building by the Illinois Tunnel Company. The contention was made that the system did not have sufficient subscribers as yet to warrant the expense on the part of the county at the present time.

The Norwood Citizens' Telephone Company has been granted a 25-year franchise by the Norwood (Ohio) council. This action was not taken without considerable opposition, and it was adopted by a very narrow margin, the vote being four to three. One of the immediate effects of the granting of this franchise will be to bring the Independent telephone companies a step nearer to Cincinnati.

The Supreme Court at Jefferson City, Mo., has decided that the charter of Kansas City does not give the city authority to pass and enforce an ordinance regulating telephone charges in that city. J. W. Garner of Kansas City instituted mandamus proceedings in the Supreme Court against the Missouri and Kansas Telephone Company to compel the company to reduce its rates to the scale fixed by a city ordinance. The writ was denied.

A favorable report has been made by the Interstate Commerce Committee on Representative Mann's bill for the construction of a telephone line between Charlevoix, Mich., and Beaver Island in Lake Michigan. The committee also favors a storm-signal station at the island. The waters at Beaver Island are extremely dangerous to shipping and many wrecks occur there. With a storm-signal station and a telephone service, vessels will receive warning in time to avoid dangers in that vicinity.

Adaptation of Magneto Telephone Systems to Central-energy Operation.

It is interesting to note, in connection with the recent article in the Western Electrician (March 5th) by Mr. H. P. Clausen on "Increasing the Efficiency of Operation of a Magneto-call Exchange System," the views of a prominent Bell engineer on a subject which, if not identical, is very similar. Malcolm C. Rorty of Boston has recently patented a system, which, although differing in detail, is designed to accomplish practically the same purpose as the plans suggested by Mr. Clausen; that is, to get rid of the old magneto and at the same time utilize central-exchange apparatus that is still in good working condition.

In cases where it is possible, convenient, or expedient coincidentally to install a common-battery system with a new switchboard no special difficulty attends the introduction of the former, since the relay switchboard was designed to harmonize with the central-energy system. There are, however, many cases where branch-terminal switchboards which have been installed are comparatively new and unworn, and it is highly desirable on the score of economy that the introduction of the common-battery service in these cases shall not necessitate the discarding of such switchboards. Attempts have been made so to reorganize these branch-terminal boards as to render them capable of being operated in association with the common-battery system. Attempts to accomplish this have often been made by utilizing the three-conductor switch-cord circuit of the relay switchboard or one closely similar, wherein the switch plug is provided with tip and ring contact surfaces for its main-circuit conductors adapted to register with spring contacts representing line conductors in the switch sockets of the line concerned and with a sleeve contact nearer the handle of the plug for its local busy-test and supervisory-signal circuit conductor, this being adapted to register with the test ring or socket frame of the switch socket in which it may be placed. But the use of this type of switchboard not only necessitates the remodeling of the branch-terminal-switchboard socket connections, but also introduces a marked tendency to the production of a false busy-test signal, indicating that lines called for are busy when they are not, which comes about because in applying the tip of the switch plug to the test ring of a switch socket of the line called for the operator is liable to bring the conducting tip and also the conducting ring immediately behind it into simultaneous contact with the test ring. Since the working battery is looped between these tip and ring contacts with the operator's testing telephone bridged across such loop, it follows that the sound indicating the busy condition of the line tested is under these circumstances heard in the receiver, and thus a line which is at liberty is liable to be reported as engaged.

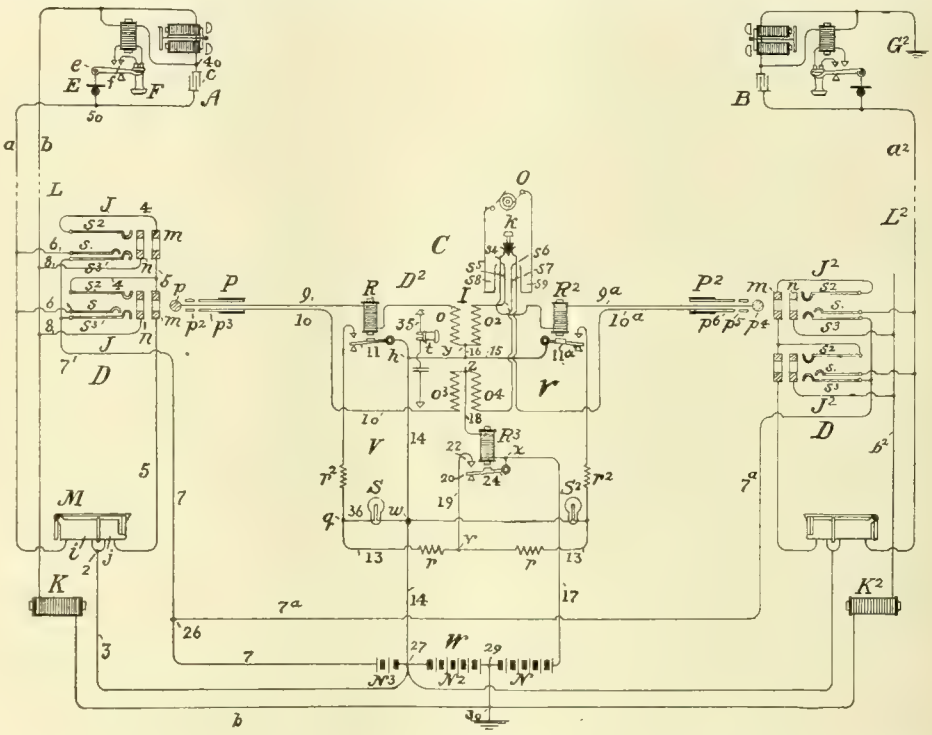
Mr. Rorty has sought to overcome this difficulty. The invention consists in combining the fixed portions generally of a branch-terminal switchboard and in particular the switch-socket devices representing the sub-station circuits centering therein with a switch-cord circuit having two conductors only, both arranged to serve as main circuit-link conductors. One cord circuit utilizes the tip contacts and the other the sleeve contacts of the associated switch plugs. The intermediate or ring contact of the plugs being unconnected with either or any cord conductor, is adapted to serve, when the plug is placed in a jack or socket, merely as a medium for uniting two of the contact springs of the jack. With a central and common battery in a bridge between the cord conductors there are combined with each switchboard circuit and with the system as a whole a governing relay in a branch circuit formed in part of the battery bridge, arranged to control the connection between the supervisory signals and a battery furnishing current for their operation, the relay being in a circuit closed when either of the switchboard plugs is inserted in a switch socket.

In carrying out the invention, both metallic-circuit and grounded-return sub-station circuits are provided for. The apparatus at the sub-stations is entirely changed, the automatic calling and the telephone circuits adapted for the common-battery type being substituted for the magneto generator and the local battery and circuit. At the central station while the multiple switch sockets, the self-resetting electromagnetic line signals and the switch plugs remain unaltered, the cord circuit is rearranged. The central battery furnishing current for talking and signaling is split into two sections by the attachment of a ground connection at its middle, which sections under certain conditions, as when double and single-conductor circuits are united, serve as separate batteries, both sections being in the metallic circuit and one only in the grounded circuit.

Referring to the accompanying drawing, (A) and (B) are sub-stations, connected with (C) a central station, (L) being a metallic circuit having two main conductors, while (L^2) is an earth return-circuit having a single complete main conductor. At the sub-stations the usual telephone and signal apparatus of the universal central-battery system is connected in the standard manner.

At the central station the switchboard apparatus contains the switch sockets of the several lines, and any appropriate number of switch cords, each being fitted with an answering plug (P) and a companion plug (P^2).

The battery comprises two sections (N) (N^2), one of them serving alone as a source of signaling-current for both main circuits and also furnishing talking-current for grounded circuits, while the two serve together as a source of transmitter-current for metallic circuits. There is also a battery (N^3), smaller than the sections of main battery, to supply current for the busy test and for the locking or resetting coil (j) of the line signals. The smaller battery is shown as being connected at one pole with section (N^2) of the larger battery, and by such connection it is possible to utilize the conductor (14) and the plug-tips and their associated



ADAPTATION OF MAGNETO TELEPHONE SYSTEMS TO CENTRAL-ENERGY OPERATION.

conductors as portions of the circuit of both batteries.

The switchboard connections of the grounded circuit (L^2) are substantially identical in character with those of the circuit (L) and are clearly shown in the diagram.

One of the group of switch cords with which each section of the switchboard is supplied is represented by (D^2). It contains two conductors or strands only, and with its plugs, circuit arrangements, and associated apparatus constitutes an important feature of the invention.

The answering switch plug (P) has the usual tip, ring and sleeve contacts. When the plug is inserted in the socket, the tip connects with the short-line spring and thereby with main conductor. The sleeve registers with the inner and outer socket rings, thereby establishing connection with the other main conductor and, by the conductive union of the rings through the metallic substance of the sleeve, closes the test circuit. The intermediate or ring contacts register with and unite the two socket springs (s^2) and (s^3). It will be noted that the ring contacts have no conductors attached to them and no connections in the cord circuit, and their sole function is to establish conductive connection between the two contact springs, and as the intermediate or ring contact is now wholly disconnected from any circuit or source of current and has no conductive relation with the tip conductor there is, of course, no longer any liability to produce false busy signals. The tip and sleeve contacts of each plug are, however, united by link conductors with the corresponding contacts of its companion plug, so that any two lines may be switched together by inserting the plugs of a pair into the respective switch sockets of such lines. The cord conductor uniting the tips of the two plugs is formed of two portions (9) (9^a) and contains the half-windings (o) (o^2) of the two helices of the induction-coil (I), while the other conducting strand uniting the sleeve contacts of the two plugs and similarly constituted of two portions includes the remaining half-windings (o^3) (o^4) of the coil, the central battery W being placed in a bridge connection of the cord conductors extending from a point (y) on one conductor between the two induction-coil half-windings to a similarly placed point (z) on the other for the purpose of supplying current to the sub-station transmitters.

Relays (R) and (R^2) control the shunt circuits of the signals (S) (S^2), acting when excited by the flow of current in the main circuit to close the shunts, thus withdrawing current from the signals to prevent their display, but opening the shunts to permit the display of the signal as soon as the main-line current ceases to flow.

By means of the relay-switch (R^3) the supply-current connection for the signals is maintained until both stations which have been engaged in a communication have replaced their receivers on their respective switch-hooks.

The smaller battery (N^3) is alone concerned with the busy-test and annunciator-locking circuit. The latter circuit is as follows: From the plus pole of the battery to switch-socket spring (s^3), thence when a plug is in the socket, through the ring contact to spring (s^2), continuing by conductor (4), external socket ring (m), conductor (5), locking coil (j) of annunciator (M), conductor (3), and point (27) to the minus pole of the small battery (N^3). The busy-test circuit can, of course, be completed only when the locking circuit has been established for a given line by the insertion of a plug in a socket, and, an abnormal potential having thereby been imparted to the test rings (m) of other sockets of the same line, the tip of some other switch plug is applied to some one of the other sockets. The operator's receiver (t) is at this moment bridged with its condenser between the cord conductors, and should the tested line be busy a definite sound signal or click will be heard therein, owing to the variation of charge in the condenser and through the instrument, which occurs by reason of the differing potential of the test ring and plug tip. If, however, the tested line be disengaged, there is no such difference of potential, and the "busy" click will not be heard in the telephone.

Briefly describing the operation of the invention, let it be assumed that station (A) wishes to communicate with station (B). The subscriber at (A) takes his telephone from the hook-switch, which closes the main circuit, causing current from battery section (N^2) to flow, so that the annunciator (M) operates to give the call signal. In response the operator inserts the plug (P) in the answering socket and receives the order in the receiver (t). The insertion of the plug connects the whole battery (W) with the main circuit, closes a local circuit of one section of the battery through the controlling relay (R^3) and plug-an-socket contacts, this being followed by the supply of current to supervisory signal (S), which, however is not displayed, because the main

circuit being closed at the sub-station it is at once shunted by the action of the supervisory relay (R) and also closes the locking circuit of annunciator (M) through plug-and-socket contacts and through the self-setting and locking coil (j), restoring the annunciator, and sets the busy test for the circuit. The order being received, the operator takes up the companion plug (P^2) and tests the line wanted by applying the tip of the plug to test ring (m) of the socket. If the line is busy, a sound indicative of such condition is heard in the receiver and the calling subscriber is informed of the fact; but if no such sound be heard the plug (P^2) is inserted into the proper socket and the call signal is sent by operating the call key (k). As soon as the plug (P^2) is inserted signal (S^2) is displayed, because circuit (L^2) being as yet open at the sub-station, no current flows and relay (R^2) is not excited and because, also, the circuits of the relay (R^2) and signal (S^2) are closed; but as soon as the subscriber (B) takes his receiver from the hook to answer the call signal (S^2) is no longer displayed, being shunted by relay (R^2), which is now energized, and by the disappearance of the signal the operator may infer that the subscriber wanted has answered the call. When the communication is ended, the two subscribers replace the receivers and both main circuits are reopened by the reintroduction of the condensers. The relays (R) (R^2), no longer excited, suffer their armatures to fall away and disestablish the shunt circuits (V). The signals (S) (S^2) are accordingly displayed and indicate an order to disconnect, the relay (R^2) still being energized and maintaining contact between its local points for the supply of current to the signals. The operator now withdraws the plugs, the display of each signal ceasing as the plug with which it is associated is withdrawn. All of the connection circuits are now opened and the normal condition of the main lines is restored.

Arthur Warren on George Westinghouse.

Some extracts from an article on the career of George Westinghouse written by Arthur Warren for the New York Times will be of interest to Western Electrician readers. Mr. Warren was until recently manager of the Westinghouse Companies' Publishing Department. He speaks of Mr. Westinghouse as a "big man, with a hundred thousand horsepower inside him; a masterful man, with 25,000 men directly under his leadership; a man who controls whatever he touches; an absolute ruler, as absolute as the czar. George Westinghouse is a trained engineer, an inventor, a manufacturer, and a financier. The combination is unique. He has more physical endurance than any 10 of the 25,000 men in his employment. He is always working, except when he sleeps, and he is a good sleeper. When one thing is accomplished another is begun. The successes do not chain his interest. Achievement attracts him, so he is ever doing some new thing, and thus his undertakings multiply." Further extracts follow:

"He organized an engine-building company, built steam engines, gas engines, and was the first man in the United States to undertake seriously the development of the steam turbine. He acquired the Parsons turbine patents for America. He organized an incandescent-lamp company, the Nernst Lamp Company, and a company for manufacturing the Cooper Hewitt lamp. He will organize a company without more ado than another man will make over eating his breakfast. I have known him at the breakfast table to buy a copper mine, send a man to Europe to investigate a newly announced electrical discovery, and give instructions for a series of experiments to be made in some entirely new direction.

"His ambition is to extend his great industries to many countries, to build them up there so that they become, as it were, national institutions, and to have their products on every sea and in every land. He is not far from realizing this ambition. Already the British Westinghouse Electric and Manufacturing Company is the greatest of its kind in the United Kingdom and has become in two or three years the most widely known industrial undertaking in the British Empire. On the Continent of Europe he has three manufactories. The commercial territory of one of them extends from St. Petersburg to the Pacific. His foresight planned those companies, and his energy got them working before the countries in which they are placed could seriously oppose the import of American manufactures by a wall of prohibitive tariffs.

"While other men were talking about the possibilities of electricity he was making the possibilities actualities. He built the first great electrical generators, as big as the biggest steam engines of the time—the generators for Niagara, 5,000 horsepower each—10 of them. He has built larger ones since.

"Power, power, power! That is the thought one associates with this man. Force and new endeavor—one would think he has enough on his hands already, but he will go on till the last gun fires. There are no brakes on that vitality except the man's self-control. No one else can throttle that 100,000 horsepower.

"He thinks so rapidly that it is hardly possible for any of his men to keep pace with him. He is the motive power of all his industries. He will strike an idea in New York, get aboard his private car, work at a plan for a new device, and, arriving at Pittsburg, hand the drawing to one of his head men with the instructions: 'Make that.'

"He has made a chain of world-encircling industries. Presumably he is proud of it, and he has a right to be. No other man has done this thing. It is an achievement imperial in its scope. It may be asked from what special achievement he derives most satisfaction. It is a natural question, and one night he made a remark which may be taken as the answer to it: 'If some day they say of me that with the air brake I contributed something to civilization, something to the safety of human life, it will be sufficient.'"

Electric Railway in Morgantown, W. Va.[1]

By Walter L. Webb.

Morgantown is situated in the northern part of West Virginia, but a few miles south of the Pennsylvania line. It is on the Monongahela River about 100 miles above Pittsburg. The elevation of the river at this point is a little over 800 feet above tide. A half mile back from the river the hills rise almost as much again. These statements have been made to illustrate briefly the fact that Morgantown is in a very hilly country—that the grades on streets and country roads are very excessive—that the usual limits of grade and the usual power requirements per car per mile of road must be thrown away and the problem attacked on an independent basis.

Laying out a route for an electric road is usually only a question of procuring the most business—assuming that there is a blanket franchise and no trouble regarding right-of-way. But in Morgantown the question of grade had an influence which made certain routes absolutely impracticable and which called out much study to determine the advisability of lesser grades. The topographical features make it somewhat of a "shoestring" town—long, narrow and strung out—the very best kind of a town to furnish business. It is the seat of the state university, which claims an enrollment of nearly a thousand students. The location of some of the university buildings is sketched on the map. There are several large glass factories and other mills located there. These furnished the justification for the location of the line along the river road. Here the line was comparatively level, the highest grade being a little less than eight per cent. The side hill above this stretch was so very steep that the people living very far from the line could not be expected to walk very far up and down that grade to take a car, and so another line at a higher level was decided to be necessary.

The result of all this is a single-track loop line about 3½ miles in length, with two long sections of double track and other passing switches, which enable cars to run in both directions, and thus give to all parts of the town a high degree of service, considering the number of cars operated. The double tracks (which, with the sidings, increase the mileage to four miles) were inserted largely with reference to the suburban extensions, which were surveyed, but which have not yet been constructed. Considerable opposition was developed when it became known that we intended to double-track nearly the whole of Main Street. I defended it by calling it an extra long "siding." When threatened with trouble by the City Council, I demonstrated to them that the double track was put there to prevent congestion of traffic—so that the tardiness of a suburban car would not disarrange the schedule of the city cars nor block traffic; that with a double track the cars would always be moving; that even if any waiting for cars became necessary, it could be done at the ends of the double track, which are outside of the business section. A sufficient number of the opposition became convinced of the advantage to the public of the double track, and it was formally authorized. During our arguments with the City Council about the double track one of our directors brought up an argument which is very interesting and somewhat novel. The width between curbs on Main Street is such that a truck, being loaded or unloaded with its back to the curb, would obstruct a car running along the middle of the street, but would not obstruct a car on the farther track of a double track. Therefore if the track were in the middle of the street, such a truck would obstruct cars running in either direction, while with a double track it would obstruct only the cars running on the near track. Therefore, whatever the schedule, a double track would allow teams twice as much time to unload as the same cars on a single track.

Track.—A large part of the line has been paved with a brick pavement. The method universally used there is to lay the brick on a thin layer of sand, which is spread directly on the subsoil. Fortunately, the soil is so firm that this makes a fair pavement as long as it is not disturbed, but after a few trenches have been dug for water, sewer and gas pipes, the surface of the pavement is about what might be expected from such a method. Considering the nature of the pavement, a concrete foundation for the track was a useless refinement, but I determined to put down a good foundation. After digging to the proper depth, the subsoil was rolled if necessary. The specifications called for rolling, but throughout a large part of the line the soil appeared so firm at a depth of 17 inches that I allowed the rolling to be omitted. Four inches of broken stone were then laid. The ties and rails were then laid and surfaced and tamped with ballast until the total thickness of ballast under the ties was about six inches. In the paved portion the ballast was filled up to about an inch above the top of the ties. Then a cushion coat of sand was laid, on which to set the paving brick. As we had some difficulty in obtaining a sufficient supply of broken stone for ballast, we used gravel for the tamping ballast. This gravel is dredged from the river at Pittsburg; it is, of course, thoroughly washed, and makes a very good ballast for tamping. It cost us about 70 cents in the track, while the broken stone cost us about $1.25. This method of track foundation proved very satisfactory. Subsoil drainage proved advisabale in a few low places. The rails used were seven-inch "Shanghai" rails. That height of rails was necessary on account of the brick pavement, and the use of such rails prevented trackage by teams on the rails.

Poles.—We used juniper poles on the line work. Juniper seems to be nearly if not quite as good as cedar, and very much cheaper than cedar can be bought now. We paid $4.31 for 35-foot poles, seven inches at top, and $6.13 for 40-foot poles, seven inches at top. These prices were f. o. b. Morgantown.

Rolling Stock.—The rolling stock called for in the initial order included six 10-bench open cars, with Brill's 21-E trucks and six 18-foot box cars with the same trucks. These were equipped with General Electric No. 67 motors and B-23 controllers. The only special feature of the rolling stock is the magnetic brake, and as this is perhaps not well known to all of you, a brief description is justifiable. On each side of the car, midway between the rails, is swung a powerful electromagnet. These magnets normally hang about one-quarter inch above the rails and are beveled at the ends, so that there is no danger of their catching on the track. They are operated from the controller, which is somewhat modified for the purpose. When it is desired to use them, the controller is turned to zero, thus throwing off the line current. Then, turning the controller past zero, the motors begin to act as dynamos and magnetize the magnets. The faster the cars are moving, the more powerful will be the action. It should be noted that these brakes act directly on the rails in spite of their being slippery or even icy; that with them there is no necessity or excuse for flat wheels; that they will work even if the trolley jumps off and there is no line current; they require no great exertion from the motorman; they consume power which otherwise goes to waste or which is spent in grinding up wheel tires and brake shoes; they do not take power from the line, as is done with the pneumatic brake. While there is, of course, a limit to the power that can be developed by these magnetic brakes, it is very much greater than the wheel brake. Finally, the brakes for the closed cars are so connected that the current runs through the electric heaters, and so the heating of the cars in winter comes from the waste energy and not as an additional drain on the line current. These brakes cost $200 each for the open cars and $290 for the closed cars, where they had the heating attachment.

Trolley Wire.—No. 0000 trolley wire was used throughout. The location of the power house is quite central, and will be still more so when the proposed extensions are built. The arrangement made it possible to make the feed wires very short and the use of No. 0000 wire made the maximum drop in voltage very small. This was still further helped by using a double-trolley wire on the short stretch of single track connecting the double tracks on Main and Front Streets. Incidentally, this eliminated the line switches and enabled the cars running in each direction to use their own wires from one end of the double-track district to the other.

Power-plant Generators.—It is a commentary on the power demanded by the grades of that line that a 200-kilowatt, 600-volt railway generator was found to be necessary to run six cars. And since it is confidently expected that the line there installed is but the nucleus of a much larger system, two such generators, each direct-connected to a 325-horsepower vertical compound Westinghouse engine, were bought. The power house was designed for the ultimate placing of four such engines. The first work of the company, after organization, was to buy up the existing electric-light plant, a corporation whose chief value lay in its franchise. Its equipment and wiring were antiquated and were already very greatly overtaxed. But the business already on hand and the business that could be counted on as soon as facilities were offered seemed to justify the immediate installation of two 180-kilowatt alternators, two-phase, 2,200 volts, running at 7,200 alternations. These were each belt-connected to 275-horsepower vertical compound Westinghouse engines, by 21-inch belts, with a span of 24 feet. Space for another such installation was also made in the design of the power house.

Boilers.—The boilers selected and immediately installed were three Stirling boilers, each of 310 nominal horsepower. These have been designed for a working pressure of 180 pounds, although the plant is now operated at about 135 pounds. Although Morgantown is situated in the heart of the region where the best of the Pittsburg and Freeport bituminous coals are at their best and cheapest, natural gas is even cheaper. And so, although these furnaces have been equipped with grates, so that a coal fire can be started up on a few moments' notice, if

1. Abstract of paper read before the Engineers' Club of Philadelphia, November 7, 1903.

the supply of gas should suddenly fail, they are also equipped with Kirkwood burners for burning the natural gas. This gas comes to the building under a pressure of 120 to 150 pounds per square inch and passes through a reducing valve which reduces the pressure to a few ounces. An automatic governor keeps this pressure constant at the firebox. A very slight adjustment of this governor by the fireman is sufficient to produce any desired change in the steam pressure. The fire room is designed for three more such boilers—enough to handle engines of more than 2,000 horsepower. The feed water for the boilers is heated by a feed-water heater of 1,200 horsepower. The question of using condensers was studied, and it was decided that they were not justifiable. The natural gas used by such large consumers is sold for five cents per thousand. In this case, however, the company holds leases on thousands of acres of gas lands, and therefore paying the gas bill is simply a matter of bookkeeping. But even allowing the actual expense in cash of the cost as charged to similar consumers, the cost of heat there is so small that such saving as might result would not pay the interest and depreciation on the plant required. The engine room and also the car barn will be heated from the exhaust steam, and it was considered that this use, together with the feed-water heater and the compounding in the engines, represented as much saving as is worth while out of 135-pound steam.

Draft.—The power house was designed for an immediate installation of 1,200 horsepower, with space for a subsequent installation of about 1,000 horsepower additional. Plans and estimates were made for a brick stack for immediate necessities and also for one for future requirements. Of course, these had to be designed on the basis of burning coal, since natural gas cannot be depended on indefinitely. A small stack would cost considerable and might have to be duplicated in a very few years. The larger stack would cost much less per horsepower, but its full capacity might not be needed for many years, and in any case it meant an immediate and large expenditure. Also, either plan called for a stack much larger than the immediate requirements for burning natural gas necessitated. The plan adopted enabled us to "eat our cake and keep it, too." A steel stack was erected which is seven feet in diameter and whose top is 50 feet above the boiler-room floor. This is large enough to furnish an adequate natural draft for the three boilers burning natural gas. The system is provided with a 10-foot fan and engine, built by the Sturtevant company, which will provide induced draft whenever necessary. The plans were also made on the basis of the installation of another fan connecting with the same stack when the three other boilers are placed. The cost of this installation was far less than that of an adequate stack; the fan and engine need not be used at present, but it is there, all ready for use on very short notice; and the maker declares that the single fan and stack now placed could develop sufficient draft for 2,000 horsepower if forced. Even the additional steam which will be required for the fan, when it becomes necessary to use it regularly, will be cheaply purchased, considering the very low price of fuel. This is another illustration of how the price of fuel there (which is so abnormally low) has a marked influence on the economies of plant installation and justifies an additional use of steam to save immediate outlay, just as in the case of the condensers it was cheaper to waste some of the energy of the steam rather than increase the outlay in order to save it.

Discussion.

William Easby, Jr.: I would like to ask if any emergency tests of the magnetic brakes were made?

Mr. Webb: We have made none there. I don't know what has been done elsewhere. There is one peculiarity about the action of those brakes to which a motorman called my attention. We were running down a rather steep grade on the road, and at the top of that grade, going at a fair speed, he turned off the current and threw the controller past the zero point; that is, up one or two notches on this brake contrivance. We were going so slowly then (half speed) that the brake had no appreciable effect, and we kept on going downhill and increased our speed. He said, "Just notice; I won't touch this." At the bottom of that grade was a street corner where he was required to slow up, and yet, without touching that controller, when he got down near the bottom of that grade we began to get such a high speed that suddenly the brake began to work automatically; the car was brought down to a very slow speed when we reached that street. It did not work until we were moving at that high speed, and then it reduced to the proper speed for crossing that street. I have learned, while riding on those cars, that it is possible, if a motorman knows how to work those brakes, to make them act in an ideal way. They need not act suddenly, but just in the way I have described. The motorman can make them work almost automatically. There is one objection, and one which I should suppose it would be an easy matter to remedy, and that is that when the car is going up a steep grade, and it is desired to stop, say at a street crossing, then the motorman must use the hand brake to hold the car, because in going up the grade the car is going so slowly that even if the current is turned off and run past the zero point so as to apply the brake, not sufficient magnetic force will be developed to hold the car, and it will at once run backward down the grade. That does not endanger the safety of the car, as, by the use of the hand brake, it is easy to hold it.

Rollin A. Whittick: I would like to ask Mr. Webb whether he can give a fuller description of the details of the power house—the roof structure, flooring, in and outside repair shop, and as to the repair bins, etc.?

Mr. Webb: The structure of the power house was made fireproof as much as possible. The roof was covered with Ludovici tile laid on light steel angle irons, which rested on jack purlins. Again, on the roof, there were five lines of trusses, about 15 feet apart. The walls were brick. The floor was concrete. The engine room and boiler room were separated by a fire wall in which there was only one very small door, so that in the event of a fire in the boiler room (which of itself was rather improbable because there was very little there to catch fire) it could hardly communicate to the engine room. Of course, all possible precautions were taken to avoid the chance of fire, owing to electrical leakage.

Mr. Whittick: I presume the same construction was used in the car barn?

Mr. Webb: Substantially, yes; except that the roof of the car barn was not made fireproof. In the case of the car barn—at least in the shed part, where the cars would be—there was nothing below the roof to catch except the cars.

Mr. Whittick: The roof was planked?

Mr. Webb: Plank, covered with slate.

Mr. Whittick: Is Mr. Webb at liberty to give us the probable cost of construction per mile, exclusive of rolling stock—the cost of rails, construction and overhead work?

Mr. Webb: Possibly I might be at liberty to do so, but I have not the figures here, except in a very approximate way—what I can remember of it. The contract price for the trackwork—for track laying, excavating, restoring the roadbed to its original condition—was, I think, 85 cents a linear foot, reduced down to 72 cents a linear foot out on the suburban part, where there was no paving to be taken care of. The materials were all furnished—that is, the rails, ties, ballast, sand to go under the paving brick, and special paving brick where desired. I said we used a Shanghai rail. I also designed a special brick which was made in Morgantown (brickmaking is one of the industries there), which, nominally at least, had the same effect as though we had a grooved rail; that is, the brick was so formed that, extending underneath the head of the rail, it came up alongside the head so as to form a groove, such as would be made by a grooved rail. I say, nominally it would do so. I am sorry to say that, like all such things, since the brick was laid on sand it did not require a very heavy truck going over it to move it just enough so that, instead of having a little narrow groove, it soon developed to be a pretty big one.

Mr. Whittick: There is just one more question regarding the electric brake. Is it possible to bring the car to a full stop on a down grade with that brake? We use a brake something of that kind, but it is impossible to come to a full stop. The car will not drift?

Mr. Webb: No.

Two New York Electric Roads Plan Consolidation.

Plans have been set on foot for the consolidation of the Utica and Mohawk Valley Traction Company and the Syracuse Rapid Transit Company, or in case such a consolidation cannot be made, the establishment of a community of interests at least. The two lines, with the completion of proposed extensions, would form a continuous road almost across the state of New York. Horace E. Andrews and John Stanley, with their associates, of Cleveland, Ohio, own the Utica and Mohawk Valley, and the Syracuse Rapid Transit Company is largely the property of the McClymonds estate of Massillon, Ohio. The first is a well-built line, with perpetual franchises over a private right-of-way. An extension is being built to Oneida, and when it is completed there will be a gap of but 26 miles between it and the Syracuse Rapid Transit. The gross earnings for 1903 were $701,062, with a surplus of $118,582. It has 103 miles of track.

The Syracuse Rapid Transit had gross earnings last year of $753,277, with $100,415 surplus. It has 64 miles of track, with perpetual franchises. A separate corporation owned by the same people has arranged to build a line from Syracuse to Oswego, a distance of 35 miles, at a cost of $1,000,000. This will open up a lot of new territory and be a good addition.

One of the interesting features of the new plant now being erected by the B. F. Sturtevant Company at Hyde Park, Mass., is an elaborate testing plate for its engines. With an output of 1,000 engines or more per year this is the essential climax of a careful system of manufacture and testing. The plate, or more properly, the plates, will be supported upon a series of heavy parallel walls, between which steam and exhaust pipes are carried, so that at almost any point in the entire area of the floor, which measures about 30 by 60 feet, steam and exhaust connections may be made to any engine. Testing facilities will be provided and a transfer crane overhead will make it a simple matter to locate or remove the engines. The same crane will transport them to the packing department, and thence load them directly upon cars which traverse the end of the building.

The Development of Electrotherapeutics.

By C. Alfred Smith.

It gives one the feeling which "a cat in a strange garret" is supposed to have when one takes up his pen to say in a strictly high-class electrical journal a word about electrotherapeutics, or the application of electricity in the treatment of disease.

A quarter of a century is a short time when we look back; it is like peering very far into the future when we look forward. The writer has had an experience along the line of the manufacture of electrotherapeutical apparatus which covers a little more than a quarter century. There were at that period batteries and belts, intended, suppositiously, for medical use; designed actually to lure the credulous patrons of the charlatan. Steadily, slowly, even painfully, the task of making a favorable impression on the mind of the educated physician was pursued. Ten years passed by, seeing the business established on a small manufacturing scale, maintained principally by the demand created by the fakir, but steadily gaining a place in satisfying the needs of the best men in the profession. Medical colleges where the word "electrotherapeutics" produced a spasm by its mere mention were led first, to discuss the subject; then to experiment in a feeble way in its use; finally, to establish a chair of electrotherapeutics.

Today no reputable college of medicine or surgery would dare to ignore the subject; today probably no branch of medical or surgical inquiry excites so much interest, occupies so much of the valuable time of the investigator, and sends out through the medium of the press so much valuable, not to say wonderful, record along the line of diagnostic and helpful or curative practice as grows out of the college, hospital and laboratory investigation by some of the most able minds throughout the world.

Starting with the simplest form of batteries, with a very limited range of electrodes, and much more limited knowledge of intelligent application, this business has progressed through all the stages of battery development, revolutionized by the adaptation of the dynamo current to safe usage in therapeutic work; introducing accurate measuring instruments to insure intelligent and accurate dosage; designing controllers and transformers to adapt the dynamo current to the heavy work of galvano-cautery, finally awakened to new life and caused to go forward with bounds and leaps, owing to the published discoveries of Professor Roentgen. The development in static machine, the Rumkorff coil and the X-ray tube has caused the human body to yield its secrets to the scrutiny of man, not as formerly, only through the dissection of the cadaver, but without discomfort or injury or annoyance through the living subject. Under the searching radiance of the X-ray the surgeon locates the trouble, plans unerringly the operation, and all needless cutting is avoided. The sense of touch has retired before the more acute sense of sight, and both medicine and surgery are the better for it.

The business which one-quarter of a century ago was practically in the hands of one house in Chicago has grown into great commercial development and importance. The business which in its infancy occupied small space, employed few hands and aggregated a few thousand dollars per year now engages the attention of many thousands of men, and the output in all branches of the work runs into the millions. The growth which, during the year 1903, has probably increased more than 25 per cent., bids fair during 1904 to surpass this percentage of gain. The progress which has been so astonishing along the whole range of general electric work and whose future along these general lines no one can foresee shows the same probability of marvelous development along this special line of electrotherapeutics.

Electrotherapeutical practice is no longer a fad. Some of the ablest minds of the world are following this special field of experimentation. The commercial end of the business must be active in its effort to keep pace with this benign beneficiary which concerns the life, well-being, comfort and health of humanity.

Unique Reciprocating Motor.

Erich Krause of Hoboken, N. J., is the inventor of a unique motor. The field coils are circular in shape and are arranged consecutively, so as to form a cylinder in the shape of a solenoid. Inside this solenoid is an armature made up of a number of iron rods arranged to form a plunger. The armature is mounted to move back and forth inside the solenoid, being supported by wheels running on longitudinal tracks. The armature carries contact makers which throw each succeeding coil into circuit ahead of the armature, and the field thus created does the work. The armature, upon reaching the end of its path in one direction, makes a final contact which reverses the current in the last field coil, and the movement is then repeated in the reverse direction, giving a reciprocating motion.

CORRESPONDENCE.

Great Britain.

London, March 5.—In 1895 a select committee of the House of Commons considered the question of introducing the metric system of weights and measures into Great Britain, and made the following resolutions: (1) That the metric system be at once legalized for all purposes. (2) After a lapse of two years it should be made compulsory by an act of Parliament. (3) That the system be taught in all public elementary schools. Nothing was done toward putting these recommendations into effect. In the House of Lords this week, however, Lord Belhaven moved the second reading of a bill which the government has promoted, having these objects in view. He said that Great Britain, the United States and Russia were the only countries in which the metric system had not been adopted. The present bill provides that the adoption of the metric system should become compulsory on April 5, 1906, or at such later date as might be directed. There was a fair amount of opposition to the bill, but among the supporters of the measure was Lord Kelvin, who said he did not attach the smallest weight to any of the objections which had been raised against the definite and compulsory introduction of the system. After some discussion the second reading was passed, and the bill referred to a select committee of the House, which will report upon it.

Considerable discussion has taken place at various times with regard to the attitude of the London County Council in respect of its contracts for tramway rails. The total value of all contracts let by the London County Council for tramway works is about $10,000,000, of which amount $750,000 represents foreign work. The council began by restricting the tenders for this work to British firms, but, owing to the limited number of tenders and the high prices, it adopted open competition, and as the result all materials are now being bought in England and at much lower prices. Altogether, the council estimates it has saved $200,000 by its policy of open competition. With regard to the receipts from the conduit-tramway system on the south side of the Thames, it is satisfactory to note that the receipts per car-mile were 12.21d. against an estimate of 12d.

The expenditure on the Postoffice telephone system, as authorized by the act of 1899, has now reached nearly $7,500,000. The system is not yet complete, although extensions are dependent upon further funds being voted by Parliament. It is intended shortly to introduce a bill into the House of Commons to authorize such additional capital. At present it is being found necessary to restrict the expenditure on telephone work in London, and complaints are being made as to the discharge of long-service workmen.

A return has been made giving the gross amount expended and received in the government telegraph service for the year ended March, 1903. The total expenditure was nearly $22,500,000, the receipts being less than this to the extent of nearly $3,000,000. It is a standing mystery, outside the government department itself, why the telegraph system cannot be made to show a surplus.

The Glasgow corporation, as I have previously mentioned, has been making a tour of those electric-supply stations in Great Britain which are employing steam turbines for driving their dynamos. They subsequently invited tenders and the corporation now recommends that the two 3,000-kilowatt turbo-generators be made by British firms, who have contracted at the price of $150,000.

The North Metropolitan Electric Power Supply Company has finally taken charge of the electric power works of the Willesden Urban District Council, which it will in the future supply in bulk. The company in question is one of the "power" supply companies in Great Britain and has already commenced the construction of two very large power houses at other points in its area, which is over 300 square miles in extent. The agreement with the Willesden Urban District Council was carried out at the suggestion of the company, which undertakes to supply the corporation at a price per unit below that which it was estimated that the local authority could itself generate current. The company is also negotiating for the purchase of another municipal undertaking in its area upon similar terms.

It is quite obvious that very soon there will have to be a modification in our present legislation in respect of tramway schemes. At every session there arise glaring instances of arbitrary action by local authorities with regard to giving their consent to schemes, which must be obtained before a bill can be introduced into Parliament, and it is having a serious influence upon the expansion of the industry.

G.

Dominion of Canada.

Ottawa, Ont., March 12.—In an address before the Canadian Mining Institute Mr. J. Obalski, inspector of mines for the province of Quebec, made the interesting announcement that radium is likely to be found in considerable quantities in Canada, especially in the Laurentian range of mountains. The white mica and coal found in Charlevoix County possess radio-activity.

The Jacques Cartier Electric Light and Power Company and the Quebec Railway, Light and Power Company entered into an agreement some months ago to advance their interests. The latter company has just issued a circular to its clients informing them of an increase in the rate of charges for the electric-light service. The result of this increase is that many of the consumers are returning to the use of gas and coal oil.

The board of directors of the Montreal Street Railway has appropriated the sum of $300,000, which will be utilized in the construction of 50 new cars. In some respects these new cars will be novel, inasmuch as they will be semi-convertible and can be used both summer and winter to excellent advantage. They will cost an average of $6,000 each.

The town of Edmonton, N. W. T., has awarded the franchise for a street railway in the town to a Montreal company. The company has secured a 30-year exclusive franchise and a perpetual franchise for its suburban lines over the town system for freight and passenger service. The company's equipment, buildings, engines, dynamos and all other property relating to the tram line are exempt from taxation for 10 years after January 1, 1905. At the end of the 10 years the company is to pay the town five per cent. of the gross earnings of the system.

The work of installing the machinery in the new power house of the Canadian Pacific Railway Company has just begun. The power house is now complete with the exception of the machinery, and it measures 120 by 105 feet. The plant, when finished, will be capable of developing 3,000 horsepower, which will be distributed over all the operations of the Canadian Pacific at Fort William, Ont., including the lighting systems, operation of the elevators, waterworks and machine shops.

The scheme of the Ontario Electric Railway Company, which was formed about a year ago, is to link by a line of electric railway the cities of Toronto and Kingston, Ont., and 29 towns along the direct line of the proposed road. All plans are now completed to start building an electric road that will carry passengers, express and freight at greatly reduced rates. The company has an authorized capital of $5,000,000, half of which will be issued at once and the remaining half to be held until further extensions than now contemplated are begun. The company can also issue $20,000 of bonds for every mile of the road built. One feature of this line will be the use of the express cars, running independently at all hours of the day or night. A two-cent-per-mile rate for passenger traffic will be maintained throughout, except in towns, where there will be a fair charge. It is proposed to generate all the electrical energy by water power, the first source of supply to be the Trent River where it empties into the Bay of Quinte. The power to be derived there is calculated to supply a sufficient force to run the cars 100 miles either way. Other plants along the line will also be established. The provisional directors of the company are Sir Richard Cartwright, R. J. Carson, John Carson and Cornelius Birmingham of Kingston, Ont., and A. L. Jewell, H. N. Smith and C. E. Smith of Boston, Mass. It is stated that the construction of the road will be commenced as soon as the frost is out of the ground this spring.

W.

New York.

New York, March 12.—An incident of importance this week was the completion on Friday afternoon of the work of coupling the headings of the Hudson River tunnel, and a distinguished party walked for the first time in history from Jersey City to Manhattan. A great deal of work yet remains to be done in the tunnel, which was commenced 25 years ago, but it is promised that electric cars shall run through it in April, 1905.

The contracts for the Pennsylvania Railroad tunnels have been assigned. The O'Rourke Engineering Construction Company will have the North River section, and that under the East River has been awarded to the English firm of S. Pearson & Son, who have been identified with recent "tube" work in London.

One noteworthy outcome of the Baltimore fire has been the general overhauling and examination of the fire-alarm system in this city. Critics allege that the Chester signal boxes, now installed at the corner of every block in Manhattan, are obsolete and inefficient, and that their connections are liable to frequent interruption by building operations. An extensive system of electrical-alarm boxes has just been completed in the boroughs of Queens and Richmond at a cost of $100,000, and now attention is turned to the question of providing duplicate switch boards and connections at an estimated cost of $70,000. It should be explained that all the existing boxes are connected with headquarters at Sixty-seventh Street, and signals are sent back thence to the engine houses in the vicinity of a call. That such a centralized system could be wholly paralyzed by some untoward fire or explosion is obvious, and so it is urged that the duplicate apparatus should be erected in a fireproof building in one of the parks.

Several pickpockets boarded a trolley car at Hoboken one night this week, and while one of the thieves pulled the trolley pole from the wire his confederate relieved the passengers of their jewelry. This has revived the discussion of an electric light which could be kept burning while the conductor replaces the pole. Such a system is simple and practical. It is in successful use on a number of electric railways in Europe, and has just been installed after careful test on the electric street-railway system of Scranton, Pa.

A Brooklyn assemblyman wants to tax imported electrical power, generated on the Canadian side of Niagara Falls. The tariff is suggested at $2 per 730 kilowatts, and a penalty of $100 a day for refusal to exhibit books and meters. As the capital invested in these "foreign" undertakings is mainly from Buffalo, the Buffalo people are not pleased with the bill. New York state has spent about $2,000,000 in various ways to preserve the falls as one of the wonders of the world, but several more millions are invested, and many more still will be invested in utilizing the waterpower there. Delegations for and against the bill of the Niagara, Lockport and Ontario Power Company have been to Albany this week. There seems to be a general balance of feeling not to allow any one corporation unlimited freedom in the matter, but to follow the example of New England and Canada and impose a tax according to the horsepower generated. It is estimated that a rate of one-fourth that payable on electrical power in New England would yield a handsome revenue, and that the money could be used to maintain and preserve the other amenities of the falls.

The task of taking down every overhead wire in the Borough of Manhattan and placing them in underground conduits is nearing completion. With the razing of the large telephone poles on Amsterdam Avenue the last overhead wires will have disappeared. The work of burying the wires began in 1886, and has gone on quietly but continuously since. There was much opposition from the operating companies at first, and so vigorously did the electric-lighting companies resist attempts to oust them from the curb that Mayor Grant issued the famous "axe order" of 1889. Every street in the borough now carries a conduit. They are of two classes—high and low tension—the former carrying the electric-light cables and the latter the telephone, fire, burglar and "ticker" wires. Each system is controlled by separate companies.

Mayor McClellan wants to make it a felony for a telegraph or telephone company to supply poolrooms with racing news; but he adds by way of suggestive afterthought that if the telegraph companies stop their service the poolroom people might try space-telegraphy.

D. W. W.

New England.

Boston, March 12.—The tunnel designed for the use of the Boston Elevated Company's trains between East Boston and the city proper, under a portion of the harbor, is now practically completed and the work of preparing for train service will proceed at once, so that it is expected to open the line for travel on or about June 17th, which is Boston's big local holiday, known as Bunker Hill Day.

The Nahant company, which was organized by the summer residents of Nahant, including Senator Lodge, was granted a franchise by the selectmen of Nahant this week. The contractors agree to have the electric railway in operation in 14 months, between Lynn and Nahant. It will practically replace a line of barges now running between the towns.

Another important decision relative to fares on some of the electric-railway systems of the state has been rendered by the Massachusetts railroad commissioners, wherein they decline to order a reduction of the fares charged for interurban service. The commission says that none of the particular fares complained of is more than a reasonable charge for the accommodation furnished.

Application has been made to the Connecticut railroad commissioners for approval of the plans of the proposed circuit line between Hartford and Springfield, on both sides of the Connecticut River.

The Wallingford Tramway Company, which holds a franchise to build from the terminus of the Meriden Electric Company's road in Wallingford to connect with the Fair Haven and Westville company's lines running into New Haven, will begin construction as early as possible in the spring. The distance is seven miles.

An electric railway is projected to connect Tiverton and Little Compton, R. I. The company interested has a charter granted by the Rhode Island General Assembly in 1903.

Bids have been called for by the Boston and Albany Railroad Company for electrical equipment of the Newton Circuit, so called, the intention being to supplant steam with electricity in the running of trains over this portion of the system, provided the cost can be figured low enough to warrant the change.

The Boston Telegraphers' Mutual Aid Association held its twentieth annual meeting last week. The affairs of the association were found to be in a flourishing condition. The election of officers resulted as follows: President, A. V. Losea; vice-president, J. F. Carter; treasurer, W. H. Sullivan; recording secretary, Edward Smullen; financial secretary, W. T. Sheridan.

Salesmen, electricians and engineers of the Stanley Electric Manufacturing Company of Pittsfield met recently and effected an organization. In connection with the meeting a banquet was served. The name of the new organization has not been decided upon, but choice will be made from the several under consideration at a meeting to be held the second Monday in April, at which time the permanent organization will be perfected.

B.

Southeastern States.

Charlotte, N. C., March 12.—The largest electrical development of the year is reported from Richmond, Va., where the Seaboard Traction Company has

been chartered, with a capital of $250,000, to build an electric railway from Richmond to Portsmouth. The principal offices will be at Suffolk, Va. The officers are as follows: President, L. R. Britt; vice-president, W. H. Robinson; treasurer, W. D. Southall; general manager, George H. Lewis of Norfolk; secretary and auditor, Lee Britt of Suffolk, Va. The line will open a quick outlet for the great trucking interests of Eastern Virginia. Power houses will be erected and part of the power may be secured from the new Appomattox River plant at Petersburg. The charter provides that work shall begin at once. The capital stock may be raised to $800,000.

In the rehabilitation of the burned district of Baltimore, several important electrical developments have just been consummated. One of these is the completion of the stringing of trolley wires for the United Railways and Electric Company. A bill has also been prepared to be introduced in the Legislature chartering the Baltimore, Westminster and Union Mills Railway Company, to run through Baltimore and Carroll Counties.

The Maryland Telephone and Telegraph Company is preparing to go into the light and power business. George R. Webb, president of the company, has been actively at work for several months on the new plans. Mr. Webb stated that a million-dollar plant would be erected. It is predicted, however, that the new move will be vigorously opposed.

The Consumers' Light, Heat and Power Company of Newport News, Va., has been placed in the hands of a receiver. T. T. Thompson, one of the largest stockholders, applied for the receivership, claiming that the road was not on a paying basis.

K. C. Menzies has been appointed temporary receiver for the Thornton Light and Power Company of Hickory, N. C. The liabilities include a complete city lighting plant valued at about $25,000. L.

Texas and Mexico.

Austin, Texas, March 10.—The City Council of Waco, Tex., has entered into a new contract with the Waco Gas Company for furnishing the city with lights for a period of 10 years, and the proposition to build a municipal electric-light plant there will not be carried out.

J. M. and E. E. Carpenter have purchased the plant of the Spindle Top Power Company at Sour Lake, Texas. The new owners state that the plant will be converted into an exclusive light and power and ice-manufacturing plant.

A new electric-light and power plant is to be installed at Zacatlan, Mexico. The plans for the proposed enterprise have been submitted by the City Council to the state government for approval.

An American company contemplates installing an electric-light and power plant at Mazatlan, Mexico.

The City Council of Colima, Mexico, has accepted the plans and estimates of Ugarte & Garcia for lighting the city with electric lights, and the matter has been referred to the governor for approval.

The Mexican government has granted a concession to Luis Fernandez Castillo of the City of Mexico for the construction and operation of a large electric-power plant in the state of Puebla, Mexico. The generating station is to be located on the Apulco River, it being proposed to utilize the Tlatlahuaqui Falls for generating 35,000 horsepower. Electric transmission lines will be built to the city of Puebla and other industrial towns of the state. A large amount of machinery will be required.

It is reported that the Northern Mexico Development Company recently organized at Alamogordo, New Mexico, will build and operate electric-power plants in the state of Chihuahua, Mexico. D. C. Sutton of San Pedro, state of Chihuahua, is general manager.

The department of public communications and works of Mexico has just issued a detailed and complete statement of all the railways existing and in operation in Mexico on January 1, 1904. It shows that the only exclusively electric railway in Mexico is that which runs between Torreon and Lerdo. It is 10 miles long. The international system of electric railway which operates between El Paso, Texas, and Ciudad Juarez, Mexico, has one kilometer of track on the Mexican side of the border. In the City of Mexico there is an extensive system of electric railway, but the system also embraces lines which are operated by steam and animal power and are not classed as exclusively electric. The system in that city embraces 241 kilometers of main track. Electricity is used on all of the principal lines there and the others are being rapidly converted into electric transit. The report also shows that there are in Mexico 240 kilometers of railways which are operated exclusively by animal power, and 25 kilometers which are operated by both animal and steam. The total number of kilometers of steam railroads is given at 15,953.

Application has just been made to the Mexican government by the Mexican (Vera Cruz) Railroad Company for a concession to establish electric traction on the section of its road known as Las Cumbres de Maltrata, where the heavy grade requires two locomotives to haul an ordinary passenger train. The electric power will be generated at a large waterfall on the Atoyac River.

The Fort Worth and Rosen Heights Street Railway Company, which was recently organized with a capital stock of $100,000, is preparing to build a system of electric street railways in Fort Worth and the suburb of North Fort Worth. The incorporators of the company are Sam Rosen and R. W. Flourney of Fort Worth, and I. Gordon, H. A. Peristein and J. S. Gordon of Beaumont, Texas.

The Mexican government has granted a concession to the Compania Hidroelectrica Queretana for the installation of an electric power plant on the San Juan del Rio, near Cadereyta, Mexico. The company is authorized to use 2,000 liters of water per second for the purpose of generating electrical energy.

It is announced that an English syndicate will make application to the state and municipal governments for a concession and franchise for the establishment and operation of an electric street-railway system at Puebla, Mexico. It is reported that Sir Weetman Pearson, the English contractor who owns the street-railway system in the city of Vera Cruz, is interested in the proposed enterprise.

It is reported that the Hidalgo and Northern Railroad Company has purchased the street-railway property in Pachuca, Mexico, the consideration being $250,000, and that the new owners will convert the system into electric lines.

The construction of an extensive system of electric railway, to connect all of the principal mines in the rich district of Guanacevi, Mexico, is contemplated. A movement has been inaugurated to form a company for the purpose, to be composed of the leading mine operators.

An electric-light and power plant is to be installed at Real del Monte, Mexico. The state government has contributed $3,500 toward the cost of the plant.

Daniel Garns, through his attorney, Salvador Cortez Rubio, has applied to the government of the state of Michoacan, Mexico, for a concession for the establishment of an electric power plant in the Tacanbaro district of that state. He proposes to utilize the waters of the Tirir River for operating the plant.

The San Felipo Mining Company, which has its principal office at Philadelphia, Pa., is installing an electric plant at its mines, situated near Ixtlan, Mexico.

A. J. Peyton of New York, and associates, contemplate installing an electric power plant at their mines, situated near Coapa, state of Michoacan, Mexico. H.

Kentucky.

Lexington, March 12.—It is announced that George B. Davis, president of the Blue Grass Consolidated Traction Company, will be in Lexington the coming week to begin the construction of the line. Judge Phillip T. Vanzile of Detroit arrived a few days ago and has been engaged in adjudicating claims against Mr. Davis' company. A few weeks ago the fiscal court revoked the franchise of the Blue Grass Consolidated and granted the Fayette Interurban Traction Company, composed of local people, a franchise over about the same route. This company now threatens injunction proceedings if Davis attempts to build a road. C. J. Bronston, president of the Fayette company, states that four lines radiating from Lexington will be built within the next 18 months.

A. L. Reis of Cincinnati and J. W. Richardson and J. E. Bohannan of Louisville have filed articles of incorporation for the Henderson City Railway Company of Henderson, Ky., with a capital stock of $250,000. The present lines will be greatly improved, it is said, and some extensions made.

The Louisville and Southern Indiana Traction Company has been granted a franchise by the city of Louisville for lines through the streets and a terminal. An ordinance was also passed giving the company a franchise for an approach to the Big Four Bridge, which will be used to bring the line into the city.

The Kentucky and Ohio River Interurban Railway Company of Paducah has been incorporated with a capital stock of $250,000 by J. J. Freundlich, C. E. Whitesides, O. B. Williams, O. B. Petit, L. B. Whitesides and C. T. Crump.

It is said that plans have been completed for building an electric line from Lexington to Frankfort. O. M. Bake, a prominent banker and electric railroad man of Hamilton, Ohio, and other Hamilton and Cincinnati men, are interested in the proposed road.

Dr. McFerran Crow of Versailles, Ky., has placed before the City Council and business men of Danville, Ky., a proposition to build a line from that city to Junction City to connect with the Louisville and Nashville and the Cincinnati Southern. The proposed company would also supply the towns with light.

The London (Ky.) Electric Light Company has been chartered, with R. M. Jackson president. It is proposed to have lights burning within 90 days. C.

Ohio.

Cleveland, March 12.—The Recorder and Computing Machines Company of Dayton has been incorporated with a capital stock of $200,000, which may later be increased to a much larger amount. W. I. Ohmer of Dayton, who holds patents on 26 different machines for recording fares and recording and computing fares and tickets, is one of the incorporators. The company will develop and manufacture the machines invented by Mr. Ohmer.

Citizens of Napoleon have voted to issue $25,000 bonds for the improvement of the water and light plant. Bonds will draw four per cent. interest. Plans have been formulated for the improvement of the properties of the Eastern Ohio Traction Company, which is now in the hands of George T. Bishop as receiver.

Manager L. E. Beilstein, of the Toledo Railways and Light Company, states that the damage to the company's lines has been greatly exaggerated in recent reports. The ballasting of a mile and a half of track was washed out, but this has been replaced. The company has good prospects for the coming year.

The people of Wapakoneta have voted to issue $7,000 water and electric-light improvement bonds to draw five per cent. interest.

The net earnings of the Northern Ohio Traction and Light Company for February were considerably larger than for the same month last year, but owing to the excessive expenses, due to weather conditions, the surplus was much smaller.

President Norman G. Kenan of the Cincinnati Gas and Electric Company states that the first two months of the year have been good. The net earnings for January were $26,000 more than for the corresponding month in 1903.

A contract for 10 cars has been let by the Eastern Construction Company for the Cleveland and Sharon Traction Company. Two baggage, two combination smokers and two buffet cars have also been ordered. It is stated that the road will be in operation by November.

It is announced that the Cincinnati Rapid Railway Company has succeeded in having its bonds underwritten. Engineers have already submitted surveys of four different routes. J. G. Schmidlapp is at the head of the company, which will build an underground railway from the center of the city to some of the suburbs.

The track on the Scioto Valley Traction line has all been laid and it is believed that cars will be running by April 15th. This is one of the few third-rail systems in the state.

The Columbus, London and Springfield and the Dayton, Springfield and Urbana electric railways have established a thorough freight service between Dayton and Columbus.

The Cincinnati, Milford and Loveland Traction Company has established a half-hour schedule between Madisonville and Milford. The contract with the Cincinnati Traction Company, which will admit the cars to the center of the city, will be signed soon, it is said.

The Fort Wayne and Southwestern Railroad Company, organized by Cleveland people, has filed a mortgage of $2,000,000 in favor of the Marion Trust Company to cover a like amount of five per cent. bonds which will be issued.

Representative Huffman has intrduced a bill in the Legislature providing that where councils refuse to grant a franchise to electric-light and heating companies an appeal may be taken to the Probate Court.

The Columbus, Newark and Zanesville Railway Company ran the first car over its tracks from Newark to Zanesville a few days ago, the trip being made in 45 minutes.

In answer to an invitation from the board of public service inviting competition to the offer of an electric-light company to light the street arches in Columbus free for a term of two years in return for certain favors, President Robert E. Sheldon of the Columbus Railway and Light Company offers to make the city a present of $6,000 in cash, providing the competing company does the same thing, to be used for some charitable purpose. It costs about $5,000 a year to light the arches, and the merchants on High Street pay half of this.

It is announced that the National Carbon Company will erect another plant this year to meet its needs in certain lines, for which the factory at Cleveland is not fitted. The new plant will cost something like $200,000.

The ordinance introduced in the Cleveland Council by Mr. McKenna, requiring all cars to be equipped with power brakes of some kind, has been passed. The ordinance allows the companies to choose their own kind, however.

Officials of the Cleveland Electric Railway Company have given the trailer train a thorough trial and believe they will be able to use this method of handling the people mornings and evenings.

S. F. Haserot and George F. McKay of Cleveland have resigned from the directorate of the Northern Texas Traction Company. John Masterson, traffic manager of the Lorain Steel Company, and Charles E. Adams, general manager of the Cleveland Hardware Company, take their places. C. A. Taylor of Texas is succeeded by J. W. Blake of Dallas. The report for February shows the earnings to be $34,575, an increase of $8,778 over the same month last year. O. M. C.

Michigan.

Detroit, March 12.—The Lansing Electric Railway Company announces that it will build a line of railway from Lansing to Pine Lake this spring if the citizens of Lansing will purchase 10,000 round-trip tickets at the rate of $1 each. The distance to Pine Lake from the Agricultural College, where the company already has a line, is seven miles.

The Grand Trunk Railway Company is considering the question of equipping the St. Clair tunnel between Port Huron and Sarnia with electrical power to supplant the present locomotive service. The objection to the system now in use is the amount of gases from the anthracite coal used as fuel by the tunnel locomotives, and the impracticability of an adequate system of ventilation.

The Michigan Milling Company of Ann Arbor has

filed with the city clerk a request for an electric-light and power franchise. The company has three mills at Ann Arbor. One has an excellent waterpower, from which it is proposed to develop electricity and transmit the same to the other mills, thus doing away with the steam power. Incidentally, the company asks for a franchise on all streets and alleys, in order to furnish electricity commercially to patrons in the city. The Washtenaw Light and Power Company has a monopoly now.

The city of Flint has been considering the matter of adding a dynamo to the waterworks plant and developing its own electricity for city lighting purposes. The engineer and superintendent of the waterworks report adversely on the proposition, saying that, while the city can make its own light as cheaply as it can buy it, the margin of profit is not enough to pay for installing the plant.

Articles of association have been filed by the Detroit Trolley Wheel and Equipment Company, with a capital stock of $100,000, all of which has been paid in.

The Jackson Street Railway Company has been sold for taxes. This includes all the property, right-of-way and seven cars. The property was sold to Charles B. Hole, representing W. N. Coler & Co. of New York, and the title will remain in his name, pending the reorganization of the company. It is thought by some that this is the first step in the consummation of a plan which originated some time ago to consolidate the Detroit, Ypsilanti, the Ann Arbor and Jackson city lines and the Jackson-Battle Creek lines.

It is understood that the work of constructing the Jackson and Fort Wayne interurban line will be under way within 30 days. The articles of association of the company have been filed in this state, and a large part of the right-of-way has been secured. Eastern capitalists have taken up the project where it was abandoned by the promoters.

The Lansing and Suburban Traction Company, organized to take over the property of the Lansing Street Railway Company and the Lansing and St. Johns railway, has filed articles of incorporation. The company's capital is fixed at $1,000,000.

Colonel Worth Bean, president of the Benton Harbor Street Railway Company, has announced that hereafter he will give transfers between his two lines of roads, which were merged two years ago, asking no consideration in return from the city. C. G. W.

Indiana.

Indianapolis, March 12.—The Jackson and Fort Wayne Interurban Railway Company has filed articles of incorporation, capitalized at $50,000. The company proposes to build an electric line between Jackson, Mich., and Fort Wayne, via Auburn, a distance of 130 miles. Among the incorporators are John H. Roberts, Joseph McKee and Charles W. Wadkins of Grand Rapids.

The Inter-State Traction Railway Company has been incorporated with a capital stock of $50,000. The company proposes to build and operate an electric line from Dayton, Ohio, to Indianapolis, passing through Union, Fayette, Rush, Shelby, Hancock and Marion Counties in Indiana. The incorporators are headed by John D. Boroff of Dayton. A 50-year franchise has been granted by the commissioners of Union County.

The Hammond, Whiting and East Chicago Electric Railway Company has been granted a 50-year franchise by the Hammond City Council. The people of Hammond have opposed the extended franchise bitterly for nearly two years, holding out for a 25-year franchise and a bonus of $25,000 or more. The council passed the ordinance during great excitement. A bonus of $10,000 and land valued at $2,000 will be given the city, the land to be used in locating new industries.

The Northern Traction Company, which is building a line from South Bend to Hammond, by way of Valparaiso, has been granted a franchise by the Valparaiso City Council and filed a $1,000 forfeit bond to complete the line this year.

The Fort Wayne and Wabash Valley Traction Company, which owns the Fort Wayne city lines and the Wabash-Logansport trolley line, has passed into the possession of the Fort Wayne and Southwestern.

The annual meeting of the stockholders of the Indiana Union Traction Company and its allied companies was held in Anderson. The financial report of the company showed gross earnings for the last year of $1,118,951.54; operating expenses, $620,136.64; total net earnings, $498,814.90. Directors were elected, there being little or no change except Mr. McCulloch's name was left out of the directorate so he could continue as president of the Indiana Union Traction Company, for which position he was re-elected in Philadelphia. The directors have set aside $150,000 with which to build central car shops in Anderson, the work to begin early in the spring.

A series of tests are being made at Purdue University to determine the relative holding power of the common railroad spike, used in this country, and the screw-spike, which is used in France and Germany.

The Indianapolis and Eastern Railway Company has discontinued its limited service to Richmond, as the result of the low bridge, which necessitated the transfer of passengers to the Richmond street-car line, which proved unsatisfactory. The limited service will be restored as soon as the bridge is raised, and will then be run through to Dayton, and possibly, Columbus, Ohio.

The dam and electric power plant on Hen Island, below Mishawaka, has been sold to M. Chapin of Chicago. The property is worth $1,500,000 and it is claimed that Mr. Chapin already owns all the important waterpower between Mishawaka and the Michigan line on the St. Joseph River.

The Town Council of Jasper, Ind., is making arrangements to purchase the electric-light plant and improve it by putting in a power house with sufficient capacity to supply the town and private residences and business houses.

During the last week the students of Purdue University made careful examinations of all the grades and curves of the Indianapolis and Northwestern Traction Company's line as a part of their technical education in electric railroading.

Seven thousand dollars worth of copper wire belonging to the Indianapolis and Northwestern Traction Company was discovered in the possession of an Indianapolis junk dealer, who had cut it into short pieces ready for shipment. Two or more of the company's former employes are under arrest charged with the theft.

The municipal electric-light plant of Anderson has been enlarged to a capacity for a city of 50,000 people. The commissioners have announced that on April 1st a 30 per cent. reduction will be made in the rates for electric-light service. F.

Northwestern States.

Minneapolis, March 12.—The Union Manufacturing Company of St. Anthony Park, a suburb of St. Paul, plans to extend its electric-light and power system to cover the district adjacent, including the St. Anthony Hill district.

S. E. Wainwright has been granted a franchise at Lenox, Iowa, for an electric-light plant.

There is considerable agitation at Sloan, Iowa, in favor of a central-heating and electric-lighting system.

An electric railway is planned as a branch of the Chicago, Ottumwa and Western, from Council Bluffs to Ottumwa, Iowa.

Bids are invited for putting in an electric-light plant at Whitefish Bay, Wis.

H. A. Seely is succeeded as superintendent of the electric-light plant at Lake City, Minn., by E. V. Lombard of Ortonville.

A route is being surveyed for an electric line from Mankato, Minn., to Vivian.

The Des Moines (Iowa) City Railway Company is contemplating extending its Sixth Avenue line to Highland Park and building a North Side cross-town line.

J. E. Gerry has assigned his electric-light franchise at Pine River, Minn., to J. G. Dawes, who will put in a plant this summer.

The Blackduck (Minn.) Electric and Telephone Company has been incorporated with a capital of $50,000. M. D. Stoner and others are interested.

Peter English of Boulder, Colo., will expend $100,000 in improvements in the Deadwood (S. D.) light plant and in installing an electric-light system at Lead, S. D.

Daniel Kelly will put in an electric-light plant at Greenwood, Neb.

The franchise for electric lighting for Neenah, Wis., was awarded to the Wisconsin Traction, Light, Heat and Power Company of Appleton. A new power house will probably be erected at Neenah.

Bonds to the amount of $10,000 have been voted by the city of South Stillwater, Minn., for establishing an electric-light plant.

Langseth & Meyer of Appleton, Wis., were awarded the contract for installing an electric-light plant at Rib Lake, Wis. The contract calls for about $10,000.

The Escanaba Electric Railway Company proposes to build a street-car line at Gladstone, Mich.

A franchise has been granted to the Iowa City, Davenport and Muscatine Railway Company for a street-car system at Iowa City.

The contract for the erection of the new power house for the Janesville (Wis.) Electric Company has been let. R.

Pacific Slope.

San Francisco, March 12.—H. G. Lacey, a prominent electrical man of Hanford, Cal., was in the city last week on business.

The Sawtelle Rotary Motor Company has been incorporated by H. Fraley, C. A. Sawtelle and others, with a capital of $500,000, to engage in business in San Francisco.

Harry W. Goode, president and general manager of the Portland General Electric Comapny and general manager of the Lewis and Clarke Exposition, was in San Francisco last week.

Superintendent W. E. Everson of the El Dorado Copper Mining Company, is negotiating with the American River Electric Company to run a line from a point near the Delmatia mine into Georgetown, Cal., for power and lighting purposes.

The Brooks-Follis Electric Corporation of San Francisico has changed hands, and James Follis, formerly the principal owner in the concern, has retired from the electrical field entirely. The new owners, F. M. Ray and Frank Fouden, formerly with the General Electric Company, are now in charge and will continue the business along the same lines as it has been conducted in the past.

C. E. Heise of the sales department of the San Francisco district agency for the Westinghouse Electric and Manufacturing Company, has gone to Pittsburg, Pa., where he will acquaint himself with the details of the alternating-current motors now being manufactured for use on several electric-railway lines. W. W. Briggs of the same department has just returned from a similar errand to Pittsburg.

Werner Van Ordin, principal owner of the South Yuba Company, is in San Francisco, and it is rumored that the California Gas and Electric Corporation is negotiating with him for the purchase of the South Yuba plant.

At the last meeting of the directors of the Clear Lake Electric Railroad and Power Company steps were taken to perfect the issue of the $600,000 worth of bonds which were voted at their former meeting. L. H. Boggs and Dr. W. R. Prather are in San Francisco arranging for the sale of the bonds. Work of grading the road will be begun on or about March 1st.

It is understood that the Watsonville Light and Power Company, which has been incorporated with a capitalization of $250,000 by F. M. Ray, C. W. Waller and others as a temporary board, will operate the combined gas and electric plants now owned by John Martin and L. P. Lowe in Watsonville. The electric-lighting plant of the Watsonville Water and Light Company has been purchased from Francis Smith, and the Pajaro Gas and Electric Company, which was controlled by L. P. Lowe, is absorbed.

The electric-lighting companies doing business in San Francisco will be put to a heavy expense by a recent ruling of the city officials in regard to transformers in buildings. Up to this time transformers have been placed promiscuously in cellars and basements, with absolutely no protection against fire. After consulting Chief Hewitt of the City Department of Engineering and Professor Cory of the State University an ordinance was passed requiring that transformers be placed either immediately under the sidewalk on a floor of not less than three inches of cement, separated from the balance of the basement by a brick or concrete wall, or in a tight steel tank ventilated to the street and standing on concrete or on metal legs of sufficient length to protect the floor. The Board of Underwriters has been urging such a measure for some time. Of the lighting companies affected, the Mutual will be put to the greatest expense, it being calculated that it will cost between $15,000 and $18,000 to make the necessary changes. The San Francisco Gas and Electric Company has only about 40 transformers which will need to be housed, the most of its apparatus being in the manholes of the conduits in the streets. A.

PERSONAL.

Herbert Laws Webb, an English electrical and telephone engineer who has spent much time in this country and who is the author of "The Telephone Handbook," has returned to England and opened an office in Old Queen Street, Westminster.

E. P. Shaw, Jr., widely known in New England street-railway circles, and a member of the Shaw syndicate, has been appointed superintendent of the Boston and Worcester street-railway system, succeeding A. C. Ralph, whose resignation was accepted a short time ago.

Mrs. Minerva M. Goll, mother of W. S. Goll, manager of the Chicago branch of the Fort Wayne Electric Works, died at the home of her son, 514 Fullerton Avenue, Chicago, on March 13th. The funeral was held on March 15th and the remains were taken to St. Louis for burial. Mr. Goll has the sympathy of a large circle of friends, as only a few months ago he buried his father.

Professor and Mrs. Curie, it is stated, expect to make a visit to the United States with the intention of here establishing a plant for the production of radium. The Bohemian mines will only furnish pitchblende for experimental purposes, the deposits not being extensive enough for commercial uses. For this reason the Curies have interested themselves in the United States as a field for the production of radium in quantities.

Philetus W. Gates and Henry W. Hoyt, general superintendent and second vice-president, respectively, of the Allis-Chalmers Company, are to retire from the company. Mr. Gates was president and Mr. Hoyt secretary and general manager of the Gates Iron Works for 15 years prior to the incorporation of the Allis-Chalmers Company in 1901. They will take a long vacation, which will be spent in travel, and will then engage in active business in Chicago.

Clarence A. Ross, who has been for several years manager of the Chicago office of the Sawyer-Man Company, was recently appointed general western agent of the same company, with headquarters at Chicago. His many friends in the incandescent-lamp business, particularly throughout the western territory, will be pleased to know of this promotion, which, of course, gives Mr. Ross control of a much more extensive territory. He is a man of large experience, having been in the electrical business for 16 years, being with the Sawyer-Man Company seven or eight years. The present well-merited promotion to the responsible position of general western agent for a company of such high standing is unquestionably a high compliment.

ELECTRIC LIGHTING.

It is reported that the town of Grafton, Ill., has just made a lighting contract for 10 years, whereby the village secures an all-night light every night in the year for about $30 a light, and the owner of the plant, it is said, is anxious for similar contracts.

The Kansas City Electric Company has removed over 15 miles of heavy copper from the business part of the city, and will remove the remaining wires soon. This work is being done in accordance with the provisions of a city ordinance. Conduits and the trolley poles of the Metropolitan Street Railway Company will be used by the electric-light company, wherever practicable, for stringing its wires.

A 15-year franchise has been granted to J. E. Stone of Dayton, Tenn., for an electric-light plant for that city. Incandescent lamps of 32 and 50 candlepower are to be furnished to the city at a maximum price of $20 and $25 a year, respectively. Lights for domestic purposes are likewise to be furnished. The plant is to be in operation not later than October 1st.

A movement is on foot in North and Upper Alton, Ill., to secure a lighting plant of their own jointly, and thus be independent of the Alton Light and Traction Company, which is now furnishing lights to both towns. The idea is to locate the power house midway between the two towns, which are only a few miles apart, and to secure a plant sufficiently large to fill the needs of both places.

The eleventh annual report of the board of electrical commissioners of the city of South Norwalk, Conn., for the fiscal year ended January 1, 1904, is at hand. The report contains all the facts and figures concerning the present condition of the electrical institutions in that city. The officers of the executive staff are: President, Joseph A. Volk; treasurer, Leslie Smith; secretary, Charles N. Smith.

City Electrician E. B. Ellicott is pleased with the action of the finance committee of Chicago in giving $200,000 out of the bond issue for extensions of the municipal lighting plant. Mr. Ellicott calculates that with this sum he can put in 2,000 more street arc lamps, do away with the payment of $103 a year for each of 720 arc lamps rented from the Commonwealth Electric Cimpany and increase the municipal electric-lighting plant 40 per cent.

A municipal electric-light plant to cost $140,000 for lighting the city south of Keokuk Street, is being planned by the city officials of St. Louis. It is intended to place the plant on the bank of the Mississippi, where it could draw its water supply direct from the river. The territory which it is intended to light is now divided between the Carondelet Gas Company and the Welsbach Lighting Company. The first company receives $54,000 annually and the latter $5,000.

The commissioners of King County, Wash., have granted to John McQuade of Issaquah, Wash., trustee in King County for the Snohomish-Cherry Valley Electric Railway Company, a franchise for the Snohomish-King County line. The line is part of the system for which two other franchises have been granted. These are to form part of the system which is planned to form a loop about 100 miles in diameter, connecting the principal towns and cities of the two counties, with several branches to the mining districts in the Cascades. All the incorporated towns, with the exception of Everett, have granted franchises over their streets.

ELECTRIC RAILWAYS.

The Chicago and Milwaukee electric railway shows an increase for February of 69 per cent. in gross and 54 per cent. in net earnings as compared with February last year. February's gross earnings this year was $18,047.

Another link in the chain of electric railways for North-central Illinois is to be added by the Springfield, Lincoln Bloomington, Pekin and Peoria Electric Railway Company, which has been incorporated with a capital of $50,000. The principal office is at Bloomington, Ill., and the company proposes to build an electric road in the vicinity indicated by its name. Lafayette Funk of Shirley, Ill., heads the list of incorporators.

The United Railways Company and the St. Louis Transit Company have filed suit in the Circuit Court against the Fidelity and Casualty Company of New York, to recover damages and insurance resulting from the explosion of boilers in the transit company's Geyer Avenue power house on December 21st last. The petition asks for $75,000, alleged to be the amount of insurance carried, and $7,500 for damages incurred by the failure of the Fidelity and Casualty Company to pay the policy.

The stockholders of the Aurora, Elgin and Chicago Railway Company held their annual meeting in Chicago and re-elected the three retiring directors—F. A. Dolph, Harry Greenbaum and L. J. Wolf. Officers will be elected later. The full road, including the Elgin branch, had been in operation eight months on January 31st. In that time it had earned a surplus above interest and taxes of $34,366. This is at the rate of $51,549 for a full year, or 3.43 per cent. on the $1,500,000 of six per cent. cumulative preferred stock. President Wolf's report showed the following statistics: Passenger earnings per car-mile, 21.72 cents; gross earnings per car-mile, 22.21 cents; operating expenses per car-mile, 11 cents; average fare per passenger, 26.15 cents.

Work will be begun at once on the new electric line between Rochester and Syracuse, N. Y., which will be known as the Rochester and Eastern. Most of the line will be constructed on a private right-of-way, part of which was given to the company. The cars will be of the most improved type, heated with electricity and equipped with telephones and air brakes. They will make the 82 miles from Rochester to Syracuse in two hours and 25 minutes. The power house will cost nearly $500,000 and will develop 8,000 horsepower. It will probably be located in Clyde, Lyons or Newark. O. J. Coughlin of Rochester is the purchasing agent.

POWER TRANSMISSION.

The Oregon Power and Transmission Company of Canyon City, Ore., is contemplating the construction of a large power plant on Strawberry Lake, Ore. W. McNaughton of San Francisco is strenuously disputing the company's right.

The Toronto and Niagara Power Company has decided to use steel towers on its transmission line from Niagara Falls, Ont., to Toronto, instead of wooden poles. The towers will be eight or 10 feet square at the base and about 50 feet high. They will be placed at intervals of about 400 feet.

Material is being shipped to Lake Isabel, 32 miles east of Everett, Wash., for the early beginning of work on what is known as the May Creek power plant, by the Everett Railway and Electric Company. The plant is designed to furnish 15,000 horsepower, to be carried to Everett for the street railway, public lighting and private power, as well as for the Everett-Snohomish interurban line of 12 miles, and later to supply other interurban trolley lines which this company will build. The cost of the plant will be about $600,000, and it will take the place of a fine steam plant built two years ago.

The Ellwood Power Company has completed its plant at Ellwood, Pa. It is expected that the plant will be one of a series that will be erected on the swift Counoquenessing River. The dam is 25 feet high, 40 feet wide at the base and 175 feet in length, between abutments. The power is developed by three turbine wheels, aggregating about 1,500 horsepower. The present steam-power requirements within a short distance of the plant are about 2,500 horsepower, and the prospect is that these requirements will, in the near future, be much enlarged. The steam plant, which is now supplying power to light the town, will shortly be put out of service by the cheaper power to be furnished by the power company, the contract having been signed.

MISCELLANEOUS.

The application of the Instantaneous Fire Alarm Company for a franchise to connect its auxiliary fire alarm with the system maintained by the city and to operate a district-telegraph, burglar and police-alarm system, in connection therewith, has been granted by the City Council of Seattle, Wash.

A highly ingenious typewriter, in which all the work is done by an electrical current from an ordinary incandescent-lamp circuit, is exhibited in New York city. The only thing that the operator has to do is to insert the paper and touch the keys. All other operations can be performed without taking the hands from the keyboard.

Artificial rubber, now that the natural sources of supply seem to be rapidly nearing exhaustion, is one of the problems which is attracting the attention of inventors. Myron G. Brownell of Denver, Colo., has recently patented a compound for this purpose which consists of the gummy particles contained in the plant picradema floribunda utilis, separated and agglomerated into a coherent mass. This substance, though insoluble in water, is soluble in light hydrocarbons, such as gasoline.

The army appropriation bill, as it passed the Senate, carries with it the following appropriations for electrical work, etc.: For purchase of special apparatus and for experimental purposes of the department of electricity and mechanism at Fort Totten, N. Y., $2,000; for purchase of special apparatus for electrician sergeants' division, school of submarine defense at Fort Totten, N. Y., $3,000; for expenses of the Signal Service, including purchase, equipment and repair of field electric telegraph, telephone apparatus (exclusive of exchange service) and maintenance of the same, electrical installations and maintenance at military posts, maintenance and repair of military telegraph lines and cables, $208,500; for completing the purchase, installation and operation of a submarine military cable from Sitka, Alaska, to Fort Liscum, Alaska, $321,580; for 25 master electricians, at $900 each and 100 electrician sergeants at $408 each, for artillery corps, $63,300; for 36 master signal electricians for Signal Corps at $900 each, $32,400.

Millis Knickerbocker of New Lenox, Ill., describes an interesting experiment which he made several years ago, before the radium craze had seized upon the scientific world. A sensitive plate was placed in a box which admitted no light rays. On the box was placed one-half of an onion, under a teacup, and left in that position during the night. On developing the plate a fine photograph of the onion was discovered, showing plainly the concentric rings. The question naturally arises: If several tons of onion juice were to be condensed, might not some uranium be obtained?

PUBLICATIONS.

The Railway and Electric Equipment Company, which has offices in Philadelphia, Chicago, Buffalo, Pittsburg and Cleveland is sending out a list of the second-hand apparatus which it now has in stock, including all sorts of electrical machinery and apparatus. The list is divided into two parts, one for electrical machinery and the other for railway equipment.

A small booklet from McLeod, Ward & Co. of New York, describes the company's Kinsman reflectors, which may be used for a variety of purposes from lighting a typewriter keyboard to illuminating an oil painting. The latest types known as the Kinsman "lamps" contain an incandescent lamp in a cylindrical glass casing, the reflector being mounted above the casing.

The 1904 catalogue of the Brown & Sharpe Manufacturing Company of Providence, R. I., is a thorough revision of the previous one and contains 482 pages. The new matter, together with the changes in the old, makes it especially desirable that this should replace former editions. The large number of tables contained, together with other general information, make it very valuable to the workman as a book of reference. The principal additions this year to the various lines of machines and tools are given in a colored insert. This catalogue is mailed upon application to any address without charge or is furnished by hardware and supply dealers.

One of the most handsome of this year's calendars comes from the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y. The design, which is a genuine photo print, represents a beautiful young lady in party attire, listening to what is evidently an interesting message coming over the telephone. At the side of the photograph is a red rose, presumably to suggest that the subject is "the sweetest flower of them all." The company is forwarding these calendars to managers of telephone companies at a nominal fee, this method of distribution being preferred, as the supply is limited.

Beginning with the April issue the name of the Index of the Technical Press, published in Brussels, Belgium, will be changed to the Engineering Press Monthly Index-Review. In the future the size of the page will be nearly doubled. In addition to about 2,000 résumés monthly, the index will contain a review of the engineering questions of the month as well as extended notices or summaries of the most remarkable articles and papers of the month, appropriately illustrated—it will, in short, be a review of reviews of the engineering press. The arrangement of the various abstracts in the index will be considerably improved upon with a view to facilitating reference.

Five new bulletins from the Emerson Electric Manufacturing Company of St. Louis cover a number of distinct applications of motor drive to a variety of machines manufactured by the company. Bulletin No. 3045 describes an alternating-current motor coupled to a direct-current generator for storage-battery charging and electroplating. These sets are of 50 and 100 kilowatts capacity. An application of motor drive to a light bench drill suitable for jobbing shops and manufacturing purposes within the range of the tool is illustrated in bulletin 3048. Emerson motor driven air pumps, for barber shops, dentists' offices, laboratories, etc., are representative of the company's latest developments in that particular line. These sets are attractively finished and make a handsome fixture for any office. They are described in bulletin No. 3009. Bulletin 3050 (replacing 3018 and 3022) contains information on electric pumps for shallow and deep wells. They are of the triplex type, geared to direct-current motors of from one-quarter to two horsepower. The last of the set of bulletins, No. 3051, is descriptive of forge and volume blowers. The motors are mounted directly on the end of the shaft in these sets, and the combination makes a very compact and substantial-appearing unit.

TRADE NEWS.

The supervising architect, Washington, D. C., will receive bids until March 30th for furnishing miscellaneous machinery complete in place for the Chicago Postoffice building, in accordance with drawings and specifications on file with the superintendent at Chicago.

Keller, Pike & Co. of Philadelphia, electrical contractors and engineers, have opened an office in Baltimore at 211 North Calvert Street. This office will be in charge of Mr. John S. Dobler of Baltimore, whose training, experience and connections especially fit him for this position.

Application will be made in the ensuing session of Parliament for a bill empowering the town of Torquay, England, to construct electric tramways. It is suggested by United States Consul J. G. Stephens at Plymouth, England, that American manufacturers

communicate with both the town clerk of Torquay and the Dolton Electric Traction Company with the view of securing contracts to supply electrical equipments.

A. C. Bunce, formerly with the General Electric Company in northwestern territory, has been placed in charge of the office of the Electrical Appliance Company of Cincinnati, Ohio, manufacturer of Churcher alternating rectifiers, interior telephone systems, aqua-phones, storage batteries, etc.

William D. Ray has severed his connection with the Westinghouse Traction Brake Company as Central States representative and will enter the steam specialty market. He will represent several well-known manufacturers in the sale of high-grade steam specialties, with offices at 312 Electricity Building, Cleveland, Ohio.

The Indiana Rubber and Insulated Wire Company of Marion, Ind., has just finished shipments to four foreign countries and has other orders to be sent abroad. The first of the recent orders was for 200,000 feet of telephone cable, which was shipped to Yokohama, Japan; the second for one ton of rubber ton of tape to Paris, France.

Sealed proposals will be received at the office of the supervising architect, Washington, D. C., until April 12th for the construction, including heating apparatus, electric wiring and conduits, of the post-office at Richmond, Ind. Drawings and specifications may be had of the postmaster at Richmond, Ind., or of J. K. Taylor, supervising architect.

At the adjourned meeting of the creditors of the Michigan Electric Company there were present or represented creditors whose claims aggregate the sum of $44,076.97, out of a total indebtedness of $59,506.09. The committee appointed at the meeting of February 25th submitted its estimate of the value of the assets of the electric company, which showed a total of $23,244.61. After some discussion as to the best course to be pursued, action was taken directing and authorizing the receiver, with the committee of creditors heretofore named as an advisory board, to dispose of the assets of the electric company as speedily as possible, in such manner as they shall determine to be for the best interests of the creditors.

F. H. Wheeler has recently resigned his position as chief engineer of the Imperial Finance and Construction Company of Toledo, Ohio, and has reopened his old office at 705 Plymouth Building, Chicago, where he will conduct the business of the Wheeler Electrical Construction Company. Mr. Wheeler has been engaged in constructing electric-light and power plants and telephone exchanges for a number of years, and says that he has a number of contracts in the West.

The National Electric Company of Milwaukee, successor to the Christensen Engineering Company, manufacturer of air brakes and electrical machinery, has recently moved its executive offices and engineering department to its new building located at the works. The building is constructed of cement blocks two feet long by one foot high and is 200 feet long by 66½ feet wide. Extensions and improvements are also being made in the company's shops to supply the necessary facilities for handling a constantly increasing business.

In August last the United States Circuit Court in Philadelphia sustained the Lange lamp-socket patent No. 434,153 and granted an injunction against the defendants in the suit of the Bryant Electric Company against J. F. Buchanan & Co., selling the New England sockets. The New England Company, which defended the suit, took an appeal to the United States Circuit Court of Appeals for the Third Circuit. That appellate court has now handed down an opinion affirming the decree of the court below, sustaining the patent and granting an injunction. This Lange patent covers the mode of fastening the cap, shell and insulation together.

BUSINESS.

The H. W. Johns-Manville Company of New York has placed on the market a new fireproofing material known as Ceilinite, which is designed especially for fireproofing the ceilings of electric cars. It is made from specially prepared asbestos in pieces one-eighth to three-eighths of an inch thick, 36 inches wide and 50 feet long.

The Electric Appliance Company of Chicago, selling agent for Zenith lamps, is sending out a handsome descriptive catalogue of these lamps to all who failed to receive one on the first distribution.

The Central Electric Company of Chicago announces that it has a large stock of Diehl electric fan motors. The company sold these fan motors throughout 1903 and is authority for the statement that they gave entire satisfaction. With a full stock for 1904 it naturally anticipates increased sales, and requests that all prospective customers write for prices.

The International Telephone Manufacturing Company of Chicago is reported to have recently practically doubled its manufacturing plant by adding new machinery, including a number of large drill presses and full automatic Brown & Sharpe screw machines. The company is said to have a heavy demand for its improved self-restoring drop express switchboard and long-distance telephones, as well as central-energy apparatus.

General Manager John Speer, of the Speer Carbon Company, St. Mary's, Pa., made a two-day stay in Chicago this week. Mr. Speer is on his usual somewhat extensive trip, which he makes several times a year, this time visiting Pittsburg, Chicago and Cincinnati. He reports an extraordinarily good year's business for the Speer Carbon Company for 1903. Under the management of Mr. Speer the company has always kept up to the times in the matter of machinery and modern business methods. In addition to being heavily interested in this extensive carbon-brush manufacturing plant, Mr. Speer is also a large stockholder in the electric-lighting station at St. Mary's, to say nothing of his being manager of and holding a large interest in the St. Mary's Opera House. The electric-lighting plant is directly under Mr. Speer's management.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) March 8, 1904.

753,839. Trolley-wire Finder. William Barnhurst, Dallas, Texas. Application filed June 1, 1903.

A bracket or housing is fastened to a trolley pole or trolley harp by means of pins or bolts, the bracket containing a grooved rope pulley or sheave carrying hinged forks for guiding the trolley wheel to the wire.

753,863. Wireless Signaling. Reginald A. Fessenden, Manteo, N. C., assignor to the National Electric Signaling Company, Pittsburg, Pa. Application filed September 28, 1901.

As an improvement in the art of signaling by electromagnetic waves, the method described consists in the practically continuous transmission and reception of electromagnetic waves or impulses, and the modification of the character of such waves or impulses without interrupting their continuity.

753,864. Signaling by Electromagnetic Waves. Reginald A. Fessenden, Fortress Monroe, Va., assignor to the National Electric Signaling Company, Pittsburg, Pa. Application filed October 1, 1903.

A laterally extending conductor consists of a series of wires adapted to radiate electromagnetic waves and having its capacity relatively much larger than that of a vertical wire of the same height. An inductance is connected between the laterally extended portion and the ground.

753,866. Brush-holder for Electrical Machines. William H. Foot, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed June 24, 1903.

The brushes are held in position by springs, each mounted on a shaft which tends to revolve and produce pressure downward upon the springs and press the brush upon the commutator, this tendency being regulated by a coil spring attached to the shaft and adjusted by a thumb screw.

753,872. Electric Printing Machine. George S. Gallagher, New York, N. Y., assignor to himself, Rupert L. Joseph and Frank E. Burrows, New York, N. Y. Application filed April 29, 1903.

Two electromagnets are required in the device, one to actuate the hammer striking the type and the other actuating a pawl controlling the movement of the type wheel.

753,875. Electrical Manufacture of Iron Alloys. Gustave Gin, Paris, France. Application filed July 7, 1902.

A process of electrically producing an alloy of iron with simultaneous production of oxides of alkalies, consists in mixing a silicic acid with the sulphate of the alkali, adding carbon to the mixture, heating the same in an electric furnace with the production of the silicate of the alkali, then introducing this alkali silicate into a second furnace, adding an oxide of iron and carbon. The process further consists in heating the mixture with the production of ferrosilicon and oxide of the alkali, and collecting the oxide of the alkali in the form of a sublimate.

753,879. Electromagnet. Willis D. Gregory, Pittsburg, Pa. Application filed April 9, 1903.

Combined with a movable armature in the electromagnet is a fixed core structurally interrupted in one or more planes transverse of the direction of magnetic lines, the portions or sections of the core being in permanent relationship to each other.

753,881. Electric Snap Switch. Gerald W. Hart, West Hartford, Conn., assignor to the Hart Manufacturing Company, Hartford, Conn. Application filed April 18, 1903.

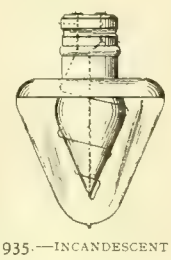
The base of the switch carries contacts which are made and broken by means of a device carried upon a rotary member mounted on a spindle.

753,903. Toll Apparatus for Telephone Exchanges. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed May 9, 1902.

A toll device for a telephone line is operated by a manual key and mechanism controlled thereby. An electromagnetic lock prevents the actuation of the toll device. An electric circuit for the lock and a switch controlling the circuit, automatically actuated at the switchboard in the course of a connection between the line having the toll device and another line, are the salient features.

753,916. Shunt Resistance. George W. Richmond, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed July 10, 1903.

A strip of suitable resistance material is made of zigzag portions, the lengths of which are spaced in pairs. A short-circuiting, clamping device is supplied for each pair of the lengths, while several pairs of supporting and spacing blocks therefor, composed of non-conducting material and having a number of grooves in their edges into which the edges of the resistance strip fit, complete the arrangement.



NO. 753,935.—INCANDESCENT LAMP.

753,918. Polarized Relay. Malcolm C. Rorty, Boston, Mass., assignor to the American Telephone and Telegraph Company, New York, N. Y. Application filed June 18, 1903.

A permanent polarizing magnet is mounted parallel to the limbs of an electromagnet and has its poles in juxtaposition to the heel and poles respectively of the electromagnet. Contact springs are mounted upon the permanent magnet; an armature is suspended between the confronting poles of the electromagnet and poised or fulcrumed on the permanent-magnet pole, having an attachment extending backward over the permanent magnet. The armature and attachment constitute a lever actuated by the electromagnet and adapted to engage the contact springs for the control of their reciprocal relation.

753,925. Electric-railway Motor. Robert Siegfried, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed May 2, 1903.

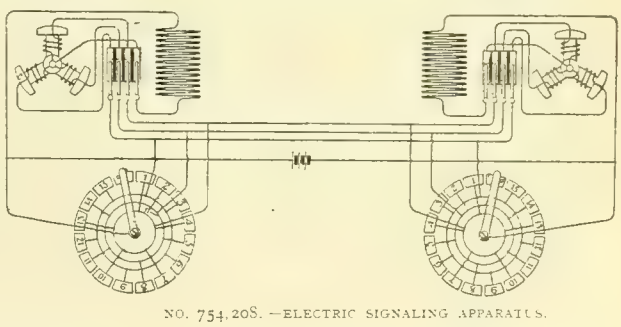
Two electric motors have their outer ends journaled upon the axles of the car truck. Substantially vertical suspension rods have their lower ends respectively attached to the inner ends of the motors, the upper ends of which are attached to a suspension bar. Springs are interposed between the suspension rods and the bar.

753,927. Switching Apparatus for Telephone Exchanges. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed March 10, 1902.

In the system described an induction device divides the plug circuit; a battery is placed in bridge with the conductors leading to the answering plug. An electromagnetic switch controls the connection of the battery with the conductors leading to the calling plug, and a local circuit for the electromagnetic switch is operatively established in registering contacts of the calling plug and the spring jack of any of the lines of one of the types of telephone lines which may enter the exchange.

753,935. Incandescent Electric Lamp. Herbert M. Taylor, Hamilton, Canada. Application filed September 2, 1902.

The lamp is provided with a globe having a neck and a curved shoulder, the latter being provided with a reflecting material upon its outer surface. A glass cone is disposed centrally within the globe and provided with an interior coating of reflecting material, the cone and globe being fused together. A leading-in wire passes axially downward through the cone and a filament is wound spirally outside the cone within the globe and connected with the tip of the wire. A wire connects with the filament and is held between the fused uniting surfaces of the cone and globe. (See cut.)



NO. 754,208.—ELECTRIC SIGNALING APPARATUS.

753,944. Transformer Case. William L. Waters, Milwaukee, Wis. Application filed March 5, 1903.

An inclosing shell of heat-conducting material, contains tubular openings extending through the material of the shell having no communication with the interior of the inclosing shell.

753,954. Electric Machine. Niels A. Christensen, Milwaukee, Wis. Application filed May 8, 1901.

A casing forms an inclosed shaft chamber, a shaft operating in the chamber. A gear on the shaft within the chamber, driven by an electric machine, is placed laterally of and in the same horizontal plane as the chamber. The electric machine has an armature shaft extending through a side wall of the casing, [illegible] on the armature shaft meshes with the gear.

753,956. Relay. H. P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company, New York, N. Y. Application filed April 1, 1901.

Combined with an electromagnet [illegible] the magnet with a spring [illegible]

armature normally open, a portion of the spring being also adapted to serve as a flexible circuit-closing contact. A stationary contact engages and bends the spring contact away from the armature when the latter moves toward the magnet.

754,005. Fire-alarm or Temperature Annunciator. John A. Olson, Minneapolis, Minn., assignor to the Temperature Annunciator Company. Application filed August 3, 1903.

A pointer moving over a dial is actuated by the expansion of a thermostatic device. Upon moving a certain distance over the dial the pointer makes contact, closing an electrical circuit and ringing an alarm bell.

754,011. Commutator for Telephonic or Other Circuits. Carl H. Prött, Rheydt, Germany. Application filed June 14, 1902.

A series of telephone or other electric stations is connected with a main station which controls communication between a central or other additional station and any station in the series. Each station in the series is provided with a communicating device capable of taking any one of three circuit-controlling positions. One of the positions leaves the apparatus normal and inactive, another position makes an operative circuit between one of the stations and the central station and the third position makes an operative circuit between any two stations of the series, the conductors being arranged to leave inactive the stations of the series which are not in speaking or other active circuit.

754,020. Electric Apparatus for Measuring and Recording Intervals of Time. Calvin J. Springer, Somerville, Mass. Application filed June 27, 1903.

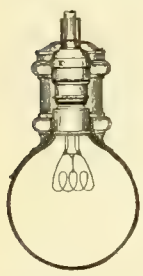
A time train is adapted to be actuated by an electromagnet whose circuit is controlled by a clock-work mechanism.

754,038. Governing Mechanism. Philip De C. Ball, St. Louis, Mo., and Charles L. Wakefield, Dallas, Texas. Application filed March 26, 1902.

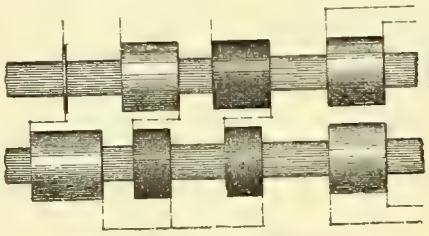
A rock shaft controlling the position of the brushes of a line of motors is operated by a centrifugal governor, thus regulating the voltage of the machine.

754,075. Gas Burner. William Kohn, Brooklyn, N. Y. Application filed July 6, 1903.

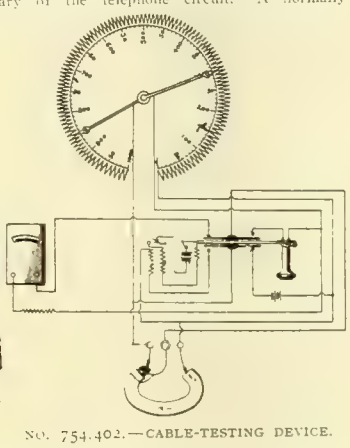
The act of turning on the gas closes an electric circuit



NO. 754,251.—INCANDESCENT LAMP.



NO. 754,371.—TRANSFORMER.



NO. 754,402.—CABLE-TESTING DEVICE.

which heats a platinum wire, lighting the gas. As the heat of the gas jet increases a thermostatic device operates automatically to open the circuit.

754,081. Battery Stopper. Albert Müller, New York, N. Y. Application filed October 24, 1903.

A stopper in the top of a battery vessel is provided with a funnel-like mouth and with an imperforate bottom, and inlet and outlet ports leading from the mouth to the interior of the battery vessel above the imperforate bottom of the stopper.

754,111. Junction Box for Electric Wires in Buildings. Boyd W. Allen, Boston, Mass. Application filed December 12, 1903.

The rear wall of the junction box is made of insulating material, whose peripheral edge is curved in cross-section. The metallic main portion or case is provided with a concavo-convex extension holding the wall in engagement. And there is also a nipple whose main portion is embedded in and beneath the surface of the wall, and whose forward portion is extended through the wall for engagement with the bracket or fixture.

754,123. Insulator Pin. James H. Bullard, Springfield, Mass. Application filed October 26, 1903.

A metal insulator pin comprises a series of webs disposed at an angle one to the other and united along their meeting lines. At or near the upper end are channels through which a plastic material may be poured, together with a stem-piece into which the lower ends of the webs merge. A bolt is located longitudinally of the stem-piece to secure the pin to its support.

754,124. Electric Motor. David P. Burdon, Jacksonville, Fla., assignor of two-thirds to Samuel P. Holmes and Gustave Muller, Jacksonville, Fla. Application filed July 13, 1903.

In an oscillatory motor is a rock shaft, an armature magnet carried by the shaft, a field magnet co-acting with the armature magnet, one of the magnets being an electromagnet, and a rotary shaft operated by crank arm and pitman upon the rock shaft.

754,127. Switch for Overhead-trolley Tracks. Walter L. Clark, Everett, Mass., assignor to J. Duncan & Co., Boston, Mass. Application filed December 24, 1903.

A switch for trolley tracks comprises a switch bracket adapted to be rigidly attached to a main rail opposite a cut-out portion of the rail. Two switch sections are each provided with switch rails and structurally or integrally combined to form a single-piece switchframe.

754,133. System of Alternating-current Distribution. Edwin R. Gill, New York, N. Y., assignor to the Invention Developing Company. Application filed September 5, 1900.

As a means for producing auxiliary current waves out of phase with an original single-phase current in a main circuit, there is supplied an auxiliary circuit having a self-induction approximately equal to that of the main circuit. A condenser and means for alternately charging the condenser from the main circuit during rise of potential in the circuit, and discharging the condenser into the auxiliary circuit, whereby the main and auxiliary circuits are made to carry periodic currents of different phases and common periodicity are the main feature of the invention.

754,147. Apparatus for Electrical Production of Nitrogen or Other Compounds. Josef von Kowalski and Ignaz Moscicki, Freiburg, Switzerland. Application filed February 21, 1903.

Consumption branches of a main circuit are arranged in parallel and in groups with means for supplying alternating current to the circuit. A pair of electrodes, a condenser and an inductance coil are arranged in series in each consumption branch, and a group inductance coil is in series with each group of consumption branches.

754,152. Signaling Apparatus. Otto Lüddeckens, Breslau, Germany. Application filed February 21, 1903.

Signal-receiving devices are located one at each signal station, and a number of signal-transmitting devices are located one at each station except one, each transmitting device being arranged to actuate all of the signal-receiving devices. An auxiliary signal-receiving device located at the station which has no signal-transmitting device, and an auxiliary signal-transmitting device located at one of the remaining stations and arranged to operate the auxiliary signal-receiving device are the remaining essential parts.

754,208. Electric Signal. Joseph E. Feller, Brooklyn, N. Y. Application filed April 24, 1902.

An electric motor is provided with a revoluble armature having a number of separate poles with conducting wires separately connected with the poles for energizing them one at a time. A transmitter is provided with circularly disposed contacts connected separately with the conducting wires. Manually-operated mechanism energizes the contacts one at a time. (See cut on the preceding page.)

754,211. Telephone or Telegraph System. Thomas W. Gleeson, Boston, and Robert Hamilton, Milton, Mass. Application filed May 1, 1903.

A number of switch-controlling motors are placed in the main line, one at each station between the ends of the secondary of the telephone circuit. A normally closed switch at each station is arranged in the main line between the ends of the secondary, while there is a normally open switch in each secondary. A condenser in each secondary enables the operator at any one of the stations to operate the motors to close the normally open switch of any one of the other stations and open the normally closed switch of that station, and to close the secondary circuit of his own station.

754,224. Telephone Repeater and System. Samuel P. Levenberg, New York, N. Y. Application filed April 24, 1903.

In a telephone repeater is a variable-resistance transmitter, an electromagnet included in a shunt from one of the leads of the variable-resistance transmitter, a vibrating diaphragm mounted adjacent the magnet, and means for controlling one of the electrodes of the transmitter in accordance with the vibrations of the diaphragm.

754,235. Extension Fixture for Incandescent Electric Lamps. Conrad M. Pitel, Meriden, Conn. Application filed May 6, 1903.

In an extension fixture for incandescent electric lamps are combined a frame, a drum located therein, electric connections, flexible electric conductors wound upon the drum, and means for electrically connecting the respective electric connections and flexible conductors.

754,251. Electric Lamp. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 6, 1903.

A spherical globe has the major portion of its surface frosted. A spherical reflector is placed so as to cover the unfrosted portion of the globe as well as the dividing line between the frosted and unfrosted portions. (See cut.)

754,261. Ozonizer. Alexander Vosmaer, Nieuwersluis, Amsterdam, and Adriaan Lebret, Utrecht, Netherlands, assignors to Ozon Maatschappy, Systeem A. Vosmaer, Amsterdam, Netherlands. Application filed September 11, 1902.

In the ozonizing apparatus is a transformer. A condenser is mounted in shunt in the secondary of the transformer and choking-coils are joined to the terminals of the secondary circuit of the transformer between the secondary circuit of the transformer and the shunt of the condenser.

754,286. Sparker. Frank Dickinson, Springport, Mich. Application filed June 15, 1903.

A plate carries both electrodes, and a push rod actuates the movable electrode. An adjustable slide mounted on the plate guides the rod.

754,291. Magnetic Clutch. Arthur C. Eastwood, Cleveland, Ohio. Application filed January 26, 1904.

A magnetic clutch includes two revolubly supported members, each having a series of rings fixed to it with a stationary coil placed to act on the rings to operatively couple the members.

754,362. Railway Signaling System. Henry Bezer, Westfield, N. J. Application filed October 16, 1901.

The clutch actuating the signaling means is held in check by an armature. When the armature is drawn up by its electromagnet the signal lever on the clutch is released and is actuated by a weight to display the required signal.

754,363. Railway Signaling System. Henry Bezer, Westfield, N. J. Original application filed October 16, 1901. Divided and this application filed February 4, 1903.

Non-polarized electric translating means control the danger signal. Conductors of a single circuit extend from the translating means along a railway line to a point in rear of the traffic-controlling means. Other conductors of a single circuit extend rearwardly from such point in rear of the traffic-controlling means to a point farther in rear, the conductors of single circuits comprising all of the means of electric intercommunication from point to point along the railway line and the translating means being responsive to control from the conductors last mentioned.

754,371. Alternating-current Transformation. Maurice Hutin and Maurice Leblanc, Paris, France, assignors to George Westinghouse, Pittsburg, Pa. Application filed April 3, 1895.

The method of generating electrical energy consists in producing two separate alternating magnetic fluxes in quadrature, and generating by the inductive influence of these fluxes three or more alternating working currents, dephased with reference to each other. (See cut.)

754,372. System of Alternating-current Transformation. Maurice Hutin and Maurice Leblanc, Paris, France, assignors to George Westinghouse, Pittsburg, Pa. Original application filed April 3, 1895. Divided and this application filed November 19, 1903.

An apparatus for generating two separate alternating magnetic fluxes in quadrature, by multiphase alternating currents, and vice versa, consists of two inductional transformers, each having as many coils as there are multiphase currents used or generated, the number of windings of the coils being graduated for one transformer in the ratio of the sines of the lags of the currents which traverse them, and for the other transformer in the ratio of the co-sines of the same lags, the homologous coils being connected in series.

754,378. Electric Switch. Norman Marshall, Newton, Mass., assignor to the Marshall Sanders Company, Boston, Mass. Application filed June 27, 1903.

The spindle contacts in the switch are moved by a spring.

754,379. Electric Switch. Norman Marshall, Newton, Mass., assignor to the Marshall Sanders Company, Boston, Mass. Application filed October 6, 1903.

A snap switch is described having cam surfaces for making contact.

754,380. Electric Switch. Norman Marshall, Newton, Mass., assignor to the Marshall Sanders Company, Boston, Mass. Application filed October 6, 1903.

Details are described.

754,397. Electric Clock. George S. Tiffany, Brooklyn, N. Y., assignor of one-half to James Van Inwagen, Chicago, Ill. Application filed November 30, 1901.

An electromagnet operates the clock-train mechanism.

754,400. Vertical Fluid-pressure Turbine. George Westinghouse, Pittsburg, Pa., assignor to the Westinghouse Machine Company, Pittsburg, Pa. Application filed June 24, 1903.

Combined with a vertical steam turbine is a dynamo supported and driven thereby, with means for applying an upwardly acting fluid pressure to the moving parts, independently of the shaft bearing, of such degrees as to wholly or largely relieve the shaft bearing from the weight of the parts.

754,402. Fault Locator for Electric Cables. Daniel E. Wiseman, Spokane, Wash. Application filed August 3, 1903.

The essential features are a resistance, a movable contact, the movable contact and the other end of the resistance being adapted to be connected respectively with the terminals of the faulty conductor of the cable. The contact is adapted to be adjusted along a scale to bring into the circuit a member of units of resistance corresponding to the units of length of the cable. A second movable contact is adapted to be adjusted along the operative resistance. A Wheatstone-bridge circuit on either side of the contact forms two ratio arms, the portions of the cable conductor on either side of the fault forming the other arms. A galvanometer, a telephone instrument, a telephone switch, etc., make up the apparatus. (See cut.)

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on March 15, 1904:

359,248. Positive Pole Plate for Secondary Batteries or Accumulators. Stefan Farbaky and Stefan Schenek, Schemnitz, Austria-Hungary.

359,260. Combined Push-Button and Thermostat. Frederick Keffer and John A. McDowell, Columbus, O.

359,306. Return Attachment for Telephone Toll-Collectors. Charles Wittenberg, Indianapolis, Ind.

359,307. Telephone Register. Charles Wittenberg, Indianapolis, Ind.

359,308. Telephone Register. Charles Wittenberg, Indianapolis, Ind.

359,309. Electric Bell. Frank B. Wood, New York, N. Y.

359,328. Electric Lamp. Carl Seel, Charlottenburg, Germany.

359,338. Apparatus for Testing Electric Circuits. Alben D. Wheeler, Hyde Park, Mass.

359,356. Telephone Switch. Charles A. Hitchcock, North East, Pa.

359,392. Electrical Apparatus for Regulating Temperature. Charles W. Johnson, Holyoke, Mass.

359,429. Electric Motor. Ernest P. Clark, New York, N. Y.

359,456. Carrier for Electropneumatic Dispatch-tube Systems. Jas. F. McLaughlin, Philadelphia, Pa.

359,492. Telephone Cabinet. Charles Balloch, New York, N. Y.

359,540. Electrical Pneumatic Dispatch Tube. James F. McLaughlin, Philadelphia, Pa.

359,552. Electric Igniter for Gas Engines. Norman C. Bassett, Chicago, Ill.

359,575. Police Telegraph System. Jacob F. Mehren and William Carroll, Chicago, Ill.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, MARCH 26, 1904 No. 13

Extending the Hydro-electric Plant at Garvins Falls, N. H.

One of the most extensive engineering works at present under way in New England is the construction of a new masonry dam across the Merrimac River at Garvins Falls, N. H., and the enlargement of the canal and power house. This work, which would be a big job under any conditions, has been doubly so during the last three months, with the temperature running as low as 35 degrees below zero some nights and with comparatively few nights when it stood above zero. The average temperature for February, day and night, was 15.6 degrees above zero.

Accompanying the cold has been an unprecedented fall of snow and high winds, which have made outdoor work very difficult. It has been necessary to mix cement with hot water, to warm the surface of all large stones, and to cover all new work at night and keep steam on it.

Since the beginning of operations last June there has been a great deal of anxiety to get the work so far along that this spring's freshets cannot damage it, and the engineers are to be congratulated that their efforts have been successful, and while high water will stop work for a few weeks, no danger is anticipated to work already in.

One of the views accompanying this article indicates the "Klondike" conditions under which the work has been done; the men engaged on the job never expect to encounter anything more severe.

A brief description of the work may be of interest to readers of the Western Electrician. The dam, including the headgate wall of the canal (which is nearly in line with the dam and the opposite abutments), is about 800 feet long, with a spillway 550 feet long. At one end 75 feet is two feet higher than the rest of the spillway. This will be uncovered at low water and will afford more relief at time of freshet. The dam is 30 feet high, with a base of 35 feet.

The bed of the river is all rock at this place, and has been blasted down to solid ledge. In this ledge has been cut a channel the width of the dam, about four feet deep, and the masonry was begun in this channel. This will effectually prevent any underleakage or any tendency to displacement.

Cut-granite facings with hearting of rubble laid in Portland cement have been used, and approximately 20,000 cubic yards of masonry will be built.

About 20,000 yards of excavating was necessary for the canal, and part of this was a good grade of stone for the hearting of the dam. An excellent grade of sand for mortar was also found on the property near by.

Every carload of cement has undergone severe tests of 24 hours and of seven and 28 days. The headgate wall and abutments are concrete and rubble-concrete. Complete stone-crushing and concrete-mixing plants are a part of the construction outfit. Fourteen steam derricks and 17 steam drills have been in operation at one time.

The canal, as enlarged, will carry the entire flow of the river at low stages and is of exceptional strength. The station, when completed, will stand entirely across the end of the canal and is being enlarged to double its present capacity. It will be equipped with Rodney Hunt horizontal turbines, directly connected to General Electric three-phase generators. Six thousand horsepower will be generated and will all be used by the Manchester Traction, Light and Power Company, which controls the electrical interests of Manchester, N. H.—street railways, lighting and power—and supplies current for a portion of the Concord and Manchester electric branch of the Boston and Maine Railroad.

The Garvins Falls plant is one of five generating stations of the Traction company and will be one of the best equipped plants in New England. Hubbard & French of Boston, consulting engineers, designed the entire hydraulic plant and George G. Shedd, C. E., has been engineer in charge since its inception. Holbrook, Cabot & Rollins, also of Boston, are the contractors, with J. B. Haviland as superintendent. The Western Electrician wishes to acknowledge the courtesies shown its correspondent by Mr. Shedd.

A. B. C.

Sand-bag Coffer Dam, Showing Old Dam in the Distance. Headgates from Canal.

Excavating the Canal View Showing Winter Work.

EXTENDING THE HYDRO-ELECTRIC PLANT AT GARVINS FALLS, NEW HAMPSHIRE.

Three-phase Motors for Shipyards.

J. A. Anderson recently read a paper before the Newcastle local section of the Institution of Electrical Engineers, in which he gave details as to the applicability of three-phase motors for driving machinery in shipyards. For ordinary work he recommends that squirrel-cage motors should be used, although such motors take 2½ times the normal current to give normal torque at starting. They are, however, cheap, and the wiring is relatively simple. For driving cranes, he said, the slip-ring motor is necessary, as, while a 10-horsepower slip-ring motor easily works a three-ton shipyard winch, a squirrel-cage motor of the same horsepower could not start

with a load of more than 1,500 pounds. In one case brought forward by the author a 50 nominal horsepower Crossley gas engine driving a shipyard shed was successfully replaced by three-phase motors of 11 horsepower in the aggregate, with an annual saving in working expenses of about $240.

Robert McCulloch.

As stated in the Western Electrician last week, Capt. Robert McCulloch, since 1899 general manager of the Chicago City Railway Company, is to leave Chicago. Mr. McCulloch will change his place of residence to become vice-president and general manager of the St. Louis Transit Company. Having lived for many years in St. Louis, the announcement of his return to that city has brought to Mr. McCulloch a shower of letters and telegrams from prominent citizens, welcoming him back and congratulating the city on its acquisition.

Robert McCulloch was born in Virginia in 1841. He was a cadet at the Virginia Military Institute at the opening of the war and entered the service of the Confederacy from there. He became adjutant of the Eighteenth Virginia Infantry and afterward a captain of a company in this regiment. He was in all the important battles fought in Virginia, and was wounded five times, once while in Pickett's celebrated charge at the battle of Gettysburg. After the war he went to St. Louis, and entered the street-railway business in 1874 as secretary and manager of the Bellefontaine Railway Company. This was a small road and the captain directed everything, from the tracklaying to the bookkeeping.

ROBERT M'CULLOCH.

In 1887 a syndicate of Chicago capitalists bought the St. Louis Railroad, the Citizens' Railway and the Cass Avenue Railway, comprising what was at that time about one-third the street-railway mileage of the city of St. Louis, and consolidated these various properties into the National Railway Company. Captain McCulloch was selected as vice-president and general manager of this syndicate and remained in this position until 1899. During this time he converted the Broadway line into a cable road, the Citizens' and Cass Avenue lines into electric roads, and made various additions and extensions to these properties. The lines under his charge paid dividends during this entire period, and in 1899 were sold to the St. Louis Transit Company at a much higher figure than that at which the Chicago capitalists purchased them.

On September 1, 1899, Captain McCulloch left St. Louis to become the general manager of the Chicago City Railway Company, and has continued in that position until the present time. His connection with the Chicago City Railway Company has been a highly successful one. Under his management the receipts have increased from $5,000,000 to $6,500,000 a year. Extensions have been made and cars have been built which serve as models for heavy city rolling stock. A model shop plant has been erected and complete plans for the rehabilitation and re-equipping of the road under the new franchise have been made. Possibly owing to its prosperous condition, the Chicago City Railway Company has been in conflict with labor organizations during the last two years. The situation was handled by Captain McCulloch with firmness, however, and a strike of the trainmen in November, 1903, lasting two weeks, resulted in a victory for the company.

The placing of Captain McCulloch in charge of the St. Louis system at this time, when the perplexing problem of satisfactorily handling a great World's Fair traffic is confronting the company's officials and engineers, is a particular tribute to his ability. And probably no other man is better fitted to solve the problem. His former connections in St. Louis make him familiar with existing conditions, and this, together with the experience which must necessarily have come from successfully managing a large street-railway in Chicago, fit him admirably for the new position.

The name of Captain McCulloch's successor in Chicago has not been announced. Nor can it be said when the Chicago City Railway Company will proceed to develop the plans for rehabilitating its lines. Plans for a comprehensive, up-to-date electrical system were perfected during Mr. McCulloch's regime, but owing to the unsatisfactory franchise situation the money market is none too anxious for investments at the present time. The company has an excellent site at the corner of Thirty-ninth and Halsted Streets for the erection of a large central power house. The perfected plans for this station call for six 5,000-kilowatt generators.

In speaking of the street-railway situation in Chicago, Captain McCulloch expressed the belief that a subway for the downtown district and the more important feeder lines was not an impossibility, and this he believed was a feasible solution of the traffic congestion problem. He said that one of the main sources of annoyance to him as manager of the Chicago City system was the constant delays occasioned by teamsters.

Captain McCulloch's relations with the traction officials in Chicago have been such as to make his duties pleasant. Still it is not without a degree of pleasure that he anticipates his return to St. Louis. He will probably assume his new duties soon after the first of April.

Edison Storage-Battery Improvements.

Thomas A. Edison has recently patented two improvements upon his storage battery, one of which comprises a tray for holding a number of cells and the other a new form of insulator to separate the plates.

The first device consists of an improved tray arranged to carry and securely hold together a series of storage batteries, so that by assembling a number of such trays with their contained cells a complete outfit will be produced adapted particularly for use with automobiles. Although the improved tray has been designed especially for use with storage batteries of the type employing an alkaline electrolyte and a nickel-plated can or receptacle, the invention may be effectively utilized in connection with reversible galvanic cells of any desired type. The object is to provide a tray for securing and holding any desired number of cells, which shall at the same time be light and cheap, which adds but little to the bulk of the apparatus, and in which danger of short-circuiting through any moisture present from any cause is reduced to a minimum.

Fig. 1 shows a side elevation and a section of a

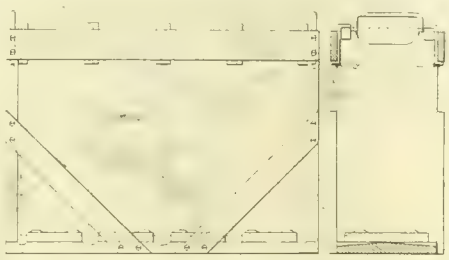


FIG. 1. EDISON STORAGE-BATTERY IMPROVEMENTS. TRAY FOR FOUR CELLS.

tray for holding four cells, showing the latter in dotted lines.

The base is provided with vertical ends suitably strengthened by braces. Connecting the ends at their tops are side braces practically forming a strong box with a solid bottom and ends, with an open top, and with substantially open sides. Secured to the bottom are blocks, each adapted to support one of the cells. On each side of the blocks are formed channels sloping from the center downwardly, as shown, so as immediately to carry off any water which may find its way to the bottom of the tray. The blocks are provided with studs (four being shown for each block), and the studs are made, preferably, of thin insulating material nailed or screwed in place. Resting upon each of the blocks is an insulating skirt provided with struck-up sockets for engaging the studs, and by reason of which engagement the skirts will be retained firmly in position on the blocks. The down-turned rim of each skirt therefore overhangs the blocks, and any moisture which may accumulate on the skirts will find its way to the bottom edge of the rim and drop or be shaken off without the possibility of permitting short-circuiting between the cells. The bottoms of the cells are formed with sockets or recesses engaging the studs on the skirt and formed by striking up the sockets, whereby the can at its bottom will be securely locked in position, however severe may be the use to which the device is put. At their upper ends the cans are locked in place by means of locks formed with a shoulder, fitting under the side brace, and with shoulders fitting over the tops of the cans. These locks are also provided with webs, which fit in between adjacent cans and electrically insulate them. The locks which are used at the corners are similarly constructed, except that the shoulders only extend to one side of the web. Below the web each of the locks is made somewhat thinner to form a shoulder, so as to prevent short-circuiting between the cans by the accumulation of moisture on the locks, since it will be noted that the cans are out of contact with the portion of each lock below the webs.

The tray in itself is light, strong and compact, and the several cells are rigidly and securely held in position. The best results are secured when the tray is formed of cypress, as this wood appears to be less affected by alkaline solutions. In order to increase the capacity of the wood to resist the decomposing and softening influences of strong alkalies it is preferabe to saturate the wood with paraffin or some other resisting hydrocarbon. The best way to apply the paraffin is to immerse the wood either

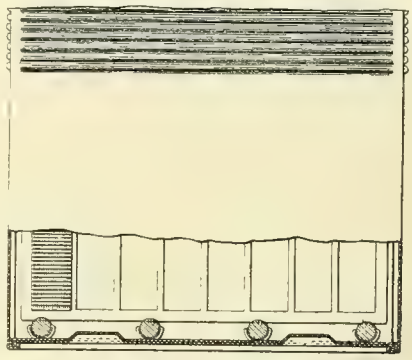


FIG. 2. EDISON STORAGE-BATTERY IMPROVEMENTS.—INSULATING SUPPORT.

in bulk or boards in a bath of paraffin maintained by heat in a molten condition and in the presence of a partial vacuum produced by a vacuum pump. Under these conditions the air within the cells of the wood appears to be withdrawn or is driven out by the heat and the molten paraffin enters to take its place, so that the wood becomes thoroughly saturated. If, on the other hand, the wood is merely dipped in molten paraffin the coating secured appears to be practically superficial and does not penetrate much within the surface.

The second invention of Mr. Edison has especial reference to the insulators which mechanically support and separate the electrodes and electrically insulate the electrodes from each other, as well as from the bottom and sides of the can or other receptacle. The object is to provide insulators or separators for this purpose which shall be cheap, light and effective, and at the same time be absolutely unaffected by electrolytic action in an alkaline solution.

Fig. 2 is a side view of a portion of one of the improved storage batteries, showing the bottom part in section to illustrate the insulating support. The can or receptacle is made, preferably, of thin sheet steel carefully nickel plated and with corrugated sides, as shown, so as to be very stiff and light, and inside of the can is inserted a lining of hard rubber or other insulating material in order to insulate the electrodes from the sides.

The electrodes are formed of plates carrying sectional corrugated perforated nickel-plated spring-steel pockets containing the active material. The bottom of the can is provided with struck-up bosses, which engage openings in a metal plate, also carefully nickel-plated, so as to be unaffected by electrolytic action. This plate rests on the bottom of the can. The plate is formed with ears, which engage the glass rods or tubes slightly above the center, so as to hold them firmly in place without, however, offering any surfaces upon which any active material might lodge. The electrode plates are supported on the rods or tubes, and the latter may be formed with slots or grooves, into which the bottom edges of the plates are received, so that the plates are properly spaced at their lower ends and transverse movement is consequently prevented.

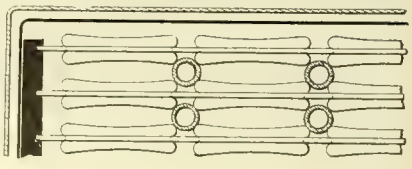


FIG. 3. EDISON STORAGE-BATTERY IMPROVEMENTS.—GLASS-TUBE INSULATORS.

In order to separate the plates mechanically and to insulate them electrically a series of glass tubes are employed, as shown in Fig. 3, and which extend longitudinally of the plates within the spaces formed between adjacent pockets. The separating rods preferably extend the entire length of the plates and rest at their lower ends on the bottom plate. In practice the use of glass insulators is said to make a light and cheap construction, while at the same time the insulators are absolutely unaffected by electrolytic action in the alkaline solution.

The Conductivity of the Atmosphere at High Voltages.[1]

By Harris J. Ryan.

From the work of Steinmetz it is known that:

a. The atmosphere and the gases generally, conduct after disruption in two forms.

1. Arcs or very hot streamers. A concentrated conduction at high-current density.

2. Corona or brush discharge. A diffused conduction at low-current density, developing heat at lower intensity.

b. 1. The dielectric strength of the atmosphere in bulk is such as to require for rupture approximately a pressure gradient of 100,000 sine wave effective volts per inch.

2. The thin zones of atmosphere that enclose the electrode and which are in immediate contact therewith have a far greater dielectric strength than air in bulk, corresponding to a ratio of dielectric strengths of from five to ten.

From the nature of sparkling discharges through air the conclusion is reasonable that whenever the flux of electric force, or more briefly the dielectric flux, through the air in a given state as to temperature, pressure, and freedom from foreign material, rises to a certain value an atomic structural rupture of the air will occur, resulting in conduction.

From Steinmetz's results it is evident that this maximum value of dielectric flux density at which atmospheric disruption will not occur will depend upon the position of the particular portion of the atmosphere being considered relative to the conductors or electrodes between which the high voltage is applied.

On alternating-current circuits, as long as none of the atmosphere in the neighborhood of high-voltage conductors is ruptured, transfer will occur only of capacity-charging current which is in leading quadrature with the voltage. However, as soon as the zones of atmosphere immediately surrounding the conductors are subjected to a dielectric flux exceeding the rupturing point, such zones become conductive, thereby doing two things:

1. The effective diameter of the conductor is increased by the presence of the conducting zone, thereby increasing the capacity of the line and consequently the charging current.

2. The presence of the conducting zone must act in effect to place a high resistance in series with the line current which the charging current must traverse. This must produce a lag in the charging current, causing it to have a power component in phase with the voltage. In effect such action is the same as though the power component of the current were conductively transferred through the atmosphere.

Where the conductors of a high-voltage transmission line are separated a distance between centers of more than 20 diameters, the dielectric flux passes from the surface of a conductor of round section at a density that is so nearly uniform about the circumference that it may for practical purposes, in the present instance, be assumed constant. In discussing these relations further the following symbols will be used:

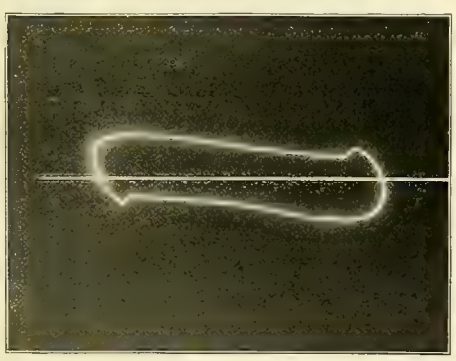


FIG. 1. CONDUCTIVITY OF THE ATMOSPHERE AT HIGH VOLTAGES.

C, the capacity of the line in farads per inch of length.

s, the distance between the conductors in inches.

r, the radius of the conductors in inches.

ϕ_0, the total dielectric flux established from conductor to conductor, measured in terms of the corresponding displacement current; i. e., in coulombs.

D_0, the dielectric flux density at the surface of the conductor in coulombs per square inch of sectional area.

D^1, the corresponding dielectric flux density at a distance slightly remote from the surface of the conductor, where the extraordinary dielectric strength of the atmospheric zone ceases and where occurs the region of greatest dielectric strain relative to the disruptive strength.

D, the corresponding dielectric flux density at any point.

1. Abstract of paper read before the American Institute of Electrical Engineers, February 26, 1904. A synopsis of Prof. Ryan's paper was given in the Western Electrician of March 5th, p. 195. Owing to the importance of the subject and the thoroughness of its treatment an abstract of the paper and disscusion are here given.

The capacity between wires in farads per inch of line is

$$C = \frac{0.00306}{\log_{10}\left[\frac{s}{r}\right]} \times 10^{-10} \qquad (3)$$

The total displacement current and, therefore, the total dielectric flux established between conductors per inch of line at the line voltage, E, is

$$\phi_0 = E\,C = \frac{0.00306}{\log_{10}\left[\frac{s}{r}\right]} \times E \times 10^{-10} \qquad (4)$$

The dielectric flux density at the surface of the conductor is

$$D_0 = \frac{\phi_0}{2\pi r} \qquad (5)$$

$$D_0 = \frac{0.00306}{2\pi r \log_{10}\left[\frac{s}{r}\right]} \times E \times 10^{-10} \qquad (6)$$

At a radial distance d from the surface of the conductor, the corresponding dielectric flux density is

$$D' = \frac{\phi_0}{2\pi (r+d)} \qquad (7)$$

$$D' = \frac{0.00306}{2\pi (r+d) \log_{10}\left[\frac{s}{r}\right]} \times E \times 10^{-10} \qquad (8)$$

In alternating-current work the maximum values of D_0 and D' are wanted, and the maximum values of the voltage waves must, therefore, be used for E, as reduced from equations (7) and (8), thus:

$$E_{max} = 2055 \log_{10}\left[\frac{s}{r}\right] \cdot r \cdot D_0 \times 10^{-10} \qquad (9)$$

$$E_{max} = 2055 \log_{10}\left[\frac{s}{r}\right] (r+d) D' \times 10^{-10} \qquad (10)$$

When Mershon's results were used to test these equations it was found that they correctly accounted for the relation between the separation of the conductors and the voltage at which the initial brush discharge took place. These results gave also a certain value for D_0 which would not give correct results when used to determine the voltage required

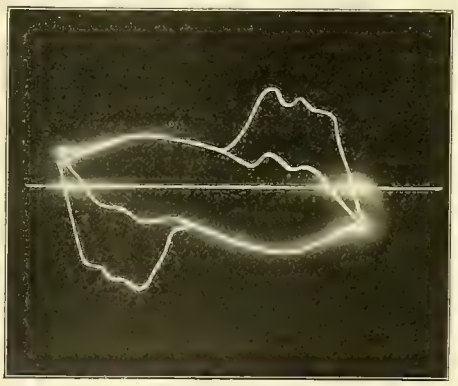


FIG. 2. CONDUCTIVITY OF THE ATMOSPHERE AT HIGH VOLTAGES.

to start the line loss for the small wires used by Scott in some of his experiments at Pittsburg.

At this point a rough laboratory test was made to see whether one would find the start of the loss between wires to occur at the same voltages for the same size of conductor and distances apart that Mershon found. The results obtained were totally different. It became evident from this disagreement that barometric and temperature variations exerted important influences. The difference between the approximate results obtained by the author and those of Mershon indicated that the voltage starting the loss between wires would vary as the barometric pressure.

It became evident that a series of experiments would be necessary in order to obtain all of the data required to write properly the formulas expressing the relation of all the factors that control the start of the atmospheric loss between wires.

It was determined first of all to check by experiment the impression gained from the observations of Scott that the visual appearance of the corona or brush discharge on the wire occurs simultaneously with the initial formation of energy loss, as the line voltage raised; and to observe the nature of the charging current with respect to the line voltage with a view to determining more data regarding the origin of the loss. Should the start of the loss be accompanied simultaneously by the visual appearance of the corona over the wire, this would be an easily discernible fact that would greatly facilitate subsequent experimental work. The point at which the atmospheric conduction loss would occur in relation to diameters of conductors, their distance apart, applied voltage, barometric pressure, temperature, moisture, and the thickness of the dielectrically powerful but thin zones of atmosphere could then be noted simply by watching for the appearance of the corona. For this purpose it was realized that the most convenient and effective laboratory arrangement of the line would be to suspend a single wire for observation at the center of a metallic tube of suitable diameter, much the same as originally suggested by Mershon.

A brass wire 0.049 inch in diameter was mounted at the center of a galvanized sheet-iron tube 15 inches in diameter and 14.5 feet long. Between this wire and the tube high pressure was applied and adjusted to any desired value up to 80,000 effective volts by means of the transformers. The arrangement permitted the coils of the wave indicator to be inserted by means of a switch, in series with the wire so as to indicate whenever desired the charging current set up from the wire to the cylinder. In order to note at a glance any departure of the wire-charging-current form from the charging-current form that should exist if no atmospheric conduction were present, a 0.75-inch brass rod with well-rounded ends was placed outside the cylinder and connected through the switch to the same terminal of the transformer as the wire. The arrangement was such as to permit quickly the switching of the indicator coil, in series either with the wire or rod.

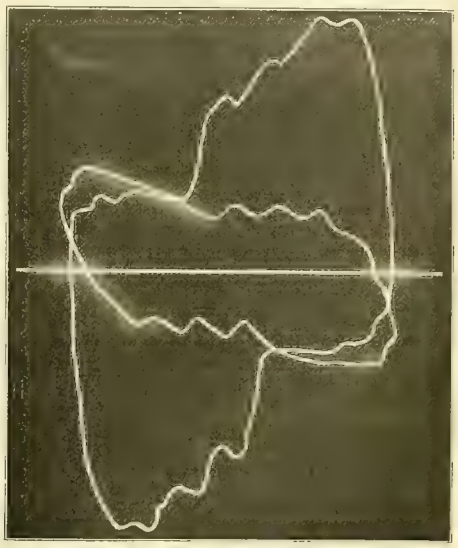


FIG. 3 CONDUCTIVITY OF THE ATMOSPHERE AT HIGH VOLTAGES.

Then at low voltages prior to the disruption of the atmosphere about the wire, the indicator diagram produced by the wire and rod charging currents were adjusted to equality by moving the rod in its position relative to the cylinder. A sine-wave current controlled by a proper circuit of inductances and capacity produced the known indicator motion.

In the use of high voltages in this manner two precautions must be taken in the use of the wave indicator. It must be entirely enclosed in a potential-guarding screen set up on high-voltage insulators and a connection must be made from the screen to the terminal of the transformer that is connected to the wire and capacity rod. The sine-wave current must pass through an insulating transformer and the secondary must be connected to the guard screen, so as to protect the low-voltage source and relieve the indicator of electric stress at all points.

A three-phase source was employed so as to draw for convenience the sine-wave current through an induction phase adjuster. By shifting the sine wave, any intricate part of the unknown wave was made to occur when the sine wave was passing through zero and, therefore, changing most rapidly, thus unfolding the intricate portion of the unknown wave so as to be observed and recorded to best advantage.

Figs. 1, 2 and 3 are halftone reproductions of diagrams of line-wire and capacity-rod-charging currents, photographed from the screen of the indicator. Eight of these were observed in this series at maximum-voltage-wave values varying from 23,000 to 48,000 volts. In Figs. 4, 5 and 6 the waves indicated in Figs. 1, 2 and 3 are drawn to scale in rectangular co-ordinates. They show at once the nature of the phenomena of atmospheric conduction, giving rise to a loss between wires at high-alternating voltages.

Waves of line and condenser-charging currents were observed at a voltage having a maximum value of 23,000. The voltage was not yet high enough to cause the atmosphere about the line wire to break and become conductive. The charging current applied from the wire to the cylinder was identical with the true capacity charging current from the rod to the cylinder.

When the voltage was slightly raised, a well-defined though small change in the line charging current appeared as a hump on either side of its indicator diagram (see Fig. 1), or a sudden increase in the current, just as it was about to pass through zero, as seen in the rectangular co-ordinate diagram of this same wave shown in Fig. 4.

At exactly the same value of voltage at which this hump in the line current appeared the corona became visible when viewed in the dark, thus settling definitely this point and providing a convenient and reliable guide in subsequent experimental studies.

It should be observed that the manner of depart-

ure from normal capacity form of the line-charging current is much as one would expect from prior knowledge. After the phenomenon has been started, at that instant in each cycle when the voltage attains a value of 20,000, the atmosphere about the line wire breaks and forms a conducting envelope about wire. As the value of the voltage is very near the maximum it follows that the disrupting dielectric strain can last but a brief portion of a cycle. Beyond this the normal true capacity condition will be resumed in which the rod and wire-charging currents are again in agreement. The atmospheric-conducting action in this instance, then, is to increase the capacity of the wire by covering it with a high-resistance conducting envelope during that portion of the cycle in which the instantaneous voltage is high enough to maintain in the atmosphere next to the line conductor a state of strain sufficient to maintain disruption.

Thus it is seen that the electric circuit from the wire to the cylinder changes during the cycle from a state of true and unvarying capacity to one of increased and variable capacity in series with a high resistance.

As the voltage is raised the departure of the line-

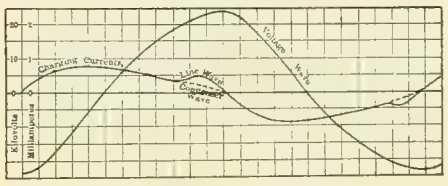


FIG. 4. CONDUCTIVITY OF THE ATMOSPHERE AT HIGH VOLTAGES.

charging current from its normal true capacity form occurs to a remarkable degree. The maximum value of the voltage wave was set at 26,500 volts and the card of Fig. 2 was obtained from which the waves of Fig. 5 were determined. Quantitatively, there are here observed precisely the same phenomena as in Figs. 1 or 4. The atmosphere remains conductive during a large part of the cycle, returning to the normal with corresponding coincidence between the condenser and line currents during the remaining small portion of the cycle. It may be noted that whereas 20,000 instantaneous volts were required to maintain a minimum corona in the condition that produced Figs. 2 and 5, the definitely lower value of 17,000 volts is required, due again probably to the higher temperature of the ruptured atmosphere.

When the voltage wave was raised to the maximum value of 48,000 volts, the cards and corresponding waves in Figs. 3 and 6 were obtained, while the disruption evidently occurs at 17,000 volts as before. So important a part is now taken by the resistance and fluctuating capacity that there is no longer a continuation at any point throughout the cycle of coincidence between the capacity rod and line-wire-charging currents.

These voltage waves were determined by integrating the capacity-rod-charging currents. Their scale was obtained by observing the maximum values by means of a spark gap. The wave-indicator scale for the currents in the case of each card was easily obtained from the effective value of the sine-wave current read from an ammeter connected in circuit with the coil.

The way was now clear to determine experimentally the validity of the expression derived above, provided there was some method for determining the distance from the surface of the conductor at which the initial break occurs. I am indebted to Mr. B. T. McCormick, a senior student in my classes last year, for a method by means of which this may be accomplished. Assisted by Mr. C. L. Gillespie

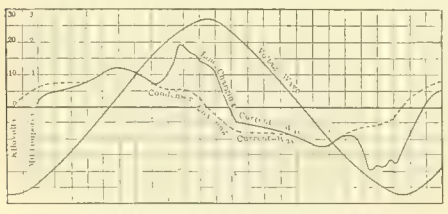


FIG. 5. CONDUCTIVITY OF THE ATMOSPHERE AT HIGH VOLTAGES.

he applied it to many of the commercial sizes of conductors ranging in diameters from two to 625 mils. At the center of the 15-inch cylinder, conductors of various diameters were mounted. An alternating voltage was applied between the conductor and the cylinder and elevated to the point at which corona is first visible in the dark. The diameter of the conductors and the maximum value of the voltage waves were observed by means of the spark gap. Corresponding to each conductor and the maximum value of the voltage at which its corona was initially formed, curves were located showing the relation between the dielectric flux density and radial distance from the surface of the conductor. These curves were then plotted in rectangular co-ordinates. The envelope of these curves, when taken at sufficiently small intervals of conductor sizes, gives the relation between the distance from the surface of the conductor and the dielectric flux density at which the atmosphere first ruptured. In this manner the relation between the conductor diameter, distance from surface and dielectric flux-rupturing density, was determined. The values thus determined are given in the synopsis. [See Western Electrician, March 5th, p. 195.]

One especially interesting feature of the results given in this table is that the distance from the surface of the conductor at which the atmosphere first ruptures is constant at 0.07 inch for all diameters above 0.25 inch, and the corresponding rupturing flux value is constant at 170×10^{-10} coulombs per square inch. The largest conductor used in these experiments was 0.625 inch in diameter. It is, however, reasonable to expect that since there is no change in the value of d due to changes in the conductor curvature when the diameter varies from 0.25 to 0.625 inch, there will be no important change in such value of d for conductors of larger diameters. At conductor diameters smaller than 0.25 inch, there is approximately a regular diminution with the diameter, of the distance of the initial rupturing zone and a corresponding approximately regular rise in the initial rupturing dielectric flux density.

To study the effects due to varying barometric pressures and temperatures, a conductor of 0.125 inch in diameter was mounted at the center of a stout brass cylinder 20 inches long and 8.75 inches in diameter, provided with packing flanges and closed with 0.5-inch plate glass at either end. By means of ordinary hand pumps and a long mercury U-tube, the atmospheric pressure could be adjusted definitely to any desired value from 18 to 36 inches of mercury. Alternating voltage was applied between the conductor and the cylinder and elevated to the point where the corona was observed in the dark to appear suddenly. The effective values of the voltage were determined by means of a Weston alternating-current voltmeter applied across the terminals of the low-voltage primary of the high-voltage transformer. Throughout all experiments the form of the voltage waves was approximately the same; viz., that given in Figs. 4, 5 and 6; frequency, 130 cycles.

To determine the effect of variation of temperature upon the voltage required to inaugurate the corona, the air in the tube was heated electrically and cooled by immersion in a salted ice pack. However, the salted-ice method for cooling was not a success and had to be abandoned, it being evident that a much more extensive method of cooling would have to be used in order to maintain the surfaces of the glass plates closing the tube free of moisture, so as to insure effective insulation and clear vision for the detection of the corona. The cooling facilities that are evidently needed were not at hand when these tests were made, last May, so we had to be contented with such temperature variation of the air as could be obtained by heating the tube electrically by means of a jacket of german-silver wire and asbestos. Observations were made to determine the combined effects of temperature and barometric pressure variation by heating the air in the tube to about 200° F., at a given barometric pressure; then, as the temperature dropped slowly by radiation and by maintaining the barometric pressure constant by use of the pump or by natural flow of the atmosphere, the voltage at the various temperatures required to start the corona were observed. The process was then repeated for another barometric pressure, until finally observations had been made covering the temperature range of from 70° F., to near 200° F., at barometric pressures ranging from 19 to 34 inches. The humidity present was that due to natural causes and was not observed.

The final equation which allows for all important factors showing the relation between the instantaneous maximum voltage, size, and separation of conductors, rupturing value of dielectric flux, and distance from the surface of the conductor at which the rupture occurs, causing initial corona formation, should, therefore, be written

$$E_{max} = \frac{17.94\, b}{459 + t} \times 3033 \log_{10}\left(\frac{s}{r}\right) D'(r + d) \times 10^{-1} \qquad (12)$$

A determined effort was made to observe the effect upon the point of initial corona formation due to the presence of moisture in the atmosphere. The ordinary air in the tube was displaced with dry air and the corona-starting voltage was then observed. Steam was then admitted to the interior of the cylinder and after allowing sufficient time for the water that was not absorbed by the air to settle upon the walls of the cylinder, the corona voltage was again observed. By this method the effect of the presence of humidity could not with certainty be detected, leading one to conclude that such effect if it does exist is small.

Where the conductors are 0.25 inch or larger in diameter, D′ and d remain uniform at

$D' = 170 \times 10^{-10}$, coulombs per sq. in., and
$d = 0.07$ inch

and equation No. (12) becomes

$$E_{max} = \frac{17.94\, b}{459 + t} \times 3500 \log_{10}\left(\frac{s}{r}\right)(r + .07) \qquad (13)$$

The data for Mershon's experimental line are:

s = 15, 22, 35, and 52 inches.
r = 0.081 inch.
D' = 200×10^{-10} coulombs per sq. in.
d = 0.035, inch.
t = about 60° F.
b = about 20 inches.

1.71 = approximate ratio of maximum to effective value of voltage wave.

Upon substituting these values in equation (12), the following results are obtained:

Separation of Lines. Inches.	Effective Voltage at Which Initial Corona Loss Occurs.	Mershon's Observations, Effective Voltage.
15	43,600	43,500
22	46,800	47,000
35	50,700	49,000
52	54,000	52,500

DISCUSSION (IN ABSTRACT).

Prof. Samuel Sheldon, Brooklyn: There are distinctly different types of conduction through ordinary atmospheric pressures from air gaps. The first of these discharges is the glow discharge; the second is a brush discharge; the third is a spark, and the fourth is the arc. Now, the glow discharge has its distinguishing characteristics. It is of a pinkish, violet color, it is in the form of a velvety covering to the electrode, it is silent in its discharge, and it seems to cover continuously very closely around the electrode if there be a path that is fitting. The discharge is polar, of the same nature as a discharge from a battery, storage battery or primary battery, and it is apparently continuous. It may be it is made up of an innumerable number of little convections of electricity, and so most of it is of a current which comes from any electrochemical source.

The second type of discharge, the brush discharge, is red-violet in color. It takes place with a hiss—it is probably intermittent in character. It starts at any definite voltage, or it may start over a range of voltages, and it has a distinctly characteristic polar choice, starting at one voltage from one point of the polarity of the ball, and at another from the opposite point of the polarity of the ball. The spark discharges white in color, and participates in the coloring of the vapors of the electrodes. This becomes evident with iron electrodes, where we have the prominent ultra-violet radiations very strong. It is probably oscillatory, perhaps due to a local circuit by its natural high-frequency period. The arc discharge is familiar to all of you, as the color to the gas or the vapors of the electrode, as the conduc-

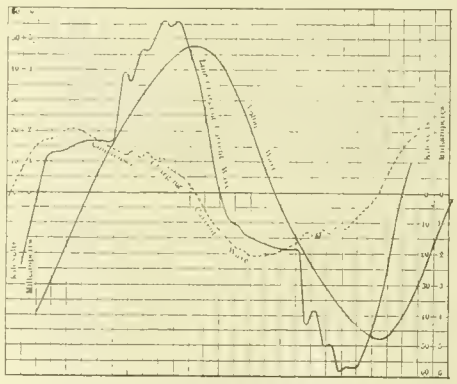


FIG. 6. CONDUCTIVITY OF THE ATMOSPHERE AT HIGH VOLTAGES.

tivity which largely results from the presence of the vapor, whether this be due to the presence of a high temperature or not. The glow and the brush discharges are due, probably, to a sort of gaseous ionization, and I am of the opinion that this corona discharge is a combination of both of these discharges.

Prof. Harold B. Smith, Worcester, Mass.: In 1901 four graduate students at the Massachusetts Institute of Technology undertook the design and construction of a 500,000-volt transformer. In carrying out that work we desired, after building the transformer, and after getting discharges over a range up to four feet, to measure the voltage, and so it occurred to me that we might perhaps use an electrostatic instrument, measuring the voltages about the several coils of the secondary and adding them up as a preliminary step. The electrometer registered as we expected for the first few measurements, and as we proceeded along up the secondary —the middle of the secondary being earth—as we proceeded away from the earth, the readings became less and less, although we knew the number of convolutions in the several coils had been carefully counted and were the same. We soon reached a point where we got a zero reading upon the instrument, and then very soon we had a reversed reading on the electrostatic instrument, which I confess bothered us. Proceeding from that point, we developed a line of reasoning where we reached the conclusion that the absolute potential embraced on the instrument was in effect exceeded by the effect of the difference of potential, and so we obtained a repulsion of the path of the electrostatic instrument, in place of contraction, as we would have ordinarily in the measurement of differences of potential. That at once led to the conception of the use of an instrument in which we connected the two instruments together, the fixed and the movable, and then attached one wire and depended wholly upon the repulsion of the absolute potential. This was a peculiarly adaptable instrument to this work.

P. H. Thomas, Pittsburg: In passing electricity through a vacuum, which is almost complete, we have three electromotive forces to consider; one is the force causing the electricity to leave one of the electrodes; another that causing it to enter the other electrode, and the third, the resistance passing through the vacuum. The resistance passing through the vacuum, with high vacuum, is not very considerable, it is not measureable. But with atmospheric pressures it must be tremendous, but have we not those elements in this case, or, at least two, to consider? The force necessary to pass current from the electrode is different from that required to force it into the electrode. If that is true, we should then test between the positive and negative limits of the alternating current due to the electrode effect, not due to the portion which is due to the resistance of the air.

The Structure of the Atom.

In the Philosophical Magazine of London Professor J. J. Thomson of Cambridge has just published an article on "The Structure of the Atom," which will be read with much interest by all who follow the electrical theory of the constitution of matter. The following synopsis of the paper was made by E. E. Fournier d'Albe for the London Electrician:

The view that the atoms of the elements consist of a number of negatively electrified corpuscles enclosed in a sphere of uniform positive electrification has suggested to J. J. Thomson the mathematical problem of the motion of a ring of negatively electrified particles placed inside a uniformly electrified sphere. He investigates the positions of equilibrium which the electrons will assume under the action of their mutual repulsion on the one hand and the attraction of the sphere on the other. He finds that the conditions of equilibrium vary steadily with an increasing number of electrons, but that at certain points a sudden change occurs. These points correspond to those at which the elements change their properties in the periodic system, and it seems, therefore, very probable that the electron theory may be made to account for the properties of the chemical elements themselves. The author considers only the various arrangements of the electrons in one plane, as he has not yet succeeded in finding a general solution for spherical distribution; but the results already attained are extremely suggestive. Those elements which easily lose a single electron are monovalent electropositive elements, such as sodium. Those which become more stable on acquiring another electron are monovalent electronegative elements, like chlorine. Those which lose or acquire two electrons are divalent elements, and those which are incapable of permanently acquiring or losing electrons are elements of no valency, like argon and helium. Radio-activity is accounted for as follows: Some systems of electrons are stable when rotating with an angular velocity greater than a certain value, but become unstable when the velocity falls below this value. Such a fall may be brought about by radiation from the atom. When, after a long interval, the velocity reaches the critical velocity, there will be what is equivalent to an explosion of the electrons, the electrons will move far away from their original positions, their potential energy will decrease, while their kinetic energy will increase. The kinetic energy gained in this way might be sufficient to carry the system out of the atom, and we should have, as in the case of radium, a part of the atom shot off. In consequence of the very slow dissipation of energy by radiation the life of the atom would be very long.

Iowa Electrical Association.

The fourth annual convention of the Iowa Electrical Association will be held in Des Moines on April 13th and 14th. Secretary Porter has announced the programme, which is full of interesting features. The Question Box will be conducted by W. J. Green of Cedar Rapids. Among the important features of the programme will be the reading of the following papers: "Uniform Accounting," Austin Burt of Waterloo; "Electric Meters," George W. Carson of Iowa City; "Combustion of Iowa Fuel," Professor George W. Bissell of Ames College; "Incandescent Lamp Tests," Professor Spinney of Iowa State College; "Station Steam Piping," C. C. Gartland of Sioux City; "Nernst Lamp Experiences," G. C .Gardner of Mt. Vernon; "Series Street Lighting," M. N. Harrison of Osceola; "Multiple Street Lighting," R. E. Lee of Clarinda; "Storage Batteries," J. T. Remey of Davenport; "Demonstration on Station Accounting," Robert Ferris of Monmouth, Ill.

The officers of the association are: President, D. F. McGee of Red Oak; vice-president, W. L. Bowers of Davenport; secretary, W. S. Porter of Eldora; treasurer, Rufus E. Lee of Clarinda.

Southern Pacific to Adopt Electricity.

For several years it has been rumored that the Southern Pacific Railway Company contemplated adopting an electric system instead of steam on its Berkeley (Cal.) branch. This change, it is said, will now be made, and it is announced that the company has already placed an order for 40 electric cars of standard gauge and with powerful motors. The new cars are to be used on the Berkeley local line and also on Webster Street in accordance with a franchise granted by the Oakland City Council to J. H. Macdonald. The "corkscrew" franchises which wind about the business center and out Webster Street, thence through Pleasant Valley, are included. Recently Mr. Macdonald outbid the transit company on a franchise in East Oakland. At the time it was stated that Mr. Macdonald probably represented the Southern Pacific Company.

Progress of Electrical Installation in New Government Building, Chicago.

Work upon the new government building in Chicago has been somewhat accelerated of late, but still its completion by November 1st of this year, as was anticipated, will not be possible.

As seen by the accompanying picture, which is reproduced from the architect's drawing, and is a good representation of the building as it now stands, the structure is a large and imposing one. The building occupies a whole square in the heart of the city bounded by Jackson, Dearborn, Adams and Clark Streets, and, with its cubical contents of 8,000,000 feet, is said to be the second in size in the United States. The walls are of granite, as are also the great pillars and ornamental work.

Naturally a building of this size will furnish a great variety of applications for electricity. Electric current will at first be supplied by the Chicago Edison Company, but space has been allowed for the installation of an isolated plant at some future time should the authorities decide that economy will warrant the change.

The electrical conduit work is now nearly completed, and it is possible to give with accuracy the figures upon this part of the work. The conduits are all of iron pipe laid in concrete beneath the floors and the number of feet of the various sizes are given in the following table:

2-inch electroduct	12,000 feet
1½-inch electroduct	3,700 feet
1¼-inch electroduct	3,500 feet
1-inch electroduct	20,000 feet
½-inch electroduct	3,000 feet
¾-inch electroduct	180,000 feet
Total	222,200 feet

A total of 225,000 feet of electrical circuits will be run in the conduits. There will be in all 4,200 ceiling boxes, 1,150 floor outlet boxes and 86 cut-out cabinets. The type of distribution centers is said to be a new feature, the conduits being continuous from the fuse terminals to the light outlets. There are also a large number of waterproof floor boxes through which wires will be run to the desks, doing away with unsightly moldings.

One main switchboard of 17 panels will be installed. The panels will be 62 inches high, two inches in thickness, the complete board being 30 feet in length. Eleven of the panels will be for lighting purposes, two will be for power feeders, three for the generators and one for totalizing. The totalizing panel will have two totalizing, illuminated-dial, 7,000-ampere ammeters, two voltmeters with three-circuit voltmeter switches and one portable, direct-reading, 250-volt voltmeter with a six-circuit switch. Direct current at 110-220 volts will be used for both light and power.

The basement, first and second floors, will be used for the handling of the mails, and the lighting of these floors will be controlled separately by four feeders distributing from the first floor.

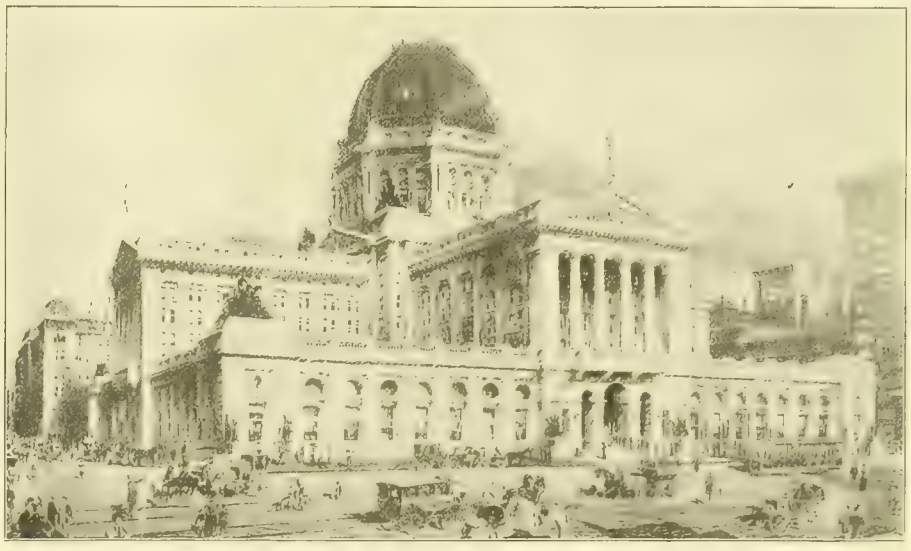
Lighting will be accomplished entirely by incandescent lamps and the number necessary is now estimated at 19,200, although a greater number probably will be installed when the building is occupied. The lighting on the first floor will be by elaborate chandeliers, with smaller chandeliers on the floors above.

To bring out the architectural beauty of the interior of the dome, 200 lamps will be concealed in the ornamental designs near the top. The large painting upon a spherical surface which is to be hung in the dome will also be lighted by incandescent lamps, which will cast their light upon the picture but will themselves be concealed.

Special lighting methods have been adopted for the court rooms, corridors and sub-treasury department, in which the lights are to be mounted in troughs, so as to cast their light upward to the ceiling, from thence to be diffused throughout the rooms.

A hot-blast system of heating will be used, the air being first tempered, then washed and dried. After being heated and humidified, it will be forced through the system of ducts by electrically driven blowers. Thirty electrically driven blowers will be required for this purpose. Of this number, 22 will be large motors of from 12 to 40 horsepower, while the remaining eight will be of smaller sizes. Besides the blower motors, there will be 16 others, ranging from three to 35 horsepower, used for various purposes about the building, such as operating the refrigerator plant, for pumping water from a deep well, for stamping and canceling machines and the like. The elevators will be operated by hydraulic power.

George O. Von Nerta is the government superintendent in charge of the building operations, and Ralph H. Chappell, formerly of the engineering corps of the United States Navy, has charge, on the spot, of the engineering work.



THE NEW GOVERNMENT BUILDING IN CHICAGO

Automatic Electric Piano Player.

A new device for automatically playing a piano by electricity has been devised by Timothy B. Powers and Major R. Jewell, both of New York city. It is asserted by the inventors that the apparatus will not only cause the piano to play, but that the tone, expression and feeling will give a faithful interpretation of the composer's purpose.

Electromagnets are arranged to operate each key and also to actuate the pedals. For controlling the circuits of the electromagnets a sheet of brass is provided with perforations to correspond in position and interval to the notes on a written page of music. The sheet is unrolled from one drum and rolled up on another, while contact makers follow over the surface. As each contact point passes through a perforation it closes, for the time being, the circuit of the electromagnet, actuating the key on the piano corresponding to that particular perforation.

In order to give feeling or expression to the music produced, rheostats are placed in each circuit, the resistances of which are thrown in or out by a separate set of electromagnets operated by a separate set of perforations on the music roll. By adding resistance to the circuit operating a key the effect of the electromagnet is weakened, resulting in a softening of the sound.

It is suggested that electric-elevator mechanisms, as a possible source of fire, should not be placed at the bottom of open elevator shafts and should be enclosed in fireproof compartments.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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DATES AHEAD.

American Electrochemical Society (annual business meeting), Washington, D. C., April 7th, 8th and 9th.

Iowa Electrical Association (fourth annual convention), Des Moines, April 14th and 15th.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

"EXPERIENCED workers are always 'afraid,'" says Mr. E. B. Clark, electrical engineer of the Illinois Steel Company, in a little pamphlet prepared for the employes of the electrical departments of that company and treating of the dangers of electricity and how to minimize them. This is quite true as a general statement and should be constantly impressed on the minds of men whose duties require them to work about electrical circuits. Almost all accidents are caused by the carelessness of inexperience or the carelessness of familiarity. In the latter case the injured man is apt to undergo an experience which will number him with the cautious ones for the rest of his life. But by heeding the suggestions in Mr. Clark's little book the knowledge of prudence may be gained without a shock that may endanger life. The pamphlet was prepared especially for the electrical workers of the Illinois Steel Company at South Chicago, but it contains so much good sense and is so generally applicable to the conditions surrounding electrical work everywhere that we have obtained permission to publish it for the benefit of the readers of the Western Electrician. The brochure is one of a series issued for the information of the employes of the electrical departments of the company named. All of them are excellent, and we hope to have the privilege of reprinting others in the future.

RATHER out of the ordinary line of papers read before technical societies, but none the worse on that account, Mr. Damon's very practical dissertation on "Opportunities in the Electrical Business" may be read with interest by all and with profit by young men casting about for advice in relation to the choice of a career. The paper was presented before the Electrical Section of the Western Society of Engineers last week and is given in abstract, with a condensed report of the discussion, in this issue. Mr. Damon sent a letter of inquiry to "100 of the leading men in Chicago engaged in the various branches of the electrical industry" asking several questions pertinent to the general subject, such as age, income, qualifications for success, and the like. The responses were very interesting and formed the basis for the paper. The average income of the 100 men is $3,440 a year. This is a good figure, as average incomes go, but the young man who contemplates it with admiration, with the idea that the electrical field possesses exceptional advantages, will do well to remember that the 100 are picked men—the leading men of the industry in the second largest city in the country. If the inquiry had been extended to all electrical men in Chicago who work with their brains rather than their hands, the average income reported would have been much smaller, of course. Mr. Damon naturally selected the leading men, because he wanted the benefit of their wider experience, and in doing so he included a few with large incomes, who brought up the general average. Nevertheless, the young man is entitled to view the topmost positions, or position, if there is such a one, as his goal; and the electrical industry, in its various branches, offers opportunities and rewards that may satisfy a moderate ambition. Few great fortunes have been made by electrical men, it is true, but many of them enjoy comfortable incomes. Young men with aptitude for the work and who are really willing to labor hard and unceasingly—how many there are who think they will work hard but who fail under test!—will be able to make their way in the electrical field, just as, with corresponding aptitude and corresponding endeavor, other young men will succeed in other callings. There is plenty of electrical work to be done, and good men are ever scarce. It is "up to" the electrical beginner to make himself a good man. If he will do that, and if his health is good, his future, materially speaking, is assured.

Of exceptional interest is the table in Mr. Damon's paper giving the vote showing the branches of the industry considered most promising. Electric railways come first, telephone work next, then power transmission, and, fourth, electrochemical application. Several other forms of electrical undertaking are mentioned, but those named constitute the first four lines on the list. The selection made accords quite well with the prevailing opinion. Great activity is noticeable in the railway and telephone fields. Perhaps electrochemical work is entitled to the third place in order of promise, but the question is an open one.

Technical training, whether by college course shop work or correspondence school, naturally occupies considerable space in a paper such as this. In considering the general subject it is of interest to note that Dr. R. M. Walmsley, president of the Northampton Institute of London, recently read a paper on "Transatlantic Engineering Schools" before the Institution of Electrical Engineers in England. Dr. Walmsley was unstinted in his praise of American technical-school methods, and more especially of the equipment of laboratories. But in the discussion of his paper there was a very general disagreement with the writer. Several speakers contended that the lavish expenditure upon the equipment of laboratories in American colleges was a waste of money. In discussing American methods the speakers generally criticized the utility of the fourth year as practiced in the United States. They asserted that an English youth is equipped with a better secondary education when he enters the technical college and can therefore proceed directly to the technical work. Too much time in America is spent in the college workshop. It was argued that the better system was practical workshop training after a three years' college course, during which sufficient time only was spent in the college workshop to insure familiarity with tools and materials.

These views are especially apropos in view of the Damon paper and the discussion that followed it.

SUBMARINE boats have a wholly speculative value in warfare, although it is probable that in wrecking operations and other industrial pursuits they may prove to be useful. Those who are doubtful of the utility of the submergible craft in naval operations will point to the recent foundering, after collision, of a British submarine boat of the latest type, as a demonstration of their argument that the risks taken in the operation of submarine torpedo boats are entirely disproportionate to their real value as an effective weapon of attack or defense.

It is true that the new boats have added a new horror to warfare, but the danger appears to inhere in the boats themselves rather than to be exerted against the enemy. The disaster at the British naval maneuvers off Portsmouth last week is in point. The submarine boat A1 was run down by a large merchant liner and 11 men were drowned, including Lieut. Mansergh, the senior officer engaged in submarine work. The loss of the boat was not known for some hours after the liner had reported to the maneuvering fleet. The officers of the liner say that they saw a glistening torpedo-like hull in the water, and it is supposed, therefore, that the submarine boat rose just before she was struck. The officers of the fleet did not suppose that the submarine had been struck and continued operations, expecting that vessel to reappear at some other point. Finally a search was made and the breaking of the waves revealed the presence of the submarine boat. There appears to be no doubt that all the members of the crew died in their steel tomb. It is presumed that the merchant ship, in striking, upset the trim of the boat and spilled the gasoline in her tanks, rendering her helpless. The crew was battened down and must have met their terrible fate from suffocation and the fumes of the gasoline.

This is not an edifying account. Electrical men are interested in the submarines from the use of the storage battery and electric motor to drive the boat when under water. But there is also a large demand for electrical apparatus for use on board ships that float on the surface after the time-honored fashion of Noah's ark and its successors. For our own part, at the risk of being considered ultra-conservative—the charge so seldom brought against those interested in electrical pursuits—we must confess to a feeling that it is largely a waste of effort to endeavor to utilize the submarine boats as a practicable, dependable force in warfare. Admitting the moral effect of their existence and the possible chance that they could find their way near enough to the target, unobserved, to make an effective attack, the benefit to be derived from their use seems still to be entirely disproportionate to the uncertainties and risks attending their operation. Ordinary torpedo-boat attack is uncertain enough against a vigilant enemy. The recent successes of the Japanese were obtained in a fight with an adversary who, from all accounts, was not vigilant. But with submarines the chances of success would appear to be very slight indeed.

Opportunities in the Electrical Business.

The first meeting of the Electrical Section of the Western Society of Engineers was held in the society's rooms in Chicago on March 18th. The meeting was well attended and if it be typical of the future meetings of the Electrical Section, this new branch of the Western Society will be an unqualified success.

H. W. Parkhurst, president of the Western Society of Engineers, called the meeting to order and said a few words about the recent affiliation of the Western Society of Engineers and the Chicago Electrical Association, after which W. B. Hale, chairman of the Electrical Section, took charge of the proceedings.

The subject of the evening was a paper by George A. Damon of Chicago upon the "Opportunities in the Electrical Business." Mr. Damon had evidently given much thought and hard work to the preparation of the paper, but was well repaid by the gratification with which it was received. He abstracted, briefly, the contents of the paper, after which it was discussed by many of those present. An abstract of Mr. Damon's paper is given herewith.

That those who have traveled well on their way toward their goal will have many opportunities to point the way to the ones behind, is well indicated by recounting several recent conversations. The first was with a boy of 18.

"I am a senior in the high school," he said, "and I want to become an electrical engineer; what shall I do?"

He was strong, bright, ambitious and willing to work.

"Some men tell me to take a college course first and enter practical work afterward; some tell me to get a few years' experience first and then take a college course, while still others tell me to study several years, work a year or two and then finish my senior year. In planning my course should I include the language studies or cut them out in favor of shop, laboratory or commercial courses? Should I try to get through in three years, or should I extend my college education over a period of five years? Others tell me to leave out the university work entirely, go to work in the shop or upon construction work, getting what theoretical training I require by attendance at night school or by taking a correspondence course. What shall I do?"

And there are some of us who will appreciate the young man's bewilderment.

The second conversation was with a professor at the head of the electrical department of one of our leading universities.

"I feel highly complimented," he said. "I have received a letter from one of the largest electrical manufacturing companies in this country, offering positions to my entire senior class. This is remarkable, for in Europe it is the custom for the technical graduates to pay for the privilege of entering the shops of the large companies. But," he continued, "I should like to find out whether or not I should advise my boys to accept this offer. What has become of the young college men who entered the shop courses in years gone by? Are they advancing as satisfactorily as the graduates who found positions in other parts of the field? Have the large companies taken care of the graduates of their testing departments with sufficient liberality to justify a young man in making the sacrifices which a shop course entails? Would it not be better all around if I offered the large company the services of my junior class for one year? What would you advise?"

The professor is to be commended in his search for information, and in his evident interest in seeing his "boys" get a fair start in the strenuous race in which they have entered.

The third conversation was with a young electrical engineer, who had graduated from high school, had then taken a college course with some practical work during vacations, and had then entered a large factory as a "special apprentice."

"I have had a fine experience," he said, "and have nothing to regret. Upon leaving college I went into the testing department of a large electrical manufacturing company, was promoted rapidly, and finally advanced into the engineering department. My compensation at first was small, but it has gradually been increased until at the end of five years' service I am receiving about $1,500 per year. I am looking out for the future, however, and am not entirely satisfied with the prospect. If I stay with my present employers, the manufacturing company, my work must be narrowed to one department of the work, and I will always be a salaried man without an opportunity to acquire an interest in the business. Would it not have been better for me to have started with a smaller company, and is it too late yet for me to begin over again? What would you suggest?"

Knowing that the leading electrical men of Chicago would afford a valuable field for studying results and would welcome an opportunity to help furnish a solution for the problems of the boy, the professor and the rising young electrical engineer, a letter of inquiry was sent to 100 of the leading men in Chicago engaged in the various branches of the electrical industry. An opportunity was given at the same time for the expression of opinion on various questions pertinent to the general subject. The response to the circular letter was hearty and spontaneous, and we are under obligations to 100 of our friends who have so kindly consented to become living examples, and willing to be analyzed for the good of the cause. The following is an analysis of results.

Young men control the business. The inquiry was, therefore, confined to men between the ages of 27 and 45, upon the theory that the older men are the product of a set of conditions which have passed away, while the youngest men are, as a rule, still engaged in a period of preparation. The number of men of each age is shown graphically. The average age is 33½ years.

The average income at each age is also plotted on a gunshot diagram and a line of average incomes determined up to the age of 38, after which there was not sufficient data to locate the curve. This income curve starts with a value of $2,170 at 27 and extends to $4,000 at the age of 38. The average income of the entire 100 men is $3,440 per year, which will give us a standard by which we can measure the different branches from a mercenary standpoint.

The 100 men may be divided into groups, as follows:

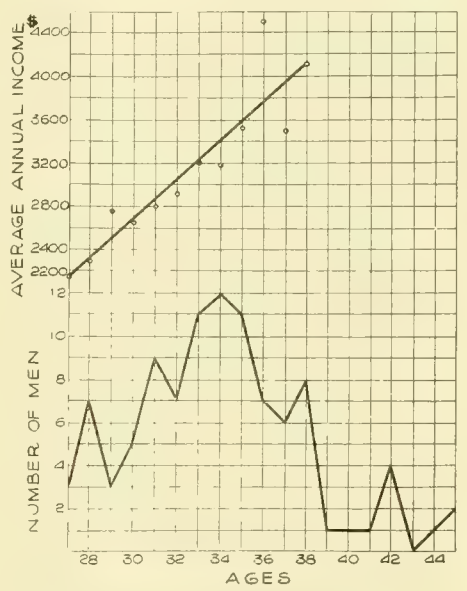
	No. of Men.	Average Age.	Average Income.
Salesmen	7	33	$2,400
Sales managers	11	36	3,400
Business men	10	36	4,800
Sales engineers	8	35	2,350
Electrical engineers	16	33	2,890
Constructing engineers	6	33	2,850
Electrical experts	8	33	3,200
Operating engineers	3	32	2,250
Operating managers and superintendents	10	34	3,550
Professors and editors	8	34	2,500
Patent attorneys	4	32	4,000
Consulting engineers	9	40	6,400

Total number of men, 100. General averages: Age, 33⅓ years; income, $3,440.

Classified in reference to incomes the record is as follows:

	Men.
Income over $10,000 per year	5
Income between $5,000 and $10,000	9
Income between $2,400 and $5,000	66
Income below $2,400	20
Total	100

Salesmen who have technical ability or possess engineering information, as a rule, get better salaries than those who do not. Add initiative and executive ability to the salesman's ability and he becomes a sales manager, with a still greater reward. Enterprise and energy put the man in possession of his own business, or often result in a partnership



OPPORTUNITIES IN THE ELECTRICAL BUSINESS. CURVE OF AVERAGE INCOMES

arrangement. A technical man without the commercial instinct is only fairly well paid. Ability to develop new methods or apparatus puts him in the expert class where the rewards are greater and in proportion to his ability.

Routine work, such as operating, is the least remunerative work of all. Operating managers and superintendents, however, are very well paid. The editors were classed with the professors, as there were too few to form a class with an average of their own. Our professors should form a union, as they are certainly entitled to higher compensation, and as we all appreciate their value we would help them win should they decide to strike. We must grant, however, that they get rewards in seeing the living results of their work, which is a compensation worthy of considerable sacrifice. The phenomenal development along all electrical lines, and particularly in the telephone business, makes the profession of patent attorney a paying one for those who are qualified for that kind of work.

The field of consulting electrical engineering looks attractive, but it will be noted that the average age is greater in this branch than in the others, which means that the successful consulting engineer brings to his work years of experience, and that it is therefore not a branch to be adopted at once by the young man. Forty per cent. of the men in the list are employed by what might be termed the "large" companies, such as the Western Electric, Chicago Edison, Chicago Telephone Company, etc. Thirty-five per cent. of the men either control the business in which they are engaged or own a partnership interest. Twenty-five per cent. of the men are not college graduates. Twenty per cent. of this hundred successful men never had any college education whatever.

The average age of the 20 men who are succeeding without a college education is 36 years, and their success, measured by a monetary standard, shows an income of $3,670 per year. The average age of 16 graduates of Cornell is also 36 years, and their success, measured by the same questionable standard, is $4,940, which shows a balance of $1,270 per year in favor of a college education. It will be noted however, that the 20 men without the education are getting along financially slightly better than the general average of $3,440 per year. This is explained by the fact that in their number are included several men who are prospering as a result of their business enterprise.

There are few non-technical men engaged in the strictly technical end of the business who reach the average income. There seems to be more openings for the man without a college training in the telephone field than in any other. The inquiry into the domestic arrangements of our hundred examples shows that 75 per cent. of them are married. The families are composed of 45 boys and 30 girls. Out of the hundred men selected only 56 per cent. belong to the American Institute of Electrical Engineers.

The answers to the questions upon which an expression of opinion was asked resulted as follows: Eighty per cent. are inclined to think that a college education is essential to the highest success. Seventy per cent. are in favor of the technical graduate taking a shop course in a large manufacturing company, but many wished to limit this course to one year. Fifty-five per cent are of the opinion that in choosing a life work better chances for advancement will be found with the smaller companies. Seventy per cent. are in favor of requiring a year's practical work of the student before graduation.

Fifty-five per cent. agree that the larger companies would be consulting the interest of the art at large by offering an apprentice course open to students during an intermission of one or two years before completing the senior year.

Each of the hundred men included in the inquiry were asked to name the three fields which he considered most promising within the immediate future and the votes received are as follows:

Electric-railway Work	73
Telephony	36
Transmission	30
Electrochemistry	7
Power Applications	21
Lighting Developments	12
Manufacturing	11
Central-station Work	9
Patent Law	6
Consulting Engineering	6
Contracting	5
Management of Properties	3
Storage Batteries	4
Reconstruction of Plants	3
Mining	3
Metallurgy	3
Turbines	2
Wireless Telegraphy, Designing, High-speed Telegraphy, Underground Conduit Construction, Isolated Plants, Train Lighting and Municipal Lighting, each	1

As a result of personal observation, tempered somewhat by the opinions of the electrical men, with whom the questions have been discussed, the writer wishes to present the following conclusions:

A young man wishing to succeed in any branch of electrical industries makes a serious mistake if he fails to use every effort to obtain a technical education. A college course is becoming easier to obtain and it is already recognized as a general requirement for advancement. A young man of high aspirations, who is so situated that he cannot secure a university course, might better, nine times out of 10, take up some other branch of work which is less intricate than the electrical art. Thomas Edison, the dean of the profession, is not a college man, but a gold medal bearing his name is to be given hereafter each year to the college graduate presenting the best thesis, and this incident is the best evidence of the present tendency toward technical education. Nearly every man who is now making his way in the electrical business without a college training, if asked what he would do if he had his life to live over will say: "I would secure a technical course in the best college I could find."

A technical course in a correspondence school which can give the proper training for an electrical engineer is yet to be produced. The correspondence schools are doing a good work and are to be recommended to those who cannot possibly avail themselves of a college course or get instruction in evening-school courses such as offered by Armour or Lewis Institutes, but a young man who will deliberately choose correspondence instruction if anything else is available is making a serious mistake. Of the hundred men in the list only two had completed correspondence course. These two men were engaged in telephone work, and both voted in favor of a college course.

Practical experience is as essential as theoretical training. Too little attention has been paid by students in getting into thorough contact with the way things are actually done. This is the result of the general practice [illegible] for himself. "I can [illegible]

he says, "and I can't get experience without a job;" and then, more or less discouraged at the outlook, he takes the first opening which presents itself, and it may or may not be the kind of work for which he is fitted. What is needed is a general clearing-house of information, a closer union between the ambitious student and the successful men who have been pioneers in the work.

The policy of the large companies in offering apprentice courses and opportunities for experience in their testing departments is to be commended. This practice, as carried on in some cases, however, is to be criticised. A representative of a large manufacturing company visits a technical school, offering to give positions to all the members of the senior class; the professor is highly complimented at this remarkable courtesy, and advises his students to accept. The "shop" course usually covers a period of two years. The hours are long and the pay is small. The "experience" gained by the student may or may not justify the sacrifice. "It depends largely on the man." In the meantime the large company has a good opportunity to select the material which it requires for its own use, and perhaps 25 per cent. of the shop graduates have reason to feel enthusiastic over the system; the others pass through days and nights of discouragement, and many leave the shop with a sense of failure, which is sure to have an influence on their future.

All men are not built alike. Then why grind them through the same mill? Should not some selections of materials be made before the mills are started, a sorting over made earlier in the process?

The trouble with a great many young men is that they don't "find" themselves early enough in life. They fail to realize their possibilities and are not prepared to grasp their opportunities. Ambition, aptitude, preparation and hard work are the stepping stones to successful attainment. Let the ambition to excel be deeply seated and directed along the lines of natural endowment; let the purpose be firm, and as day follows night the preparation will be thorough and the man will be known by his works. "If I had to do it over again I would pick out some definite line of work suited to my talents and work like fury" is the advice of many successful and even unsuccessful men.

The purpose of this paper is to encourage a general discussion, which may be of some help in arousing the latent ambitions of the young men who have not selected their life work, by showing them the boundless opportunities of an undeveloped science; to encourage the efforts of the students in our colleges by presenting the results which have been attained by their predecessors; to crystallize the sentiment in favor of a scientific combination of theory and practice, and, finally, to give an opportunity to the men on the fighting line to point the way to their successors who must come to the front prepared in every way, if they intend to take some part in the phenomenal developments which are to be expected.

Discussion.

Prof. P. B. Woodworth of Lewis Institute of Technology was heartily in accord with all the points brought out in the paper with one exception. He does not believe that it is advisable under any circumstance for a young man to leave his college course and take a year of practical work before graduation. The student gets out of the spirit of his work at school and cannot get back into line again in a year's time. What the learner should acquire at college is common sense, together with good, solid mathematical knowledge and the ability to read current things; then he must be able to go out and produce.

Prof. C. E. Freeman of Armour Institute agreed with Mr. Damon in the matter of correspondence-school education. He holds that the ability to answer questions already answered is not one of the qualifications of an engineer. He also believes that shop experience, though an excellent thing, should not be obtained by interrupting the college course. Experience in this line should be acquired in the 18 months or two years following graduation.

F. R. McBerty read an excellent discussion on the paper. Referring to the large number of men engaged in the practice of telephone engineering who are not technically educated, Mr. McBerty ascribes this to the fact that telephony thus far has been in a transitory state, requiring judgment and shrewd guessing. Every step in the advancement of telephony is marked by numerous patents, by far the larger number of which were taken out by men not technically educated. He believes that many so-called non-technical men have really the same technical knowledge as those who have finished a college course, having gained this knowledge through their own efforts. Telephony is a science, and the most refined calculations in light and power work are but rough approximations when compared to the problems which arise in the practice of telephone engineering.

S. G. McMeen pointed out the fact that money is not the lodestone which should attract the engineer, but that it is that indefinable something about the practice of his profession which is a never-ending source of enjoyment to the engineer whose heart is in his work.

Dr. F. A. C. Perrine of Pittsfield, Mass., who fortunately was present at the meeting while on a flying trip to Chicago, was also firmly of the opinion that the college course should not be broken into by a year of practical work, not only for the reason that the student's studies are interrupted, but also because his practical work is interrupted by the last year in college. In so doing a man makes, as it were, a false start in his life work. Thoughtfulness, he believes, is the prime factor in success. The only thing which should lead a man to take up the profession of engineering is love for the work. With love for the work he will do it well, and in doing it well he will attract his employer's attention and surely receive his reward as far as pay is concerned.

E. P. Warner then said a few words about the early training of the boy and its effect upon his work in after life. A boy should not be compelled to study for the profession of engineering when his natural bent is in another direction, and the college professors should bear this fact in mind and do all in their power to persuade students who have no natural aptitude for the work to make a change before they are made to do so by bitter experience. Professor Freeman in answering this said that as far as possible he made it a point to do this, and that invariably students in his classes who showed no natural adaptability for engineering work found obstacles arising in their path whereby they were compelled to change their course.

How to Minimize Danger in Handling Electrical Apparatus.[1]

The dangers peculiar to the duties of those engaged in electrical work may be classified under four general heads: (1) Those attributable to shocks; by shocks meaning injury due to the passage of current through the body. (2) Those attributable to burns or injuries caused by burning some portion of the body by contact with an electric arc. (3) Flashes or injuries to the eyes by exposure to the intense light of an arc. (4) Those attributable to falls caused primarily by shocks or burns.

Shocks.—A shock may be received from any electrical circuit, provided the body or some portion of the body be allowed to form a link in the circuit. No shock can be obtained unless the circuit is completed through the body. This result may follow, however, either by making contact directly to the two sides of a circuit, or by allowing the body to form only a part of the connecting circuit from side to side, as, for instance, by standing on the ground and touching one side of a circuit while a ground exists on the other side.

The severity of a shock depends upon the amount of current passing through the body. This current depends upon the voltage of the circuit and the completeness of contact. It is possible to receive a fatal shock from a 125-volt circuit under certain conditions, which are unusual, however.

The circuits in use on the South Works plant [South Chicago plant of the Illinois Steel Company], in the order of their danger, are as follows:

Transmission circuit to Buffington.—This is a 20,000-volt, three-phase, alternating-current circuit. It is extremely dangerous. No work should ever be done upon this circuit or upon any apparatus connected to it unless it is absolutely certain that the power has been cut off. With such a high voltage the ordinary precautions, such as standing on an insulator, or wearing insulated gloves, are of no value. No lineman should ever climb the poles carrying this circuit, and no attendant should attempt to adjust apparatus used for the control of this circuit, without special instructions from the chief electrician. If, through any accident, a line should become crossed with this transmission line, or the transmission line itself should become broken, no work must be attempted until it is absolutely certain that power has been cut off from both ends of the high-tension line. This is an extremely dangerous circuit, and caution in its care cannot be urged too strongly.

The series arc circuits come next in order of danger. These carry direct-current voltages to as high as 5,000 volts, depending upon the number of lamps burning. These circuits are generally "dead" during the day. At night there is very little work to be done in connection with the circuits, but occasionally it becomes necessary to adjust, or possibly to change a lamp. None but experienced men should attempt this work. The greatest danger, with a voltage as high as this, arises from a possibility of grounds. The leakage alone from the circuit to ground may cause death. Whenever it is necessary for the proper attendant to do work on a live series arc circuit he should adopt every possible precaution. The lamp should be cut off by means of the switch. This does not isolate the lamp from the circuit, however, and the attendant should not touch the lamp unless he is standing on a dry box or other insulating platform. Before taking hold with either hand he should touch the parts upon which he intends to work gently with the tips of his fingers, to make sure he will receive no shock. In other words, he should approach the work with great caution.

The 2,200-volt feeders from the alternating-current station come next in order of danger, and the same general precautions should be exercised in handling these circuits as with the series arc circuits. The voltage is sufficiently high to cause instant death to one making reasonably good contact with both sides of the circuit. Each circuit has three wires, with 2,200 volts from any one wire to either of the other two. If one wire is broken, there may still be 2,200 volts across the other two. Circuits are "live" day and night. The insulation on the wires cannot be depended upon to protect a man from shock. When working on a pole carrying these circuits a man may be seriously shocked simply by touching the insulated covering while he is sitting on a cross-arm, especially if the pole and wire are wet. Never work on one of these circuits "live" without special instructions from the chief electrician.

The 1,100-volt incandescent circuits come next in order of danger. The same instructions hold true with reference to these circuits as for the 2,200-volt feeders.

The 440-volt, alternating-current power feeders should be handled with great care; the pressure is sufficiently high to cause severe shocks, which may be fatal under certain conditions. An experienced man may handle these circuits while they are live if he uses proper precautions, but it is very much better to cut off the power when possible. The circuit must not be handled while live except by special instruction from the foreman in charge of the work.

The 250-volt direct-current power circuits, under ordinary conditions, are not likely to cause death by shock, but the same precaution should be observed in handling these circuits as in handling those of higher voltage, not only to avoid possible injury from shocks and burns, but to form habits of precaution in handling wires.

There are many special conditions which make any electrical work dangerous. Even telephone or signal wires may become crossed with high-tension wires and become charged with danger. It is not possible to explain in detail all such possible cases, but it is to be noted that experienced workers are always "afraid."

It might be mentioned that care should be taken not to "open" or "break" the shunt field of a motor in such a way as to allow the inductive discharge to cause shock. The arc which is drawn when opening a shunt field is caused by a high induced electromotive force, and will cause just as serious a shock as any other high voltage.

Burns.—This class of injury frequently accompanies injury by shock, though it is possible to receive injury by burn even where no shock is experienced. Such cases consist in the injured one coming in contact with an electric arc. The most usual cause of an unexpected electric arc is a short-circuit. This may be caused in many ways. A lineman may get his pliers across from side to side of the circuit; he may allow a wire to drop across; he may bring two sides of a circuit in contact with each other without knowing that they are of opposite polarities, or while thinking they are dead. The resulting arc may burn him seriously. The only way to avoid these accidents is to avoid the short-circuits. The man working on the circuits should never take any step unless he has full knowledge of what the results may be. Knowing the danger, he should take no chances. Most such accidents arise from carelessness or lack of caution.

A frequent cause of arcs is the opening of a switch carrying a large amount of current, an operation, especially if the voltage is high, which may burn a man's hand. Also, arcs are caused by closing switches on circuits where repair work has been done and the line left short-circuited. The trouble usually appears at switches and causes them to be destroyed with violent arcing.

Flashes.—A most annoying, though not deadly, danger exists in the exposure of the delicate nerves of the eye to the intense light of an electric arc. It seems needless to warn men against deliberately looking at an arc, but inasmuch as the injury to the eye does not manifest itself for several hours, it is perhaps not out of place to give warning to all electrical workers that they should not underestimate this danger. Never look at an intense light except with adequate protection to the eyes, such as is afforded from heavy blue or black glasses.

Most flashes are received at the time of an unexpected arc. To avoid this danger, protect the eyes as much as possible by turning them away when there is a possibility of an arc.

Falls.—When a lineman or other electrical worker is engaged at some point where a fall would be dangerous, he should be especially careful not to receive even slight shocks. The surprise of a sudden shock, even though the shock itself is light, may cause an unconscious contraction of the muscles, which may precipitate a man from a position otherwise secure.

Care of Injured.—A man who has been injured by shock may become unconscious. Frequently he may be resuscitated by the application of the rules for the resuscitation of persons apparently drowned. The principal object of these rules is to establish artificial respiration. Every electrical worker should familiarize himself with these rules. In general, the proper course is to place the shocked man upon his back with something under his shoulders to raise his chest. By taking hold of the wrists of the patient and alternately pressing his arms to his chest and raising them over his head, air will be forced alternately out of and into the lungs. This should be continued for two or three hours, if need be, at the rate of about 16 times per minute.

The man should be removed to the hospital, how-

[1] This is a reprint of a little pamphlet prepared by Mr. P. B. Clark for the information of employes of the electrical departments of the Illinois Steel Company. Mr. Clark, who is assistant general superintendent of the works at South Chicago, is an electrical engineer. The pamphlet was prepared for the use of practical men, and difficult terms have been avoided. Believing that it will be of value to other practical men than those employed by the Illinois Steel Company, the Western Electrician sought and obtained permission to republish it.

ever, as quickly as possible and placed under the care of a physician.

In case a flash has been received, it may not become painful until several hours later, at which time, however, the pain may be very severe. To avoid suffering, seek the advice of a physician immediately after receiving the flash, even though the eyes do not seem painful. In this case, as in all others of injury, the man should report at once to the hospital.

Precautions to Be Observed.—Avoid working on live circuits as much as possible.

Where the power has been cut off by opening a switch located some distance from where the work is being done, always place a sign on the switch stating that men are working on the line.

When the work is completed, remove the sign. No man except the man who placed it should ever remove such a sign.

Never close a switch without full knowledge concerning the circuit and why the switch was opened.

Never handle electric wires while standing or sitting in a wet place without extra precaution to obtain insulation from ground.

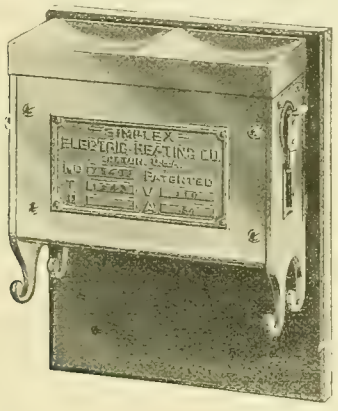
In handling any circuit known to be live use only one hand. It is best to keep the other hand behind the back. The most dangerous shocks are those from hand to hand.

So far as possible, treat all circuits as though they were live, even though you believe them to be dead.

Be cautious and alert at all times and under all conditions.

Curling-iron and Cosmetic Heater for Theater Dressing Rooms.

The effort to reduce theater hazards to the minimum on the part of owners, managers and insurance companies has made a demand for electric curling-iron and grease-paint heaters so as to enable gas to be eliminated from stage dressing rooms. In addition to its previous product in this line the Simplex Electric Heating Company of Cambridge, Mass., has recently brought out a new type of combined grease-paint and curling-iron heater, which



CURLING-IRON AND COSMETIC HEATER.

is shown in the accompanying picture. While it is a combination device, the heating of the grease paint is independently controlled.

The grease-paint heater is divided in two sections and forms the top of the device and is controlled by a quick-opening switch on the left side. The curling iron is inserted at the right side and the current is automatically turned on or off by the action of putting in and removing the curling iron. Hooks are provided for hanging the curling iron when out of use. The apparatus is finished in polished nickel and is mounted on enamel slate and arranged to fasten to a standard outlet box or on the wall as ordered. This product is the result of the co-operation of an expert theater electrician, George A. McCurdy of New York and the company's engineers, and has been installed in several theaters.

Death of Jesse Spalding.

Jesse Spalding, a pioneer lumber dealer of Chicago and at one time president of the Chicago Union Traction Company, died at his home, 1709 Prairie Avenue, Chicago, on March 17th. He had been in poor health for some years and it is thought his death was caused from worry over the recent critical illness of his wife. At the time of his death Mr. Spalding was president of the Spalding Lumber Company, and his business interests included holdings in several large banks of Chicago. He had been active in municipal affairs, having, under the administration of Mayor Colvin, when the city treasury was practically empty, served for three years as chairman of the council finance committee. In 1899, when the Union Traction Company obtained control of the systems previously operated by the North Chicago and West Chicago companies, Mr. Spalding became its president and remained in charge until May 28, 1900, when ill health forced him to retire.

Mr. Spalding was born in Pennsylvania 67 years ago and spent much of his early life in rafting logs down the Susquehanna River. When 23 years of age he was buying logs for himself and later established a sales yard in Chicago at Lumber and Twelfth Streets. It was partly through his efforts that the ship canal was built across the peninsula from Sturgeon Bay to Lake Michigan, thereby shortening the lumber route to Chicago by 150 miles.

Surviving Mr. Spalding are a widow and four children, Mrs. R. L. McElwel, Mrs. G. H. Harris, Mrs. H. H. Walker and Charles F. Spalding. The funeral took place on March 19th from the Grace Episcopal Church. The honorary pallbearers were J. Ogden Armour, Marshall Field, Robert T. Lincoln, James H. Eckels, Franklin McVeagh, Thomas Murdoch, A. A. Sprague, John J. Mitchell, Erskine M. Phelps, Charles E. Dyer and James M. Donald.

Electrical Legislation Pending in Congress.

The result of the continued unsatisfactory service which is being rendered to the patrons of the telephone by the Chesapeake and Potomac Telephone Company has been the introduction of a bill before Congress for the purpose of granting a charter to a new company, to be known as the District Telephone Company, which is to render service at a cost of not exceeding $36 a year for private residence telephones and $48 for public offices.

A joint resolution has been presented for the purpose of directing the Secretary of the Navy to make a thorough test of the Cobham obliterator and recorder of wireless telegraphy, designed to obliterate all forms of wireless communication, with selective transmission during obliteration, within a range of 100 miles, and said to destroy all forms of electrically controlled and operated torpedoes, mines, and so forth, and which, it is further asserted, is practically adapted to naval and coast defense use, with a new system of inverted wireless transmission extending the art of wireless telegraphy to a greater range of attainment and greater distance of transmission, with less power than heretofore ever attained. For this purpose the sum of $5,000 may be appropriated.

Senator Gallinger has introduced a bill to regulate the use of telegraph wires in the District of Columbia, wherein it is provided that all telegraph poles and their attached wires not the property of the District and which are now standing within the limits of the District shall be removed, with a certain named list of exceptions, the work of removal to be done under the direction of the commissioners, who are given the power to notify any telegraph companies who are now or may at any time hereafter be located in the District to lay the conduits necessary for the compliance with the requirements of the bill, the work to be done as expeditiously as possible.

Fireproofing at St. Louis Exposition.

Exhibitors are requested to notice that fabrics for use at the St. Louis World's Fair for decorative purposes, including burlaps, lace curtains, stage accessories or canvas for oil paints shall be rendered fire-resisting by thoroughly impregnating the fabric with a strong solution containing tungstate of soda and at least one of the following-named chemicals: Phosphate of ammonia, sulphate of ammonia, boric acid, borax.

Sufficient quantity of the chemicals must remain in the fabric to render the fabric satisfactory when submitted to the following test: First, chemical must not, when dry, be liable to dust out by rubbing; second, when article is passed through flame at a speed slow enough to carbonize the fabric, the products of destructive distillation are not readily inflammable; third, carbonized fabric, after second treatment, shall not glow when ignited in Bunsen or alcohol flame, after being removed from the flame.

COMMUNICATION.

Thawing Ice in Water Pipes by Electric Heat.

To the Editor of the Western Electrician:

We notice in your issue of even date some reference made to the possibility of thawing frozen water pipes by electric current. Thinking that it might interest your readers, we will mention that about two weeks ago we thawed out an eight-inch cast-iron main that was frozen up. During Sunday, while we were shut down for a few hours, we connected one of our direct-current generators to convenient fire hydrants and turned on 1,800 amperes at 10 volts without rheostat of any kind. We simply regulated the speed of our waterwheels until we got the required amperes, leaving the voltage to be what it might. After running for a few minutes we found that our conductors were not equal to 1,800 amperes, so we reduced to 1,400, at which we ran for about 55 minutes, when the water came. The total length of water main in circuit was about 600 feet.

E. PETERSON,
Manager Crookston Water Works, Power and Light Company.

Crookston, Minn., March 19, 1904.

PATENT LITIGATION.

Tesla Split-phase Motor.

The suit of the Westinghouse Electric and Manufacturing Company against the Mutual Life Insurance Company of New York and H. C. Mandeville, brought to recover for alleged infringement by the defendants of Tesla patents, Nos. 511,559 and 511,560, has been decided in favor of the complainant. The infringement complained of was brought about by the use by the defendants of an alternating split-phase motor in a recording wattmeter, the infringing apparatus used being the Gutman meter. Judge Hazel, in his opinion, filed in the United States Circuit Court for the Western District of New York, on final hearing, says that the defense is "want of patentability, non-infringement and anticipation."

The first claim of patent No. 511,559 relates broadly to the method and extent of retardation of the phase of the current. The second claim refers specifically to the method of accomplishing in the electric currents a difference of phase. The claims of patent No. 511,560 refer particularly to the apparatus for effecting the object of the process of patent 511,559, and specify the devices constituting the split-phase motor with a single circuit. The construction adopted by the court is as follows:

"By the method and means therein described Tesla dispensed with one of the line circuits, and was able to run the motor by means of alternating currents from a single original source. This was accomplished by means which retarded the phases of the current in all circuits, or so varied the relative resistance of the motor circuits as to maintain the necessary difference in phase in the currents. Such utilization of a single original source by thus splitting a single current into two currents was an improvement of great practical value."

Of the contention that the patents were invalid because anticipated by the admitted publications of Prof. Galileo Ferraris on April 22, 1888, in Turin, Italy, Judge Hazel says: "Upon careful consideration of the proofs I have arrived at the conclusion that the actual date of the Tesla inventions is prior to this publication and that the patents were not void for anticipation. According to the evidence, Tesla conceived his invention in his laboratory, No. 89 Liberty Street, New York city, and completed the same in the month of September, 1887. He made disclosure thereof to others during the fall of 1887."

Judge Hazel concludes with the statement that the defendant has failed to establish any of the grounds upon which complainant's right to sue for infringement depends, and the complainant is therefore entitled to a decree in the usual form, with costs and disbursements.

Trolley Contact Spring.

Judges Lurton, Severns and Richards of the United States Circuit Court of Appeals of the Sixth Circuit have rendered a decision sustaining the validity of the eighth claim of the Anderson patent No. 412,155, covering improvements in electric trolley wheels. The eighth claim bears directly on the metallic conducting brushes between the hub of the trolley wheel and the trolley frame. The suit was that of the General Electric Company versus the International Specialty Company, in an appeal from the Circuit Court of the United States for the Eastern District of Michigan, which held that in the defendant's structure the metallic conducting brushes do not bear upon the hubs of the trolley wheel, but are placed between the trolley frame and the end of the journal or bearing of the trolley wheel, and do not, therefore, infringe the Anderson patent. This decision is now reversed, and, in the opinion rendered, the Court of Appeals says in part:

"The defendant's device in the present case is essentially the same as that which we had held to be an infringement in the Star Brass Works' case. The conducting brushes are metallic, they bear upon the ends of the hub and not the periphery of the hub or wheel, connect it with the trolley harp or frame, and are placed in a protected position within the harp or frame. * * * Nothing has been presented to us upon this hearing which would justify a reversal of our holding in the Star Brass Works case, that the eighth claim is valid, and since we are satisfied that there is no essential difference between the defendant's structure and that before us in the Star Brass Works case, we must sustain the charge of infringement."

Hiccoughs Cured by Electricity.

Electricity, it is said, has been applied successfully for the cure of hiccoughs. Frank Green, a student in the life class of drawing at the Trenton School of Industrial Art, Trenton, N. J., was the patient, and after three days' suffering with the malady he was in a much weakened condition. Then a friend suggested the use of electricity, and a light current was applied to Green's body. An improvement was noted and the strength of the current was increased. Finally, upon applying a sudden shock, the hiccoughing ceased, and, according to the newspaper account, the cure was complete.

The Association of Railway Telegraph Superintendents will hold its annual meeting this year in Indianapolis, Ind., on June 15th and 16th. The headquarters will be at the Hotel English.

Central States Long-distance Telephone Merger.

A consolidation of all Independent long-distance telephone companies operating in Ohio, Indiana, Illinois and Missouri, forming a chain from Cleveland to St. Louis, is the promised result of a meeting held in Indianapolis on March 19th by a number of the most prominent Independent telephone men in the Central States. The formulating of plans and the discussion of means to the proposed merger took place in executive session, but it was given out that an arrangement had been agreed upon between the various Independent companies whereby they will use each other's lines for long-distance service in other states, and that when necessary short connecting lines will be built so as to put into effect the co-operative service.

It is understood that the United States Telephone Company of Cleveland, over whose lines the traffic of numerous Independent telephone companies is carried on, is backing the plan, although the idea was first conceived by Mr. S. P. Sheerin of Indianapolis, who called the meeting. The principal companies to the merger are the United States Telephone Company, the Pittsburg and Allegheny Telephone Company, the New Long-distance Telephone Company, the Cuyahoga Telephone Company of Cleveland, the Citizens' Telephone Company of Columbus, Ohio, the United Telephone Company of Bluffton, Ind., the Indianapolis Telephone Company and the Kinloch Telephone Company of St. Louis. It is now pretty generally believed that the formation of the Indianapolis Telephone Company recently was the preliminary step in the merging of the companies named for the purposes in view.

The following representative telephone men attended the meeting and after its close were the guests of the officials of the New Long-distance company at dinner at the Columbia Club: Maxime Reber, James B. Hoge and F. S. Dickson of Cleveland, James E. Brailey of Toledo, C. M. Foster, C. H. Ledlie, Breckinridge Jones, W. D. Orthwine, August Gehner, W. F. Nolker, Philip Stock, J. I. Drummond, Philip Scanlon, H. L. Reber, W. H. Bassett, E. B. Denison, W. R. McCanne and D. W. Pitman of St. Louis, J. D. Powers, J. A. Armstrong, M. Tetu and M. R. Brailey of Louisville, J. C. Splain of Pittsburg, Hugh Dougherty of Bluffton, C. F. Ramsey of Crawfordsville, S. P. Sheerin and H. B. Sales of Indianapolis.

Western Telephone Company.

The annual meeting of the Western Telephone and Telegraph Company, successor of the old Erie company, was held in Jersey City, N. J., last week. The annual report of the directors for the year ended January 31, 1904, showed gross earnings of $1,238,221, as compared with $1,304,210 for the preceding year. The net income was $699,631, an increase of $25,782 over 1902-03. Dividends of $640,000 were paid, leaving a balance of $59,631. President Fish stated that the year showed satisfactory growth in all the controlled companies. The number of exchanges operated by the Cleveland, the Northwestern, the Southwestern and the Wisconsin companies at the end of the year was 306, and the exchange stations numbered 132,337. The close of the year showed 91,847 miles of toll wire, and the total new construction work during the year required $2,546,659. The sale of the Michigan Telephone Company, whose stock was principally owned by the Western, has not affected the company, says Mr. Fish, as the securities have not been rated as having any specific value.

Telephones Used for Gambling Purposes.

A crusade against gambling is in progress in Chicago. As one feature of it the police demand that the Chicago Telephone Company discontinue telephone service to persons making books on the races. This demand has been met by the following statement from General Manager Hibbard of the company: "We will remove all telephones which are used for gambling purposes, but we want the city of Chicago to take the responsibility, as we have no proof that the telephones are being used for gambling purposes, and will take them out only on the order of the police." This statement is intended to notify the city officials that they will be held responsible in case any of the telephone subscribers sue the telephone company for damages for the cutting off of the telephone service. Assistant Chief Schuettler is said to have been given a list of 500 telephones which are being used for obtaining race results.

The Missouri and Kansas Telephone Company has reduced the rates in Kansas City, Mo., to $3.50 a month for unlimited individual service; unlimited selective signal service, party line, $2.50 a month; unlimited party-line service, $2 a month; limited nickel-in-the-slot, minimum, $1.50 a month. Ten years ago business houses paid $120 a year and residences, $72.

Telephone News from the Northwest.

The Windom (Minn.) Mutual Telephone Company has decided to raise rates to $2 a month for business connections.

The Clearwater (Minn.) Telephone Company has increased its capital stock from $10,000 to $25,000 and will extend its lines through the county.

A consolidation of the Minnesota Mutual Telephone Company, the White Bear Telephone Company and the Maple Leaf Telephone Company, all operating in adjacent territory near Rush City, Minn., is being negotiated.

The Farmers' and Merchants' Telephone Company of Arlington, Minn., has been formed, and a local exchange will be installed with a line running to Green Isle and other points.

The Milton (N. D.) Telephone Company has incorporated with $10,000 capital. A line will be built to Olga and later to Soper and other towns.

The Vought-Berger Company of La Crosse, Wis., manufacturer of telephone apparatus, may remove to Minneapolis or St. Paul. Capitalists of the Twin Cities are negotiating for the business and may remove the plant to a location in the Midway district and expand the business.

The Thompson, Caldwell and Wilson Telephone Company will commence work on its new system at Brookings, S. D., at once. Several rural lines will also be put in.

The Twin City Telephone Company is considering plans for building a telephone line from Minneapolis to Waverly, Minn.

The telephone companies of Western Iowa and South Dakota are talking of forming a long-distance circuit between Sioux Falls, Mitchell and Yankton, S. D., and Sioux City, Iowa.

A local telephone company has been organized at Sheyenne, N. D., and a local system will be installed.

A franchise has been granted at Newton, Iowa, to the Reasnor Telephone Company.

The Polk City (Iowa) Telephone Company has incorporated with a capital of $3,000.

The Iowa Telephone Company has moved its head offices from Davenport to Des Moines.

J. R. Adamson of Broken Bow was granted a franchise at Ravenna, Neb., for an Independent telephone system.

The Independent Mutual Telephone Company of Ottertail County has been organized. A line will be built connecting Underwood and Dalton, Minn.

A telephone franchise has been granted at Bowbells, N. D., to G. L. Bickford and others. R.

Indiana Telephone Items.

The following telephone companies were incorporated last week: Camden Co-operative Telephone Company, Camden and in Carroll County, U. T. Tesh; Coffman-Heller Telephone Company, Center Township, Hancock County, Luther Newhouse; Terhune Co-operative Telephone Company, Terhune and in Boone County, L. A. King; Mexico Home Telephone Company, Mexico and throughout Miami County, H. C. Strong.

The Cumberland Telephone Company, operating in Southern Indiana, has granted free toll service in Harrison, Floyd and Crawford Counties. The lines between the principal cities—Carrydon, New Albany and Evansville—were kept busy the first day under the new and liberal arrangement. Turns were taken like going to mill. The new arrangement is regarded as a great convenience and has already popularized the Cumberland company among a large number of patrons.

The Home Telephone Company of Logansport is obliged to purchase an additional switchboard to increase the capacity. Already the company has let the contract to lay a number of additional cable lines. The company has already connected up a dozen or more village and town exchanges and a score more are applicants. These village exchanges each have from 150 to 200 farmer lines and the service afforded is proving so satisfactory that every small exchange in the Home company's large territory is seeking connection. These branches will be taken on as fast as cable lines can be constructed. F.

Ohio Telephone Notes.

Without solicitation the Cuyahoga Telephone Company of Cleveland has secured more than 125 new subscribers since the new switchboard was installed, and it is believed that within a reasonable time its business will be doubled. This will add materially to the business of the United States Telephone Company also, since the Cuyahoga secures more business of this kind than any of the other connections. Reports of officers of the Cuyahoga company for February show the gross earnings a little less than for January, but the surplus was slightly larger, being $5,488.51.

The Montpelier Telephone Company of Montpelier, Ohio, has notified the secretary of state of an increase of capital stock from $15,000 to $50,000.

The Brown County Telephone Company of Georgetown has been incorporated with a capital stock of $20,000 by O. E. Bare, W. J. Marshall, H. C. Landon, G. Bambach and John C. Martin.

The Hartsgrove Citizens' Farmers' Association has had an interesting experience in the telephone line. It was organized to be operated on the mutual plan, each member being entitled to one telephone and the expense divided pro rata. The company now has 500 subscribers, with 35 miles of line and two exchanges. It operates in Rome, Hartsgrove, Windsor, Trumbull, Harpersville, Thompson and Armstrong. So far there has been no competition from the Bell company. The officers are: President, Robert Marro; secretary, L. W. Lee; treasurer, J. V. Wilson; manager, E. W. Hunt. C.

Michigan Telephone Matters.

The annual meeting of the Union Telephone Company's stockholders, which has just been held at Alma received reports from the secretary and manager which show the company to be in excellent financial condition and business to be rapidly on the increase. At present the company owns over 1,700 miles of toll lines and has over 4,000 subscribers. The officers elected for the ensuing year are as follows: President, S. E. Parkill, Owosso; vice-president, James P. Gibbs, Ithaca; secretary, J. H. Fildew, St. Johns; treasurer, G. S. Ward, Alma; general manager W. J. Melchers, Alma. Representatives were in attendance from Ithaca, St. Louis, St. Johns, Vestaburg, Shepherd, Edmore, Owosso, Merrill and Mt. Pleasant.

The last of the old Detroit Telephone Company's wires have been removed from the downtown streets of Detroit, and the Michigan State Telephone Company, successor to the Michigan Telephone Company, will abandon some of the conduits and wires. W.

State Supervision of Telephone and Telegraph Companies.

A public hearing was recently given by the legislative committee on mercantile affairs of the Massachusetts Legislature, at which the bills of Senator Callender and Representative Dietrick were thoroughly discussed. The bills provide that the Board of Gas and Electric Light Commissioners shall have general supervision of all companies engaged in the transmission of intelligence by electricity, shall make all necessary investigations thereof, and shall keep itself informed as to the compliance of the companies with the provisions of law. Other sections provide for the making of complaints as to the prices charged and service rendered; preventing of increase of rates without consent of board and after public hearing, and the furnishing of information by the company as to rates, service and other incidents in its business.

Senator Callender in favoring his bill recounted the history of the legislative fight that has been made in past years, beginning with 1898, when the great fight was made to gain control over these companies. He said that the use of the telephone was first a luxury, later a convenience and now a great public necessity. He stated that he did not propose to introduce evidence, but that the petitions that had been signed and the facts in the case he would let speak for themselves. Representative Dietrick went over the same ground. A. W. Chamberlain and W. H. Hammond also spoke in favor of the bills. L. A. Goudy of the Northeastern Telephone Company of Portland, Me., was the principal telephone man to support the bill. He believed that Massachusetts should have supervision and control over the telephone and telegraph companies, as it does over the other public-service corporations.

In opposition, the principal speakers were V. S. Sears, representing the Fall River Automatic Telephone Company and the New Bedford Automatic Telephone Company; Robert McKay of the Globe Automatic Telephone Company of Chicago, and Mr. Hall, representing the Bell company. Both Mr. Sears and Mr. McKay said that they did not oppose the general provisions of the bill, but they objected to the sections providing that competing companies may not enter the field already occupied in a town without the consent of the mayor and aldermen or board of selectmen. They did not oppose an investigation of the telephone companies or a commission to supervise them, but did object strongly to the limiting of competition. Mr. Hall stated that there was no reason for state supervision. The rates, he said, had been constantly reduced, mistakes in answering calls were reduced to a minimum, and as regards incorrect charges, he said that his company's system was such that if incorrect charges did occur the company was the loser and not the subscriber.

Arthur Lord appeared in opposition as counsel representing the telegraph interests. He said that as far as the telegraph companies are concerned there is no call for such legislation. Omitting the press and the bankers and brokers, less than one per cent. of the public are users of the telegraph, so the public at large is not interested in the matter.

Bell Output for February.

The American Telephone and Telegraph Company's instrument output statement for the second month of the current year exhibits a lighter net output than for the corresponding period of 1903 or 1902. Comparisons are appended:

February	1904.	1903.	1902.	1901.
Gross output	84,402	91,841	95,584	73,310
Returned	37,093	35,185	36,855	26,144
Net output	47,309	56,656	58,729	47,166
January 1 to March 1				
Gross output	175,046	221,681	182,996	139,358
Returned	73,947	78,474	71,651	51,910
Net output	101,099	143,207	111,345	87,448
Total under rental Mar. 1	3,880,616	3,293,527	2,637,355	2,040,264

Two Methods of Giving Toll Service in Connection with Automatic Exchanges.

By Charles S. Winston.

Although many men assert their belief that the automatic telephone exchange is the exchange of the future, and that the automatic switchboard is destined to replace the manually operated board, I think all will agree that toll service cannot be extensively furnished without the aid of human intelligence at the central office. The necessity of recording the exact duration of a toll conversation, the arranging for the proper charge and the multitude and varying steps which must be taken in order to reach the person called for will, at any rate, prevent the "hello girl" from becoming a museum curiosity.

It is the purpose of this paper to describe, as briefly and as simply as possible, the methods of operation of the circuits which were installed during the last year by the Kellogg Switchboard and Supply Company in toll boards built for use in connection with the automatic-exchange apparatus of the Automatic Electric Company at Dayton, Ohio, and at Grand Rapids, Mich. As these two exchanges are the first ones of any considerable size to employ automatic switchboards, a new field of toll work was opened up by them, and the matter, therefore, appears to be one of much interest.

The automatic exchange at Grand Rapids is adapted to numbers requiring four movements of the subscriber's dial, giving a capacity for something less than 10,000 lines. In order to make some of the terms that it will be necessary for me to use in this description intelligible, it may be stated that the automatic switchboard as at present developed, is essentially a trunking system. At Grand Rapids each subscriber's line terminates at the central office in a switching device termed a first selector, the function of which is, in response to the first movement of the subscriber's dial, to continue his line through a trunk line leading to a second switch, termed a second selector. This is in a group corresponding to the particular thousand in which the called subscriber's number exists. The second movement of the subscriber's dial operates the second selector and continues the line connection through a trunk leading to a third switching device, called a connector. The connection is thus continued to the group of hundreds corresponding to the second digit in the called subscriber's number. The third movement of the dial operates this connector to pick out the group of tens in which the called-for subscriber belongs, and the fourth movement causes the connector to select the proper unit, thus completing the connection with the called subscriber's line.

Each line at Grand Rapids upon entering the exchange passes through the main distributing frame and then through a cut-off jack located in a so-called switching section in the toll room, to the first connector.

The dial on the telephone set of each subscriber in the automatic exchange has, in addition to the 10 holes ordinarily furnished and marked consecutively from 0 to 9, one marked "Toll." Whenever a subscriber desires a toll connection he will place his finger in this extra hole and turn the dial. By so doing he will operate the first selector. The operation of this selector will establish a connection between the subscriber's instrument and the first of a number of recording trunk lines which is not in use. Each recording trunk line ends in a lamp and jack at a position of the toll board termed the "recording operator's position." When, then, the automatic subscriber turns his dial, as stated above, a circuit is established from his telephone to the recording operator's position. If the subscriber were calling a second automatic subscriber, he would, after making the proper movement of his dial, press the ringing button, thus grounding one side of the line and operating a relay, which would cause current from generator to pass out over the line of the called subscriber and ring the bell of that subscriber. In the case of a call for toll, the subscriber will press the ringing button in the same manner, but the result of his act will not be the same. Instead of closing a circuit for generator current, a relay at the recording operator's position will be operated and a lamp lighted, thus attracting the attention of the recording operator.

In front of this latter operator are located a certain number of plugs adapted to use in connection with the recording trunk lines. In response to the lighting of the trunk lamp the recording operator will insert one of these plugs into the trunk jack and, after throwing a listening key, obtain from the subscriber the information necessary for establishing the connection. She will then write the information obtained on a ticket, pass it to a toll-line operator and tell the subscriber to hang up his receiver and wait until called. The hanging up of his receiver restores his line to its normal condition, so that he is free to receive or send other calls.

Each toll-line operator's position is provided with a certain number of cord circuits, one plug of each circuit being adapted for use in connection with a multiple or answering jack of a toll line, and the other in connection with a multiple jack of a toll trunk line leading to the switching section. This latter trunk terminates in a plug which may be connected with any local line by inserting it into the cut-off jack of the line at that section. To state this in another way: Each toll line is multipled through the toll sections as in ordinary manual practice, and one side of each toll operator's cord circuit is adapted to use in connection with these jacks. These toll trunk lines terminate in plugs on the toll-switching section, and connection may be made between any automatic subscriber's line and any trunk line by inserting the plug of the latter into the jack of the former.

As soon as the toll operator, as described above, receives the ticket from the recording operator, which will give her the name and address of both the calling and the called parties, she will insert one of the plugs which is adapted to toll service into a jack of the desired toll line and call the person who is wanted. When the toll operator succeeds in finding the desired person at the toll station, she will speak over an order wire to the operator at the switching section, give to this operator the number of the automatic subscriber who previously called for toll, and receive in return the number of the trunk line which is to be used for the connection. The toll-line operator will then insert the plug corresponding to the toll plug already in the toll-line jack into a multiple jack of the designated trunk; and the switching operator will, after testing the cut-off jack of the automatic line and finding it free, insert the toll-trunk plug into it. The toll-line operator will immediately assume charge of the connection and ring the automatic subscriber. When he answers she will tell him to make a movement of his dial, after which she will allow the conversation to begin. The reason for making this request requires explanation. According to my understanding, at the end of conversation between two automatic subscribers the apparatus at the exchange is restored to its normal position when the calling subscriber hangs up his receiver, he thereby placing temporary ground upon both sides of the line simultaneously to bring about this result. As the called subscriber makes no movement of his dial before conversation, his instrument is not in a position to ground the line when he replaces the receiver. In the case of a toll connection, however, the automatic subscriber is called from the toll board, and as his instrument must perform the clearing-out function, it is necessary first to place it in condition to do this by a preliminary movement of the dial. Connected in series across the automatic end of each cord circuit are the windings of a double-wound relay, the inside terminals of which are connected to the ungrounded side of battery. Whenever ground is applied to either or both sides of a line to which a cord circuit is connected, this relay will be energized and a lamp displayed. This lamp serves as a disconnect signal and enables the subscriber to signal the operator by pressing the ringing key, thus placing a ground on one side of the line, or if his dial has previously been moved, to give a clearing-out signal by hanging up his receiver.

At the termination of a conversation the operator receives, therefore, a double disconnect signal—the falling of a clearing drop in the toll side of the cord and the lighting of a lamp in the automatic side. The act on the part of the toll operator of removing the automatic plug from the toll trunk jack will light a lamp associated with the toll-trunk plug at the switching section, and the operator at this section will remove the connection.

Except for the fact that the toll-line operator makes out the ticket herself, the steps which it is necessary to take in establishing and removing the connection when a person at a toll station calls for an automatic subscriber is the same as described above, after the toll-line operator receives the ticket from the recording operator. In establishing such a connection the recording operator plays no part.

It will be noted from the above description that during a conversation between a toll and an automatic subscriber, the connection normally existing between the automatic subscriber's station and the automatic exchange is broken at the switching section, and therefore the multitude of contacts in the talking circuit and the bridges always present across the talking circuit during conversation between two automatic subscribers are removed. There is, therefore, no inherent reason why excellent toll service should not be furnished.

While the Dayton toll board is similar in many respects to the one at Grand Rapids, there are many radical differences between them. At Dayton the dials are not provided with special holes for calling toll, but a certain number is used, in order to reach the long-distance board. With this exception, the subscribers at the two places will notice no difference in the steps which are necessary in order to obtain a toll connection. However, at Dayton there is no switching section, and, although an automatic subscriber desiring a toll connection is first placed in communication with a recording operator, who, after obtaining the necessary information for making out a ticket, requests him to hang up his receiver, yet conversation takes place through the automatic exchange apparatus, the toll operator calling the automatic subscriber by means of a dial similar to the ones furnished the subscribers. One dial is furnished for each operator's position, and a key in each cord circuit enables the dial to be used in connection with any one.

The disconnect signal is received at the toll board in the same manner as at Grand Rapids. If, however, the automatic subscriber did not move his dial when requested to do so by the operator, arrangement is made, by means of which a ground is momentarily placed upon the trunk line and the automatic subscriber's apparatus thus restored to its normal position when the operator takes down the connection. This feature makes it impossible for a subscriber's line to be held up.

A summing up of the advantages of each system is hardly necessary, as they are evident. Suffice it to say, however, that the Grand Rapids system is by far the better, as a talking circuit not loaded down with bridges is furnished and the duties of the operators are similar to those of operators in the most up-to-date toll systems. The Dayton board is preferable in one respect. As a switching section and cut-off jacks are not required, the initial cost of the equipment is less than that of a system similar to the one at Grand Rapids.

GENERAL TELEPHONE NEWS.

The annual meeting of the American Telephone and Telegraph Company will be held in New York city on March 29th.

All bids for a telephone franchise have been rejected by the general board of councilmen at Covington, Ky., and the franchise will again be advertised.

The Kansas City Home Telephone Company has applied to the City Council of Argentine for a 20-year franchise to build and maintain a telephone system in that city. A rate of $60 a year for business telephones and $30 a year for residences is proposed.

Crossed telephone wires are said to have caused a bell to ring repeatedly in the National Bank at Elnora, Ind., just at the time when burglars were at work in the building. Evidently thinking it a burglar alarm, the robbers ran away. The safe had been drilled and nitroglycerin and a fuse had been inserted.

It is announced that the Grant County Telephone Company of Silver City, New Mexico, will build a long-distance telephone line to the different mining camps, situated in the Burro Mountains. This company now has an extensive telephone system, extending to all the leading mining camps and towns in the southwestern part of New Mexico.

The Independent Telephone Company has been incorporated in Hanford, Cal., by H. L. McGubbin, C. P. Carrasco and J. Mills, with a capital stock of $25,000. It is the intention of the company to do a general telephone business and to construct a line running from Lemoore to Hanford, a distance of 10 miles. The headquarters of the company are at Lemoore, Cal.

The Commercial Union Telephone Company has been organized at Troy, N. Y., for the purpose of taking over the business of several Independent companies doing business in that section, and the company plans to greatly extend its business without delay, taking in the territory as far east as North Adams, Pittsfield and Springfield, Mass., and on the north as far as Plattsburg, N. Y. The company also plans to make further extensions during the coming years. The Independent companies of Troy, Saratoga Springs and Glens Falls are included in the consolidation. Among the directors of the new concern is Edward Davis of Philadelphia.

On account of the many changes which will be occasioned by the usual May moving, the Illinois Tunnel Company of Chicago announces that the free service of its automatic telephones will be extended until April 30th. A new telephone directory will be delivered on April 4th. This directory will contain the names, addresses and business classification of more than 2,500 new subscribers whose telephones have been installed since issuing the last directory. The company expects to have 10,000 main-line telephones in service in the business district at an early date. The installation of telephone extensions and private branch exchanges which preserve the secrecy of the service will be begun by May 15, 1904, insuring, it is said, 25,000 telephone connections by January 1, 1905.

MANUFACTURERS AND DEALERS.

The Automatic Electric Company of Chicago announces that the Citizens' Telephone Company of Columbus, Ohio, has increased the order placed with the former some time ago. The original order called for complete automatic equipment for 7,000 stations, initial installation. The new order makes the number of stations to be installed in the beginning 8,000. The Citizens' company will erect a new building for the automatic exchange, which will be designed especially for this type of equipment.

Those desiring some useful hints upon the installation and operation of interior-telephone systems will do well to examine bulletin No. 149, recently issued by the Holtzer-Cabot Electric Company of Boston, Mass. These systems are of three kinds, the intercommunicating system, the speaking-tube system and the switchboard system. The first is wired to enable each station to make its connections without the intervention of a central operator, the second is used where service is intermittent and is composed of a common talking circuit for all the telephones, only one conversation being possible at one time. The third system makes use of a central switchboard with operator. The bulletin contains practical information and good diagrams.

Advertising.[1]

By Henry W. Hart.

For the last few days you have been listening to explanations of the strong features, the salient qualities of the products of our house. These have been pointed out by men who have made a special study of the particular conditions of which they speak. Undoubtedly, much new information has been brought to your attention, with which you were before not thoroughly familiar.

To me has been given the task of proving that 100 multiplied by 10 equals 1,000—of attempting to make the obvious interesting, the familiar novel; in short, to demonstrate that advertising pays; and, having shown this, to indicate, rapidly and briefly, the various methods by which it is made to pay. So convinced am I that you are thoroughly familiar with this great modern force, advertising, which, within the last 15 years—yes, the last 10 years—has been so marvelously developed, that I feel almost as though I were attempting to demonstrate a truism. This conviction, however, will enable me to be brief.

Does advertising pay? Carefully compiled statistics, published by the New York Times, show that this country alone spends one billion dollars a year for advertising—three times the value of the wheat crop, nearly five times that of the gold production, and 10 times that of the iron industry. There must be some profit traceable to this expenditure, or it would not be invested year after year. To show the growth of general advertising: Harpers Magazine, for one month (October) in 1864, contained 3¼ pages of advertising; in October, 1887, it contained 37 pages of advertising, and in October, 1903, it contained 141 pages.

To mention specific cases of profitable advertising, always more convincing than even the most obvious generalities, the great publishing house, of which formerly I was associate editor, and later advertising manager, was, five years ago, suffering from malignant dry rot. It was living in its brilliant past—doing business on the reputation of a name, famous throughout the country, to be sure, but doing little or nothing to live up to that reputation. The result—dry rot; rapidly falling far behind its younger and modern competitors. Among other things it did not do, was to advertise to any appreciable extent. During the last two or three years, however, this house has been using quarter and half pages in the popular magazines at $250 to $500 a page per issue; larger spaces in the music-trade journals, and great quantities of printed matter and circular letters. I venture to say that $50,000 a year is now being paid for its total advertising of all kinds. At the same time it is rapidly regaining the foremost position among publishers. What bearing had the advertising on this renaissance? I believe it is both a cause and an effect.

To merely mention well-known cases familiar to all of us where advertising in all its many forms constitutes fully two-thirds of the selling effort, the Postum Company, manufacturer also of grape-nuts and other food products, spends as much as $600,000 annually advertising them. One million dollars was spent last year in advertising Force. Over $600,000 is spent annually in advertising Ayer's remedies, and over $1,000,000 in advertising Peruna. The cost for a full page for a single issue in the Ladies' Home Journal is $4,000. The Procter & Gamble Company has made a three-year contract for a single page in each issue, to be devoted to Ivory soap. For this space it will pay $4,000 a month, $48,000 a year, or $144,000 for the complete contract. This, of course, being only a small part of its total advertising. Then there are Sapolio, Royal baking powder, Omega oil, Remington typewriter, Uneeda biscuit—all familiar acquaintances surely, and made so by advertising.

These goods appeal to the general public. But among manufacturers, who, like ourselves, do business, not with the general public but with special classes, the trades and supply houses, might be mentioned an equal number of well-known concerns made so in great part by advertising—Allis-Chalmers Company, Westinghouse interests, Worthington Pump Company, General Electric Company, the Edison interests, Peerless Rubber Company, etc. If advertising did not pay, we cannot suppose for a moment that such concerns as I have mentioned, occupying, as they do, foremost positions in the business world, presumably because of far-seeing business acumen, would be false to those business principles in one instance, and spend this money uselessly. And we can pretty accurately gauge what is being spent, because the amount of space used, and some idea of the quantity of the printed matter issued is made as public as possible; and we know what space and printing cost.

Advertising is not an expense, but a profitable investment. The three departments vital to the development of any business of to-day are the manufacturing, the publicity department and the sales department, all of practically equal importance to the business; each indispensable to the other. The publicity or advertising department is perhaps more closely allied with the sales department; these two working together for the common end—the selling of goods. The advertising preparing the way, sowing the seed, as it were, for the sales department.

Methods of advertising can be broadly divided into three general classes—trade-paper advertising, printed matter and circularizing.

Trade-paper Advertising.—"Constant dropping will wear away even stone." Constant advertising is not less potent to make its impression even on the hardened mind of the purchasing agent. The single drop has no effect beyond a temporary dampness. The single ad is not even damp. It is the cumulative force of advertising that pays.

At a conservative estimate, there are 100,000 concerns and individuals in this country that should be buying some of our goods. There are the architects, the builders, the contractors, the railroads and manufacturing plants of all kinds classed as steam users; the engineers, hardware dealers, general stores, automobile manufacturers and owners, electrical power plants, electrical railways, to mention only a few of the classifications. Each one of these trades, professions and great enterprises has innumerable journals devoted to its own particular interests. And these journals are subscribed to, paid for, and read by the men in these lines. And the advertising pages are read no less thoroughly and interestedly than the others. The men that read these papers are the men we want to buy our goods. One of the cheapest and best ways of keeping these men posted in regard to what we have to sell is by printing the facts in good big type where they cannot help but see them—and that is in the trade papers that they read. Where there is a babel of tongues, we must speak loud to be heard, and speak often to be understood.

This is not doing the work of the salesman; it is doing the work the salesman should not have to do. It is clearing the way for the salesman, so that he can do more of the work that shows on the books—the actual selling of goods—and less of the missionary or educative work which is more cheaply and more thoroughly done by proper advertising. If the salesman has to spend a part of his valuable time doing this missionary work, he frequently cannot clinch the order on the spot. But the competitor who follows finds things in nice shape to make a sale. In other words, if our salesmen had to spend all their time explaining why covering pipes and boilers saves coal, they would have no time to actually sell some of our coverings made for the purpose. The next salesman that obtained an audience, however, would find the prospective customer already convinced of the advantage of insulation and ready to hear about the special covering that would meet his requirements.

We must, therefore, by advertising, prepare the way for our salesmen to do business, and not leave them merely to prepare the way for our competitors' salesmen. Besides this, the largest selling force could actually see and interview only a very small percentage of the 100,000 possible customers. But constant advertising can, and does, see and interview them all. It is the man known to be interested in our goods that we want the salesman to interview. Advertising can create this interest and can ferret out the interested man.

Of the thousands of trade papers published, 50 of the very best will usually cover adequately all the various interests that one concern wishes to reach. And in these 50 should be used not spaces two or three inches square (the size of a couple of special-delivery stamps), nor one-eighth pages, the size of a postal card, but quarters, halves, and a few whole pages that will really advertise.

It is sometimes questioned whether advertising in trade papers pays. If a man should ask, Does twice 2 make 1½? you would wonder whether it would be possible for you to explain to that man just what the answer is, and why.

No business could be done without advertising. The printing of the firm's name and a list of the goods on a letter head, the hanging of a sign over the door, is advertising, and is the result of the instinctive conviction that advertising is a necessity. If this much advertising is good, more is better.

It is impossible and unnecessary to attempt always to trace direct results from periodical advertising, unless one is doing a strictly mail-order business. But I venture to say that if we stopped advertising altogether, in all trade papers, and sent out no more printed matter, business would fall off fully one-half.

The right kind of advertising costs money, but it is not expensive, because the returns in actual business are manyfold. In order to secure the maximum benefit from advertising space, the advertising "copy" must be, first of all, of such a nature that it will be immediately noticeable among the hundreds of other ads that surround it. This is perhaps best accomplished by means of some striking design incorporating an original idea, which arrests the reader's attention. Having thus buttonholed the audience, your story can be told. And this story should be such as to hold the attention aroused by the striking idea: it should tell something definite about the goods advertised; tell why they are better than all the other goods of the same kind, and this, either because they are cheaper or higher grade, or because they possess some individual advantage peculiar to these goods alone. The object is, not to print your entire catalogue in a quarter-page ad, but to arouse the reader's interest sufficiently to insure a certain familiarity with the name and qualities of the goods advertised, or even to induce him to write for further information.

In this connection, let me quote from an article (published in the January Atlantic Monthly) entitled "The Psychology of Advertising," by Walter Dill Scott, professor of psychology in the Northwestern University:

"There are many advertisements that do not pay. One man has roughly estimated that 75 per cent. of all advertisements do not pay, yet the other 25 per cent. pay so well that there is scarcely a business man who is willing to stand idly by and allow his competitors to do the advertising. The expense connected with advertising has increased, the competition between rival concerns has become keener, and consequently the demand for good advertising has become imperative.

"One of the greatest weaknesses of the present-day advertising is found in the fact that the writer of the advertisement fails to appeal either directly or indirectly to the senses. A piano is primarily a thing not to look at or an object for profitable investment, but it is a musical instrument. It might be beautiful and cheap, but still be very undesirable. The chief thing about a piano is the quality of its tone. Many advertisers of pianos do not seem to have the slightest appreciation of this fact. When they attempt to describe a piano they seem as men groping in the dark. Their statements are general and meaningless. As an example of such a failure, the advertisement of the Knabe piano is typical:

THE KNABE.

Its successful growth and experience of nearly 75 years guarantees to new friends the greatest degree of tried and tested EXCELLENCE, judged from any standpoint of criticism or comparison. WM. KNABE & CO.
New York. Baltimore. Washington.

"This is a half-page advertisement, but it contains no illustration, makes no reference to tone or to any other quality of music, and does not even suggest that the Knabe is a musical instrument at all. Many advertisers describe the appearance and durability of the case or the cost of the entire instrument, but ordinarily their statements are so general that the advertisement could be applied equally well to perfumes, fountain pens, bicycles, automobiles, snuff, or sausages, but would be equally inefficient if used to advertise any of them. They do not describe or refer in any way to the essential characteristics of a piano.

"The following is a quotation in full of an advertisement of the Vose piano, but with the words 'sewing machine' substituted for 'piano.' This advertisement, like the one quoted above, contains no illustration, and it will be noted that there is nothing in the text which does not apply equally well to a sewing machine:

VOSE SEWING MACHINES.

Have Been Established Over 51 Years.

They are perfect examples of sewing machine strength. The construction of the VOSE is the result of fifty years of development and the application of the highest mechanical skill to the production of each separate part.

By our easy payment plan, every family in moderate circumstances can own a fine sewing machine. We allow a liberal price for old instruments in exchange, and deliver the sewing machine in your house free of expense. You can deal with us at a distant point the same as in Boston. Send for our descriptive catalog H, which gives full information.

VOSE & SONS SEWING MACHINE CO.,
161 Boylston St., Boston, Mass.

"The head of the publicity department, therefore, as the New York Times says, must look to these matters of proper copy. He is the first man consulted in every new scheme of promotion. He is the originator of new ideas. It is because of the fertility of invention that he holds his position. As to his minor qualifications, he must know how to write English and how to read proof. He must have a thorough knowledge of all kinds of type, and of the quality and cost of papers and stocks. He must know how an ad is going to look on the printed page. He must have the same wide comprehension of all manner of illustrations, though he never drew a picture or handled a camera in his life. He must be able to judge correctly of the value of a picture in advertising his business: its inherent suitability to the subject; its power of attracting attention. He must be able to conceive ideas and designs of his own and turn them over to the artist for illustration."

This, then, is the object and the value of trade-paper advertising—to go where as many prospective customers as possible can be reached and their attention drawn to something we wish to sell them. It is a field, fruitful in the past, but open to infinitely greater development, and one that cannot well be disregarded.

The printed matter of a house, issued to influence trade, should be attractive, definite, conclusive, and by no means cheap looking. The first impression of a house is often obtained from its printed matter—its catalogue, most likely. First impressions are lasting, and it is therefore well to make them as favorable as possible. A salesman would not be allowed to represent the house in shabby and cheap-looking clothing. Neither should printed matter be allowed to go out poorly dressed. It is human nature to judge first, superficially—by externals.

In addition to catalogues a liberal use of envelope enclosures, folders, etc., is of the greatest advantage. Every customer, as well as every prospective customer, should have dropped on his desk, every month at least, and possibly every two weeks in the season, some attractive, convincing printed matter, keeping our name favorably and pleasantly before him at all times. It is always profitable to co-operate with the retail dealers and the supply houses, in articles for which a demand can be created

[1] Paper read before the convention of managers and salesmen of the H. W. Johns-Manville Company in New York City on February 18, 1904. Mr. Hart is advertising manager of the company named.

in part by the display of attractive and striking window cards, hangers, etc.

I have had the pleasure of submitting to your individual consideration the annual report of the advertising department, including the factory printing plant and circularizing division for 1903, and it will therefore be unnecessary to enter into detail regarding the development of this department during the last year and a half. A mention of the leading features, however, may not be without interest:

In 1902 the advertising department numbered six members. Today it numbers 16. In 1902 our printing plant occupied a space of approximately 10 by 15 feet. Today it occupies a space 25 by 100 feet and executes 100 per cent. of our printing orders, which include catalogues, fine color work, account books, etc. With our new cylinder press in operation, in conjunction with two small jobbers, the factory printing plant has a capacity of over 1,500,000 pieces of printed matter a month.

Union Engineering Building.

The project of erecting a large building in New York city to constitute a central home for engineering is assured by the following letter from Andrew Carnegie addressed to the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, and the Engineers' Club:

New York City, March 14, 1904.

It will give me great pleasure to devote, say, one and a half million of dollars for the erection of a suitable union home for you all in New York City. With best wishes, truly yours,

ANDREW CARNEGIE

The three national engineering societies named and the Engineers' Club have already taken action for the proper conduct of the magnificent trust for engineering created by this letter. The requisite land has been purchased by Mr. Carnegie, to be eventually taken over and paid for by the engineering organizations named. The plot has a frontage of 125 feet on Thirty-ninth Street between Fifth and Sixth Avenues. The Engineers' Club has already purchased two lots on Fortieth Street abutting the lots for the Engineering Building. Plans for the architectural part of the undertaking are already under way, and the architects will soon be selected. The existing property is to be vacated July 1, 1904, when the work will be begun and be pushed to completion. It is hoped to have it ready for occupancy in 1906.

The three engineering societies have a combined membership of over 9,000, and are gaining from 10 to 15 per cent. yearly. They administer a total annual income of $135,000, and their assets in property and cash amount from $250,000 to $300,000, which is being augmented by gifts and subscriptions. The Engineers' Club will occupy a separate building immediately adjoining. Its membership is about 1,200, and it administers a budget of about $120,000 a year.

The total amount involved in the enterprise will be not less than $2,500,000. The new building will probably be 12 stories in height, with a frontage of 125 feet. It will contain four or five auditoriums of different size—one seating from 1,200 to 1,500 persons—appropriately equipped for scientific meetings, lectures and demonstrations. Then there will be an engineering museum and a noble library hall, where all the libraries of the societies—some 50,000 volumes—will be united in one. While these four societies are to have their spacious headquarters in the new building, several kindred bodies, representing more than 5,000 members, have already made urgent requests for accommodations there.

The Engineers' Club Building, to be separate, will flank the union building, and the two will share the same resources of light, heat and power, and will be advantageously situated for mutual social benefit. These buildings, moreover, which will face on two streets, are to harmonize in architecture as well as in function.

The representatives of the four bodies interested as direct beneficiaries and trustees of Mr. Carnegie's gift are Professor F. R. Hutton, C. Wallace Hunt and J. M. Dodge of the American Society of Mechanical Engineers; Dr. A. R. Ledoux, Theodore Dwight and C. Kirchoff of the American Institute of Mining Engineers; Charles F. Scott, Bion J. Arnold and Schuyler S. Wheeler of the American Institute of Electrical Engineers, and J. C. Kafer, W. H. Fletcher and T. C. Martin of the Engineers' Club.

FIG. 1. ELECTRICITY IN GOLD DREDGING—PLANT IN OPERATION.

Electricity in Gold Dredging.

By the use of electricity in gold dredging, gold-bearing earth averaging no more than 10 cents a cubic yard may be worked over with profit. The gold-bearing soil, which is usually 10 to 50 feet in depth, is generally a gravel deposit left in old river channels.

The two types of electric dredges which have been used in California secure the soil by either lifting it through centrifugal pumps or by an endless chain of buckets. The latter system seems to be the most favorable, and most of the improvements seem to be along the line of this type of dredger. A boat is built in a pit where it is to be operated, and the necessary machinery placed aboard. The pit is then filled with water to a depth of from 25 to 40 feet. The boats are fed by a cable about 500 feet long, which runs from the shore to the boat. Generally these cables are arranged for three-phase, 60-cycle current, standard line voltage, but one or two of the boats now in use are fed by a 4,000-volt, four-wire cable, which is carried directly to the boat and the transformers placed on the boat. The lower voltage cables are rubber-insulated and triple-braid waterproof. The 4,000-volt cables are leaded and armored. The transformers are sometimes placed on the boat and sometimes on a pole near the boat, usually the latter arrangement.

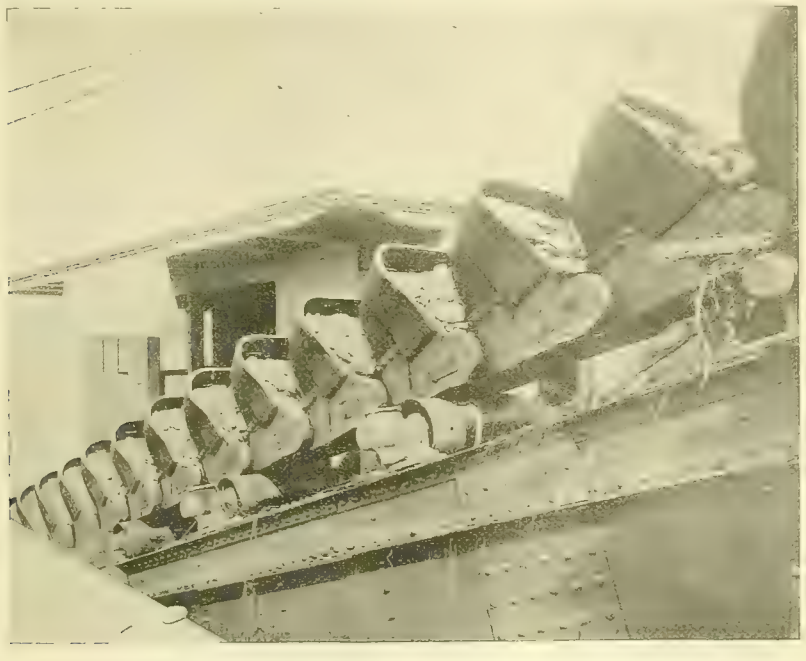


FIG. 2. ELECTRICITY IN GOLD DREDGING.—LINE OF BUCKETS.

The dredger digs its own channel, depositing the soil which has been worked behind. The soil is elevated into a grizzly or similar screening device where the rocks are washed from the soil, the rocks being delivered to the carrier that deposits them out of the way behind the dredger. The soil is then washed through shakers and riffles, leaving the gold deposited on saving tables, to be taken up with quicksilver, and the worked-over soil is run out at the stern of the boat.

Fig. 1 is a picture of a dredge working in a sand pile and discharging onto the gravel pile in the rear. Fig. 2 is a view of one of the bucket lines.

A typical dredging outfit recently furnished to the Western Engineering and Construction Company by the General Electric Company consists of one 50-horsepower motor, with controller and resistance, for driving the bucket line; one 15-horsepower motor, with controller and resistance, for operating the winches (this apparatus is for working the head lines and changing the direction of the boat to suit the work); one 40-horsepower motor, direct-connected to a centrifugal pump (this pump furnishes water for washing the soil); one 15-horsepower motor, to drive the stacker or conveying belt which disposes of the stones; one 15-horsepower motor, for operating the shaking screens; one 30-horsepower motor, for operating the sand pump (this motor is worked occasionally when the sand accumulates too thickly at the back of the boat, and delivers it out on the rock pile through a long pipe), and one three-horsepower motor, for operating a deck and bilge pump, used for general washing purposes.

The buckets hold from three to five cubic feet each, five cubic feet being the standard size, and are operated at a normal speed of 22 buckets a minute. The dredge will dig from 50,000 to 75,000 cubic yards a month.

One Way to Beat a Telephone Company.

"One of the telephone companies charged me a quarter for service they did not furnish last week," said a man at the Coates House this morning, "but I got even with them."

"How did you do it?" a man standing at the desk asked.

"When I was in St. Joe Friday I told a business man there I'd call him on the telephone Monday. I arranged for him to have his clerk say he was out of town if he wanted me to come up and see him. I called Monday and received word that the man was out of town. That was all I wanted to know. I went to St. Joe and saw the man. The telephone company served me without cost. I may have 'beat' them that time, but they 'beat' me the other time. Now we're even."—Kansas City Star.

The Fountain Creek Telephone Company of East Lynn, Ill., has been incorporated with a capital of $34,000. The incorporators are W. A. Yeazel, G. H. Wieland and H. H. Tucker.

Transformer Primary Cut-out.

An improved form of a transformer primary cut-out, designed to protect the high-tension side of transformers, is introduced by the Westinghouse Electric and Manufacturing Company. It is made entirely of porcelain, and its form is such that it has high insulating and arc-breaking qualities. The plug to which the fuse is attached projects between the terminals, the upper end of it rising well into the top of the block and interposing an effective

FIG. 1. CUT-OUT READY FOR MOUNTING.

barrier, and thus making it impossible to maintain an arc. This fuse is 11 inches in length, making a long break, and is so placed that the vapors of a discharge are blown down and out of the device and away from the terminals. Fig. 1 shows the device complete, while Fig. 2 shows the fuse terminals and the plug.

The line wire is carried directly to the top of the device and attached to it as to an ordinary insulator, which it thus displaces. To reach the terminal the wire must be bent around the edge of the block, and is so supported in an angle between the terminal post and the porcelain case that it cannot be loosened by any swaying of the wire in the wind. The plug enters from the bottom. When it is raised into

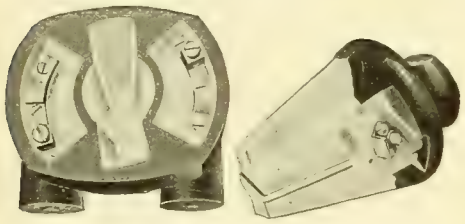


FIG. 2. CUT-OUT SHOWING FUSE TERMINALS AND PLUG.

place, a partial turn draws the knife blades on the plug into the jaws on the block, preventing the plug from dropping out or being blown out.

All live parts are protected from the weather by the projecting edges of the block and by placing the terminals well above its lower surface, with no apertures in the side or top. A bend in the fuse wire brings it into plain view at all times, and it is thus possible to observe its condition without removing the plug, guarding against any liability of opening the circuit when there is a current upon the line.

The cut-out is fastened to the cross-arm or other support by two screws, passing through porcelain tubes, which form a portion of the block. It has a rated capacity of 2,500 volts, 30 amperes. It is small, light, easy to install and to re-fuse, and promises to be a desirable addition to the assortment of electrical line apparatus.

Street-railway System in Hull, England.

The tramway system of Hull, England, is superior in many respects to that existing in almost any American city, says United State Consul Walter C. Hamm. It is owned and operated by the city. The cars are double-deckers, employing the overhead trolley, and the speed varies in different parts of the city, the maximum being 12 miles an hour. The fare is 1d. (two cents) on all lines and for all distances. Speaking of the system and the interesting financial results from the low fares, Mr. Hamm says: "During the latest 12 months reported on there were 10 miles of double track, or 20 miles of single track in operation. The gross income was about $445,000; the cost of operation about $233,000, and the gross profit, $212,000. Deducting interest on the investment, [illegible] sum, a net profit of $122,000, or an average of over $12,000 a mile of double track, went into the city treasury.

"The wages paid look low to an American. Motormen receive from $6.75 to $8.50 a week, and conductors from $5 to $6.50 a week. But it must be remembered that the house rents and some kinds of provisions are lower in England than in most American cities. This difference might make it necessary to add $2 a week to the wages of Hull motormen and conductors when comparing them with the wages of the same class of American workingmen. But as the total wages paid on the whole system was a little less than the net profits, after deducting interest and sinking fund, it is evident that wages could be doubled and still a small profit be shown."

CORRESPONDENCE.

Great Britain.

London, March 9.—During the last session of Parliament a bill was passed having for its object the facilitation of the application of electric traction to existing steam railways. Under the old condition of affairs, a railway company wishing to apply electricity to its system had to make application to Parliament by means of a special bill, an extremely expensive method of procedure. But the Railways (Electrical Power) Act of 1903 has changed all this. Under this act the usual parliamentary notices have to be made, but after advertising the intentions of a company, in this way, an application has to be made to the Board of Trade within one month for a provisional order under the act, and, if this is granted, a confirmation by the government is all that is required to complete the transaction. A fee of $250 has to be paid with the application to the Board of Trade.

The London County Council, under whose jurisdiction come all theaters in London, has just issued, through its special committee, a revised list of rules to be observed in order to prevent the possibility of fire as far as may be. They include the regulation that a properly qualified man must be in charge of all electrical installations in theaters. In all temporary work, wires and cables must be adequately and firmly fixed, and in all cases where they are within reach of the public, they must be encased. All joints must be soldered and taped if used for more than one week, and if less than one week all wires larger than seven-twenty S. W. G. or its equivalent, must be soldered. All circuits must be subdivided as much as possible, no subcircuit exceeding 10 amperes. All main switches, fuses, etc., which are the property of the electric supply company must be distinguished by being colored red with a white band. At least one pair of rubber gloves must be provided for the use of the electricians in charge of the installation as a precaution in the event of high voltage occurring, and they must be kept on the stage switchboard and in good order. At least one bucket, filled with dry sand, must be kept in some accessible position on the stage in readiness for use in dealing with an electric fire, and one must also be kept in each of the intake rooms. These rules, which are evidently the outcome of the public uneasiness which manifested itself here after the Chicago theater fire, have been adopted by the council and will in future be enforced.

Now that a bill has been introduced into Parliament having for its object the use of the metric system of weights and measures by compulsion, a report has been issued by the Colonial Office showing the replies which have been received from the various British crown colonies and self-governing colonies in answer to a request for an expression of opinion upon this matter. It may possibly be remembered that in 1902 a conference of the colonial premiers was held in London, and one of the resolutions passed then was to the effect that it would be advisable to adopt the metric system. The replies from all the colonies above referred to, however, would not tend to show that unanimity of opinion which might be inferred from the passing of the resolution in 1902. Only some dozen are absolutely in favor of the adoption of the system, the large majority of the remainder being doubtful or unwilling to move in the matter until Great Britain adopts the system. Several are willing to take up the system conditional on some neighboring state doing likewise. Jamaica and British Honduras would wait until the United States adopts, while from Canada and a few smaller colonies no replies have been received. The bill introduced in the House of Lords last week is now under consideration by a committee of that House.

Quite a stir was created in wireless-telegraph circles at the end of last week, when it was stated in the Times that certain of the messages sent by its correspondent at the seat of the Russo-Japanese war had been transmitted over certain distances by means of the De Forest wireless telegraph. But it turned out that this was not so, and that the messages in question had been sent by the Times' special steamer. Apparently, some De Forest apparatus is at the front, but as Mr. De Forest is not now in England, little information can be obtained. An official announcement has been made by Lloyds' that signaling of vessels at the Fastnet lighthouse will commence on April 1st by means of wireless telegraphy. The use of wireless telegraphy will be between the Fastnet Rock, where the lighthouse is, and the mainland, in connection with which difficulties have been encountered for many years.

Under the Education Act of 1903, the London County Council is to be entrusted with the management of all educational matters in London, including technical training, and a draft scheme has been drawn up. From this, however, it is seen that all the members of the new Education Board will be members of the London County Council, and some dissatisfaction is expressed that there is not more "outside" representation in the shape of educational experts. A memorial has been presented to this effect.

The cable tramways in the south of London are to be reconstructed upon the conduit system, and the County Council has accepted a tender amounting to nearly $500,000 for this work. G.

New York.

New York, March 19.—The utiliation of the waterpower at Niagara Falls is still an absorbing topic at Albany. The cry against the proposals of the Lockport and Ontario Power Company (which have been approved by the lower house) is no longer on the ground of preserving the beauties of the falls, but against the general principle of granting an exclusive and perpetual monopoly to the applicants, who, under the measure now before the Senate, may take unlimited water from the river and distribute electrical energy to any place in the state of New York. The Senate so far has passed a motion favorable to the bill and at the same time has accepted a resolution from Senator Brown to memorialize the President to enter into a treaty with Great Britain to prevent further franchises being granted for the utilization of the waterpower of the Niagara River.

The grounding of a feed wire tied up the elevated traffic on Brooklyn Bridge for three hours this morning during the busiest hours of the morning. The stoppage of traffic affected hundreds of thousands of passengers, and the unusual sight was witnessed of a continuous line of elevated cars stalled right across the bridge and far into Brooklyn. The trains were emptied of their passengers by improvising a continuous promenade through the length of the cars.

Amicable arrangements are pending as to the trolley traffic over the Williamsburg Bridge. The details of the working of the tentative system are rather complicated; but briefly, the Metropolitan company will pass its Manhattan cars over the bridge and around a loop on the other side, while the Brooklyn cars will have a loop at the New York end and the option of using the loop at the Brooklyn end. The terms of the franchises are similar to those enforced for Brooklyn Bridge—the city will build and own the tracks and two three-cent-fare tickets are to be sold for a nickel. There are several schemes in the air for connecting the bridge traffic with that of the existing Manhattan lines; but on this point the Brooklyn Rapid Transit directorate declares that it is not anxious to connect with any New York subway, owing to the unsuitability of the cars for subway work.

The Rapid Transit Commission has been busy this week considering the Elsberg bill now up at Albany. The commissioners, without endorsing the claim that the city should have power to operate any future subways, nevertheless have agreed that the question should be submitted to a popular vote; and they also oppose the granting of franchises in perpetuity and desire to limit the expenditure upon a subway scheme to $50,000,000.

The cross-town car lines on Eighth and Fourteenth Streets (the latter just recently "electrified") have been leased for 999 years to the Metropolitan Street Railway Company at a rental equivalent to 15 per cent. on a capital of $600,000, of which the Metropolitan company owns about $498,000. The stock has hitherto paid 10 per cent., but the increased interest is attributed to the change in motive power.

The Interborough company's architects have filed plans for a new electrical power house at Washington Heights, the two-story building being estimated to cost $100,000. An interesting feature of the plans is the provision for insulated treads designed for the protection of the engineers.

More information regarding the dispute as to the city lighting is forthcoming. The bids opened this week from the Edison, Brush and United Electric companies all quote at the rate of $146 a year for arc lamps, or at the same figure as previously. The Consolidated Gas Company quotes $17.25 per street lamp, a reduction of 25 cents on last year's contract. These bids do not satisfy the commissioner, who is apparently trying to force the companies to come into court with evidence when they argue their claims for outstanding moneys due them.

The municipal authorities of the city of Manchester, England, have just made a contract with the Westinghouse Electric and Manufacturing Company for the supply of 200 electrical surface cars at a cost of about $250,000.

The United States cruiser Baltimore, in proceeding from New York down the coast of Virginia, tested its newly installed space-telegraph apparatus on Monday and succeeded in maintaining intercommunication with the Norfolk navy yard at a distance of 75 miles. D. W. W.

New England.

Boston, March 19.—The Superior Court has ordered decrees accepting the reports of the receivers, John A. Hall and Charles M. Thayer, relative to the affairs of the Worcester and Southbridge Street Railway Company, except in the case of four claims contested. Three of these were referred to George S. Taft, appointed as auditor thereon. The approved claims aggregate about $1,000,000. The unapproved ones amount to less than $40,000.

The cities of Lowell and Chelsea have petitioned the Legislature for legislation authorizing them to construct and maintain conduits for electric wires, cables and conductors. This is virtually the same proposition as those of previous years for municipal-conduit privileges.

The town of Mansfield has put into operation its new municipal lighting plant, recently completed, which runs 27 arc and 320 incandescent street lamps.

Directors of the Marlboro and Westboro Street

Railway Company have closed a deal with the Boston suburban companies syndicate whereby the latter is to furnish power for a 10-year period to the company. Intimate relations between these two factors in transportation between the suburbs west of Boston and the city of Worcester are increased to such an extent by this arrangement that much significance is attached to the situation, and it is considered indicative of a purpose to compete with the new and very successful Boston and Worcester company for a share in the through patronage.

The Helios Manufacturing Company has been organized at Portland, Me., to manufacture electrical machinery. Frank D. Marshall of Portland is president and F. H. Smith of Boston, treasurer. George E. Parker of Boston and Robert E. Goodwin of Concord, Mass., are also directors.

A significant feature of one of the legislative hearings this week before the committee on street railways was the presence of General William A. Bancroft of the Boston Elevated Railway Company and his announced opposition on behalf of the road to additional subways to outlying sections, the company being of the opinion that elevated structures are preferable where practicable. B.

Southeastern States.

Charlotte, N. C., March 19.—The city of Albany, Ga., has contracted with the Albany Power and Manufacturing Company for 300 horsepower to be delivered at the city electric-light plant at $8,000 annually. The power company is developing a big power on Muckafoonee Creek, near the city. The saving to the city is estimated at $3,000 or over annually.

Atorneys have been engaged to look into the matter of a charter for the proposed electric railway between Greenville, S. C., and Anderson, and the line is said to be assured.

The Bessemer, Brookwood and Blocton Railway and Light Company has been granted a franchise by the city of Birmingham, Ala., to build an electric railway.

The state Legislature of Virginia has refused to take up the matter of the city of Newport News issuing $100,000 bonds to establish a municipal electric-light plant.

The town of Concord, N. C., has voted to purchase the electric-light plant at $8,500.

The Eastern Electric Company of Newport News, Va., has been chartered, with A. L. Powell as president.

B. J. Sloan has entered into a 10-year contract to furnish the city of Waynesville, N. C., with power for electric light. The power will be generated at the falls on Pigeon River. The city will take at least 125 horsepower at $20 a horsepower a year.

The Salisbury (N. C.) and Spencer Railway and Electric Company has bought the Salisbury Gas and Electric Lighting Company. It is added that the deal will result in an electric line being built between the two towns.

An electric-light plant is being agitated for West Point, Va., by citizens and outside capitalists.

The Seaboard Traction Company has been chartered at Richmond, Va., to operate electric lines along the seaboard of Virginia, between Portsmouth and Richmond. L.

Indiana.

Indianapolis, March 21.—The Wayne County Commissioners have declared the franchise granted two years ago to the Union City Traction Company forfeited. The Columbus, Greensburg and Richmond Company now proposes to build through the same territory and the people are encouraging the enterprise.

Representatives of the Richmond and Northwestern Traction Company, which recently reorganized, announce that the proposed road has been financed by eastern capital and that the road between Richmond and Newcastle will be built this spring. The City Council of Newcastle has granted the road a franchise.

F. J. Shultz and W. N. Harding, representing Indianapolis and Chicago capitalists, spent the whole of last week inspecting a number of routes for proposed interurban electric railways from Evansville to surrounding towns and cities. It is now assured that at least two lines will be built out from Evansville by these men during the coming summer.

Jeffersonville and Seymour capitalists, headed by George H. Voight and Louis Schneck, have employed expert hydraulic engineers to examine Fourteen Mile Creek and the Tunnel Mill property with a view to utilizing the falls of the solid stone tunnel for developing electricity. The experts have already reported that sufficient fall can be had to furnish 10,000 horsepower. It is the intention to form a company, establish a power plant and operate an electric railway to connect Jeffersonville and New Washington.

Fifty electrical and mechanical engineering students from the Kentucky University were the guests of Purdue University last week. The students were highly pleased with the methods and apparatus of the Indiana college and their cordial reception.

State Statistician Johnson of Indiana says that the dearth of farm hands in Indiana is largely due to the coming of the interurban railways and their rapid development in the state. The work of construction and operation of these lines have enabled workmen to get off the farms to accept positions that seemingly offered more money. Consequently the farm laborer is able to ask more money this year than at any previous time for his services. F.

Ohio.

Cleveland, March 19.—Negotiations between the Kuhlman Car Company of Cleveland and the J. G. Brill Car Company of Philadelphia were completed this week and the property of the former has passed to the control of the latter. Samuel E. Curwin of Philadelphia was elected president of the reorganized company, to take the place of Fayette Brown of Cleveland. Charles A. Ricks continues as secretary. This makes three plants for the Brill company.

The Cincinnati Lighting Supplies Company has been dissolved. N. R. Park was the president of the company.

The Cleveland Electric Railway Company has ceased issuing transfers on transfers on the Wilson Avenue line on account of the abuse patrons of the road put them to. It was impossible to make the transfers so that passengers could not make a round trip on a single fare. From the best-paying line in the city the Wilson Avenue branch became the poorest piece of road in the system.

The towers for carrying the high-tension wires across the river at Elyria are now being built. They will be 125 feet in height.

The city of Toledo has paid the Toledo Railways and Light Company $19,000 on the lighting contract and still owes $112,000, with no money in the light fund to pay it.

R. M. Martin has brought suit for $10,000 damages against the Big Consolidated railroad in Cleveland on a peculiar complaint. Because of a broken glass in the vestibule of a car he was operating as motorman on February 15, 1902, he says he contracted lung trouble. The starter, he alleges, compelled him to take the car out against his will.

In effect, Mayor Johnson of Cleveland, has asked the City Council to petition the state Legislature to adopt a provision in the new code governing cities by which that body will have the power to fix the fare which street railways shall charge. The mayor claims that the Legislature is about to pass laws that will make it impossible to secure three-cent fares, and he desires that something shall be done to put the regulation of the matter in the hands of the city authorities. The mayor claims that the power is now inherent in the council, and he wants the point clearly defined by the Legislature, so that there will be no possibility of construing the statutes some other way.

The interurbans interested in the new depot to be built in Cleveland have decided to accept the franchise passed by the City Council a few days ago, and officers of the roads have been instructed accordingly. The building will be erected at the southwest corner of the Public Square.

Twenty new street lights have been added by the Toledo City Council. They will be furnished by the Toledo Railways and Light Company at $1,600 a year.

The Cleveland Still Alarm Company has been incorporated with a capital stock of $10,000. W. B. Woodbury, assistant manager of the Cuyahoga Telephone Company, and four other Cleveland men are the incorporators.

A practical demonstration was given in the courts at Newport, Ky., a few days ago to show that it is impossible for a man to be seriously injured by coming in contact with a controller box that is grounded. Wires were run into the courthouse, and the demonstration was made before the jury. The suit was that of Charles Smith against the street-railway company for $20,000 damages.

The People's Electric Light Company of Bedford has filed notice of an increase of capital stock from $10,000 to $25,000. It just passed into the hands of Philadelphia men.

The Northern Ohio Traction and Light Company is negotiating the lease of 1,000 acres of coal lands along its line to an operating company.

Electrical workers employed on the construction of the municipal light plant at Columbus have declared a strike. They demand 30 cents an hour instead of $2.50 a day, and require that all workmen report at the plant instead of where they are to work both night and morning, going and coming on the city's time.

The Cincinnati Suburban Belt Railway Company is planning to build a line connecting Linwood and Cumminsville with many small towns lying just north of Cincinnati, including Madisonville, Oakley, Norwood, Bond Hill, St. Bernard and Winton Place. The power house will be at Bond Hill. Cars built after the style of interurban coaches will be used.

B. M. Brown has been appointed superintendent of the Columbus, London and Springfield Railway Company. Heretofore he has held the title of assistant superintendent. Mr. Brown is also superintendent of the Dayton, Springfield and Urbana Electric Railway Company, and will probably retain that position also.

W. P. Hazen has resigned as chief engineer of the Columbus, London and Springfield Railway Company in Ohio, to accept a similar position with the Cincinnati, Georgetown and Portsmouth Railroad.

J. C. Gillette, formerly superintendent of the Marion Railway and Light Company, Marion, Ohio, has been appointed master mechanic of the Columbus, Delaware and Marion Electric Railroad Company, with headquarters at Stratford.

G. J. A. Paul has been appointed superintendent of the Youngstown and Sharon Street Railway Company, to succeed Godfrey Morgan. Mr. Paul was formerly superintendent of the city lines at Streator, Ill. O. M. C.

Michigan.

Detroit, March 19.—The Confederation of Electrical Workers of Michigan held its semi-annual convention at Saginaw last week, the session being held behind closed doors. The organization has a membership of 1,000 and the president is Charles V. Ross of Saginaw.

The Thorne Electric Company of Bay City has been incorporated with a capital of $2,500.

H. C. Hoagland, formerly superintendent of the Kalamazoo Valley Electric Company, who resigned because of differences with other officers over a bond issue, has filed a petition asking for a receiver and an injunction to restrain the officials from making a bond issue. The company, which is capitalized for $500,000, has several power dams on the river and furnishes power to all the electric roads between Allegan and Jackson, and for many factories in Kalamazoo, Battle Creek and other cities. The court has issued a temporary injunction forbidding any bond issues, and set March 25th for the hearing on making the injunction permanent and appointing a receiver.

W. B. Sears, consulting engineer of the Detroit, Flint and Saginaw railway (electric), has provided plans for the crossing over the Pere Marquette tracks at Bridgeport.

The Bay City Traction and Electric Company will install a $6,000 storage battery in connection with the development of its new extension in that city, to equalize the demands on the engine capacity. Contracts have also been let for an addition to the power house to make room for the additional machinery required by the combining of the electric-lighting and traction plants.

The Michigan Traction Company has inaugurated a new ticket system to replace the present system of paying cash fares on its interurban cars. Arrangements have been made so that a single or round-trip ticket may be purchased from Kalamazoo to Battle Creek over its own lines from Battle Creek to Jackson over the Battle Creek and Jackson line and from Jackson to Detroit over the Detroit, Ypsilanti, Ann Arbor line. At present there are no through cars from Kalamazoo to Detroit, hence there is no necessity for through tickets.

The Cascade Electric Company of Grand Rapids has been incorporated under the state laws. The capital is $15,000.

The Detroit, Monroe and Toledo Short Line has been greatly handicapped in completing its northern terminus. The overhead work has been finished for some days and rail-laying has just been completed. Cars can now be run from Toledo to Wyandotte, and it is expected that cars will be run into Detroit soon. C. G. W.

Northwestern Notations.

Minneapolis, March 19.—The Cannon River Electric Power Company expects to proceed with the development of its plans for utilizing waterpower in the Cannon River, near Cannon Falls, Minn., this summer. Bids are to be taken for the work about April 1st, it is understood.

The Gas and Electric Company of Stillwater, Minn., will start work on the new electric power plant at Somerset, Wis., as soon as the weather will permit. The work is to be pushed along to completion as rapidly as possible.

J. J. Keef of York, Neb., has been granted an electric-light franchise at Harvard, Neb.

The city of Barrett, Minn., has voted to install an electric-light plant.

The electric-light plant at New London, Wis., has been purchased by the city.

H. Dotson succeeds J. Johnson as secretary of the Black Hills and Spearfish Valley Electric Railway Company. He says that work will begin at once on the proposed line from Spearfish, S. D., to Lead and Deadwood.

The proposition to build a new power house at Wadena, Minn., for the electric-light plant was defeated at the recent election.

The electric-light and waterworks system at Marshfield, Wis., has been purchased by that city. The purchase price was $150,000.

Work has been resumed on the new power plant for the Wausau (Wis.) Electric Company.

Work on the proposed dam to be built at Elk River, Minn., by the Minnesota Power and Trolley Company will be rushed from now on, the bill authorizing the structure having been passed by Congress and signed by the President.

At Sparta, Wis., a proposition to build an electric-light plant has been voted down.

The Escanaba (Mich.) Electric Railway Company will extend its line from Escanaba to Gladstone.

The Iowa City, Davenport and Muscatine Electric Railroad Company and the Eastern Iowa Railroad Company are contending for a right-of-way between Iowa City and Muscatine.

John R. Hogg proposes to put in an electric-light plant at Drayton, N. D. R.

Rocky Mountain States.

Salt Lake City, Utah, March 17.—The management of the Manitou and Pikes Peak Cog Railroad, near Colorado Springs, Colo., has announced that work on the conversion of the system into an electrical road will be commenced early this summer. Plans are practically complete and estimates on the equipment are being received.

A plan to connect Payette, Idaho, and Boise with an electric railway is being strongly urged by Payette capitalists, and it is being favorably considered by the Boise Rapid Transit Company. The Payette promoters propose to construct a line half the distance to connect with the transit company's prospective extension.

The Clark Power Company is making surveys at Richfield, Utah, with a view to constructing a large power plant which will have a capacity sufficient to supply the entire county with electrical energy. The company also proposes to build electric railroads in that section.

An innovation on the Montana Central Railroad is the conversion of its telegraph system into a telephone line between Neihart and Great Falls, Mont. The telephones have been installed and will be used as long as the system proves satisfactory. A similar change has been made by the Montana and Great Northern in its telegraph line between Great Falls and Shelby Junction. G.

Pacific Slope.

San Francisco, March 17.—A rival electric-light company in San Francisco is a possibility. Solicitors have been about town seeing what could be done, and their reports are said to be satisfactory to the promoters.

The sales department of the California Electrical Works has issued at a considerable cost a neat little leather-covered pocket price list, covering its entire line of goods. The book is very convenient for customers.

Alexander Rosborough of the Siskiyou Electric Light and Power Company has been in San Francisco arranging for the purchase of additional waterwheels and electric machinery for the company's plants. The Fall Creek plant will have an additional 1,000-kilowatt generator, two turbines and another waterwheel. A 300-kilowatt machine will be added to the Ashland Electric Light and Power Company plant, which has been purchased. The generating plant at Fort Jones has also been acquired and improvements will be made there.

The Livermore Water and Power Company has been acquired by the California Gas and Electric Corporation, in addition to the acquisitions reported last week. The plant will remain in the charge of Daniel Murphy, but the electric-lighting current will be supplied from the Standard transmission line. The California corporation is also negotiating for the purchase of the Big Creek Power Company's plant, near Watsonville, and it is rumored that the Mutual Electric Light Company may also be acquired.

The plant of the Truckee (Cal.) Electric Light Company, which is operated by water from the Truckee River, was partly flooded during the recent heavy rains and has been unable to supply sufficient current.

L. P. Lowe, consulting engineer of the Pajaro Gas and Electric Company, states that an auxiliary plant will be established at the gas plant at Watsonville to furnish electric lights. The Pajaro Company will hereafter be known as the Watsonville Light and Power Company. This company has called a stockholders' meeting for May 11th, to consider the matter of creating a bonded indebtedness of $200,000. X.

PERSONAL.

E. I. Holland has been appointed superintendent of the Great Falls (Mont.) Street Railway Company and of the Boston and Great Falls Electric Light Company.

Charles F. Annett has accepted the position of sales agent of the Shelby Electric Company, with offices in Chicago. Mr. Annett was formerly assistant superintendent of telegraphs for the Illinois Central Railroad.

Mr. and Mrs. G. A. McKinlock have sailed for a trip abroad, much of which will be devoted to points of interest in Italy, particularly Rome. Mr. McKinlock is president of the Central Electric Company of Chicago.

J. Henry Hallberg has resigned as general superintendent of the electric department of the Cincinnati Gas and Electric Company and is succeeded by William Von Phul, who has been associated with Sargent & Lundy of Chicago, consulting engineers.

Thomas A. Edison is enjoying a brief respite from work on his plantation near Fort Myers, Fla. In May, it is said, Mr. Edison will sail for England, where, according to the London correspondent of the New York World, elaborate preparations are in progress for his reception.

C. O. Baker, Jr., for so many years the popular and efficient master of transportation for the National Electric Light Association, has resigned from that position. Mr. Baker expects to be in Europe at the time of the Boston meeting in May, and feels that he should not continue in the office unless he can personally attend to the duties connected with it. President Edgar has appointed Mr. George F. Porter, formerly secretary of the association, to succeed Mr. Baker.

Mr. E. Rathenau of the Allgemeine Electric Company has been decorated, with several others, by the emperor of Germany in connection with the high-speed electric-railway work. The decoration conferred, it is said, is that of the Order of the Red Eagle with the clasp.

Mr. C. Brush, who has been an assistant of President Claflin of the Boston Suburban companies, has assumed the office of general manager of the Newton, Lexington and Boston, the Newton and Boston, and the Westboro and Hopkinton street-railway companies, which are in the Suburban syndicate.

L. E. Watson, manager of the Northwestern Electric, Heat and Power Company of Kearney, Neb., has resigned his position and accepted a similar position with a mining company in Oregon. C. M. Wickstrom will take Mr. Watson's position at Kearney.

Thomas Lowry, the "traction magnate" of St. Paul and Minneapolis, is being urged as one of the delegates at large from Minnesota to the Republican national convention. Mr. Lowry is a multi-millionaire and has always been active in party councils and a liberal contributor to party funds.

Frank C. Mason, superintendent of the police-telegraph bureau of Brooklyn, is about to resign his position and retire to private life. Mr. Mason has for a number of years been one of the most prominent attendants at the conventions of municipal electricians, before whom he has read valuable papers on practical subjects. Several of his papers have been published in the Western Electrician.

W. A. Rudd has been chosen to succeed J. F. Nathan, whose resignation as manager of the Western Union Telegraph Company at Boston was recently reported. Mr. Rudd was manager of the Postal company at Memphis, Tenn., and will be succeeded by J. S. Murphy, manager at Selma, Ala., whose place will be filled by R. S. Peace of Birmingham.

J. E. Woodbridge, of the railway engineering department of the General Electric Company, is in England. He will have much to do with the carrying out of important contracts taken by the British Thomson-Houston Company for the equipment of underground railways in London. He is a native of Duluth and a graduate of the Massachusetts Institute of Technology.

ELECTRIC LIGHTING.

The city of Clarion, Iowa, is about to improve its electric-light plant. New machinery will be installed.

The Leavenworth Lighting and Heating Company of Leavenworth, Kan., has just installed a new Corliss engine which weighs 140,000 pounds. This increases the lighting capacity to 19,000 lights.

The E. M. Dean syndicate of Grand Rapids, Mich., has purchased the plants of the Citizens' Gas Company and the Vincennes Electric Light and Power Company at Vincennes, Ind. About $50,000 will be spent in improvements.

ELECTRIC RAILWAYS

With the opening of spring the Rockford (Ill.) Railway, Light and Power Company contemplates a great many improvements. A large amount of double track will be laid and 14 new cars have been ordered. The cars will be modern and well equipped throughout, being vestibuled and supplied with air brakes.

A new electric railway is contemplated from Freeport to Dixon, Ill., via Polo, Ill. C. T. Smith is named as president and Boyd P. Hill is one of the principal stockholders. Construction will be begun some time in April, or as soon as right-of-way can be secured.

The Metropolitan Street Railway Company of Kansas City, Mo., is extending its Grandview extension from Eighteenth Street to the new Kansas City Park, one mile west of the city limits. The Metropolitan officials placed in the city treasury last year $10,000, to be expended in the park, and will give fully as much this year.

The Chicago Union Traction Company has suffered another destructive fire. On Sunday night last the Western Avenue and Division Street car barns were completely destroyed, together with 103 cars. The loss is estimated at $100,000. This makes a total loss to the company by fire of 353 cars within a week, the fire of March 14th destroying 250. The losses, it is said, will result in barns being broken up into smaller areas by fire walls.

Officials of the New York subway are planning one of the biggest celebrations ever held in New York city for the opening of the rapid transit subway, which, it is now thought, can take place in June. Although the plans as yet are merely in a formative state the proposition now being considered is to expend approximately $200,000 on the celebration and thus obtain a demonstration that shall be in keeping with what is considered the most important enterprise ever undertaken by the city. The idea at present is to have the first train carry as passengers more distinguished men of the world than ever has been carried by any other one train in the history of railroad enterprises and to have this train and the various stations along the route elaborately decorated.

The Smith-Dows Construction Company, which is building the electric line between Cedar Rapids and Iowa City, is going to extend its line south and east from Iowa City, giving an outlet on the Mississippi River. With the extension that the company will build from Cedar Rapids north to Waterloo it will have a through line to Muscatine and probably one of the best-paying electric properties in the state.

The Middlesex and Somerset Traction Company of New Jersey, which has 50 miles of track in Middlesex and Somerset Counties, is reported to have been sold to the Public Service corporation of New Jersey for $2,250,000. The latter already controls all the trolley lines in Northern New Jersey, and the purchase of the property mentioned completes its through line from New York to Philadelphia, other connecting lines and roads under construction having been purchased within a few weeks.

Of the 6,660 electric cars of Great Britain 90 per cent. are double-deckers. The question naturally arises whether the use of the double-deck car increases the time occupied by a passenger in getting on or off. It would seem that more time would be taken in the case of the double-deck car than in that of the single-deck, but observations have shown that the average length of stop per passenger with a double-decker is only 1.9 seconds, while with a 12-seated, open, single-deck car the average time is 2.8 seconds.

AUTOMOBILES.

The seventh annual international automobile and bicycle exposition, under the auspices of the Society of German Bicycle Manufacturers, will be held at the Crystal Palace, Leipzig, on October 16th to 25th.

The Board of Aldermen of New York city has instructed Fire Commissioner Hayes to purchase two automobiles at a cost of not more than $4,000 each for use in the fire department. One will be used by the fire chief in Manhattan and the other by the deputy chief in charge of Brooklyn and Queens.

POWER TRANSMISSION.

Although but five years have passed since the inauguration of the power supply of Buffalo from electrical energy generated at Niagara Falls, yet to-day nearly one-half the power necessary for operating the machinery within the city's limits come from this one source. A great impetus has been given to the industrial growth of Buffalo by the introduction of this cheap form of energy.

SOCIETIES AND SCHOOLS.

The physicists and chemists of the Michigan Schoolmasters' Club will be in session at the State Normal College at Ypsilanti, Mich., on March 31st and April 1st. An elaborate programme has been prepared. Among the papers to be read is one on "Radium and Its Properties," by Professor H. S. Carhart of the University of Michigan.

The next meeting of the Chicago branch of the American Institute of Electrical Engineers will be held March 29th at the rooms of the Western Society of Engineers. The general topic of the evening will be high-tension transmission. The discussion will cover the same subjects as those to be taken up at this week's meeting in New York.

James I. Ayer, chairman of the committee on relations with kindred organizations of the National Electric Light Association, announces that arrangements have been made by which the association will have a permanent headquarters at the St. Louis World's Fair, consisting of a railed enclosure furnished with chairs, a convenient desk, stationery, etc., for the use of its members. The location will be in a section used also for an Edison historical exhibition, the headquarters of the Association of Edison Illuminating Companies and the headquarters of the American Institute of Electrical Engineers.

TELEGRAPH.

The German Atlantic Cable Company has distributed $391,337 in dividends for 1903, besides devoting $155,832 to the renewal of the depreciation funds. The dividend is 5½ per cent., against 5 per cent. for 1902.

The Canadian Pacific railway will string another duplex copper wire from Montreal to Winnipeg and a new copper wire from the latter place to Regina. A new line of telegraph poles will also be erected from Portage la Prairie west.

The report of the Western Union Telegraph Company for the quarter ended December 31st shows a surplus of $14,360,345.97. The estimated surplus on March 31st will be in round numbers $16,110,000. After deducting from this amount interest on the bonded debt and the amount of a dividend of 1¼ per cent. on the capital stock issued, a

surplus of $14,600,000 will remain. In view of these statements it has been decided to pay the dividend of 1¼ per cent. on the capital stock on or after April 15th.

The central cable office of the Western Union Telegraph Company announces that, owing to the interruption of the Mole St. Nicholas-Cape Haitien cable, telegraphic communication with Santo Domingo, Curacao and Venezuela is difficult.

Reports have been received from the island of Guam that the cable ship Scotia, which went ashore there recently on Spanish Rock, is a total loss. The Scotia is a vessel of 2,776 tons register, 379 feet long, 48 feet beam and 30 feet depth of hold. She was built at Glasgow in 1862 and is owned by the Telegraph Construction and Maintenance Company of London. She was last reported as having sailed from Singapore on January 29th for Honolulu.

SPACE TELEGRAPHY.

Further tests are to be made of several space-telegraph systems by the Navy Department between the Brooklyn navy yard and the station at Navesink Highlands, N. J. Later the system which produces the best result will be tested between shore stations and ships and ship and ship. The Navy Department continues to receive encouraging reports of space-telegraph achievements at sea. Recently the Minneapolis at Guantanamo made connections with the Yankee, 80 miles away.

PUBLICATIONS.

Pass & Seymour of Solvay, N. Y., are sending out a small pamphlet descriptive of sign receptacles. These devices are simple in construction and are weatherproof, the leading-in wires being of the best grade, rubber-covered.

The first catalogue issued by the Crowe Metal Manufacturing Company of Chicago makes a very creditable appearance. This company manufactures by a new process name plates and metal advertising cards, pictures of which are tastefully arranged in the catalogue. The new process is said to cheapen the cost of production and allow of the manufacture of plates at figures which will appeal especially to the small consumer.

The F. Bissell Company of Toledo, Ohio, has issued another addition to its perpetual catalogue in the form of three bulletins treating respectively G. I. circuit breakers, Ward Leonard field rheostats and P. C. & W. patent needle annunciators. The latter bulletin contains descriptions and illustrations of a great variety of apparatus for annunciator work, including electric bell outfits, push buttons, hotel switchboard annunciators, buzzers, etc.

MISCELLANEOUS.

An engineering feat presenting great difficulties is the erection of the railway bridge across the Zambesi River at Victoria Falls, S. A. The structure will tower 420 feet above the water level of the gorge below. The construction will begin from both sides at once and electric telpherage will play an important part in the work.

A marked increase in the price of iridium, the second in commercial importance of the platinum group of metals, is reported to have taken effect during the last month. This fact is of importance to the electrical, chemical and dental industries, which are extensive consumers of the various alloys of iridium and platinum. Recent reports indicate a marked shortage in the supply of iridium, while the demand for this metal is increasing.

The Chilean battleship Libertad is equipped with electrical apparatus on an elaborate scale. Especially is this noticeable in the use of incandescent lamps. A total of 1,000 lamps is installed, mostly of 16 candlepower, although some 50-light clusters are used on the yardarms and in the coal bunkers. Five generators on board have a combined output of 250 kilowatts. There are five powerful searchlights provided with automatic-feed lamps. In addition current is supplied to 70 motors, electrical power being used wherever possible.

The trio of "car-barn bandits"—Gustave Marx, Harry Van Dine and Peter Niedermeyer—arrested for the killing of two employes of the Chicago City Railway Company while in the act of robbing the receiving clerk at the company's Sixty-second Street car barns in Chicago last fall, have been tried, convicted of murder and sentenced to death on the gallows. The trial has already cost the taxpayers more than $60,000. The trio have confessed to at least a dozen other murders. The fourth member of the gang, Emile Roeski, will be tried separately.

Under date of January 7th United States Consul Slocum, writing from Warsaw, Russia, stated that there would be an electrical exhibit in Warsaw extending from May 1st to August 1st. He added that it might be to the advantage of American manufacturers to send exhibits, particularly so in view of the fact that it is believed locally that the current year has opened a period of great industrial activity, especially in the electrotechnical branch. No announcement has been made as to whether the breaking out of the war with Japan will interfere with the plans.

A bill has been introduced in the House at Washington by Representative Rider to provide for the extension of letters patent for seven years from and after the passage of the act to Baker A. Jamison and Tallmadge A. Lambert, administrators of George B. Simpson, covering a patent originally granted on May 21, 1867, to George B. Simpson, the patent in question covering an improvement in the method of insulating submarine cables, No. 65,019. The bill instructs the commissioner of patents to grant the extension of the patent upon the payment of the usual fees, with an important proviso to the effect that no charge shall be made for the use of the patent from the time of the expiration to the time of the renewal. The matter has been referred to the committee on patents.

TRADE NEWS.

A receiver has been appointed for the Corning Electric Company of Corning, Iowa, of which F. L. Larue is principal stockholder. The liabilities are said to be large.

It is unofficially reported that the interests represented by William Stanley have withdrawn from the Allis-Chalmers Company as regards the recent arrangements with that company in entering the electrical field.

James B. Cahoon, electrical and hydraulic engineer of New York city and former president of the National Electric Light Association, has recently removed his office to suite 1725-6 in the New Building, No. 42 Broadway.

The Leffler Electro-Magnetic Railway Company, Chicago, has issued $600,000 of bonds, secured by its plant, property rights and franchises, for the purpose of making future improvements and further developing its system of electromagnetic railway cars and motors.

Bids will be received at the office of the supervising architect, Washington, D. C., until April 25th for the construction, including plumbing, electric wiring and conduits, of the postoffice at Chillicothe, Ohio. Drawings and specifications may be had at the office of the postmaster at Chillicothe, Ohio.

At the annual meeting of the Electric Storage Battery Company, held in Philadelphia, the old board of directors was re-elected. The stockholders approved the annual report, which showed an increase of $388,384 in the surplus after dividends had been paid. The gross earnings for the year were $1,761,058.

The building occupied by the Chicago branch of the American Electrical Works at 82 Lake Street was badly damaged by fire last week, causing a loss from fire and water to the electrical company of about $15,000. Mr. F. E. Donohoe, manager, has opened temporary offices at 1419 Ashland Block until the loss can be adjusted and permanent quarters secured.

Sealed proposals are being invited until April 23d for installing at the New York navy yard one turbo-alternator with exciter set, five induction motors, one motor generator, two switchboards and accessories. The appropriation for the work is $44,000. Specifications will be furnished upon application to the Bureau of Yards and Docks, Washington, D. C., or the commandant of the New York navy yard. Sealed proposals are also invited until April 9th for installing an electric elevator in building No. 4 at the League Island navy yard. Plans and specifications will be furnished upon application to the bureau at Washington, D. C., or to the commandant of the navy yard at League Island.

W. H. Abbott has become a member of the firm of E. P. Roberts & Co. of Cleveland, Ohio, and the name has been changed to the Roberts & Abbott Company. Through his work since beginning the electrical and general engineering business in Cleveland, and for many years before, Mr. Roberts has become well known. The same may be said of Mr. Abbott. For some years Mr. Abbott has been consulting engineer of the Pomeroy syndicate of Cleveland, and before that was engaged in various branches of the electrical business. He graduated from the University of Chicago with the degree of bachelor of science and then took a post-graduate course in the Ecole Internationale des Electriciens at Paris, France.

The National Electric Company, successor to the Christensen Engineering Company, Milwaukee, will exhibit its electrical and air-brake apparatus at the St. Louis Exposition. Part of the electrical exhibit will include a 1,500-kilowatt alternating-current generator. This unit will be in operation at the central power station, furnishing power for various purposes. In addition, a number of smaller alternating and direct-current machines will be exhibited, including a complete exhibit of the Christensen air-brake equipment. In a recent issue it was erroneously stated that this company builds alternators as high as 500 kilowatts in capacity, whereas, as may be judged by the foregoing, the figure should have been 1,500 kilowatts.

BUSINESS.

The Electric Storage Battery Company of Philadelphia has recently closed a contract with the Northern Illinois Lighting and Traction Company at Ottawa, Ill., for the installation of a battery of Chloride accumulators having a capacity of 160 kilowatt-hours. This battery is to be used for current regulation.

Considerable attention seems to be attracted to the Pardridge reflector manufactured by the Pardridge Shade and Reflector Company of Chicago. It has recently been illustrated in the columns of one of the big Chicago dailies, and among its users are the South Side elevated railway and the Illinois Central railroad.

The Woolley Foundry and Machine Works of Anderson, Ind., is receiving commendation for the Burger automatic gas engine, which is one of its products. The engine is said to regulate very closely and to be economical of fuel. The method of governing is the same as that used by many steam engines, the governor being located in the flywheel.

The Bullock Electric Manufacturing Company of Cincinnati has just received an order from the Denver Gas and Electric Company, Denver, Colo., for one 1,500-kilowatt, 2,400-volt, three-phase, 60-cycle, flywheel-type generator. This machine is a duplicate of one installed for the Denver company about a year ago. The new installation, together with four 600-kilowatt, three-phase, 2,400-volt alternators, makes a total of 6,000 kilowatts in Bullock alternators now in place in the Denver plant.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) March 15 1904.

754,406. Electrically Operated Stopping Means at Railway Danger Signals. William L. Adamson, Philadelphia, Pa. Application filed June 12, 1903.

A third rail electrically energized by a signal co-operates with a contact wheel adapted to ride the rail. A solenoid energized by the contact of the wheel and rail, and a valve interposed between the throttle valve and the cylinders of a locomotive and adapted to prevent the flow of steam to the cylinders when the wheel and third rail are in contact make up the apparatus.

754,410. Electric Time Alarm. Emil M. Benesch, Denver, Colo. Application filed March 7, 1903.

Combined with a clock face having a pair of dials are indicator hands operating in connection with the dials, one to indicate the hour when a current is to be turned on and the other the number of hours for its duration. Automatic mechanism controlled by these hands makes and breaks an electrical circuit.

754,428. Lamp. John L. Creveling, New York, N. Y., assignor to the Safety Car Heating and Lighting Company. Application filed March 22, 1901.

A combination lamp is described which contains gas inlets and a burner and also incandescent bulbs and the necessary leads. The lamp is for use especially in car lighting.

754,429. Means for Electrical Distribution. John L. Creveling, New York, N. Y. Application filed May 10, 1901.

The apparatus consists mainly of a generator, storage battery and translating devices. A pair of variable resistances, one in the main circuit and the other in the field circuit co-operate with a pair of movable members. An endwise-movable member is operatively connected with the moveable members, while a centrifugally-actuated mechanism, varying in speed with the armature shaft of the generator, is operatively connected with the endwise-movable member. A number of successively operative springs control the centrifugal mechanism and operate at the critical speeds of the generator. (See cut on next page.)

754,451. Electrical Water Heater. Harry M. Hill, St. Louis, Mo., assignor to the Hill Electrical Manufacturing Company, St. Louis, Mo. Application filed June 1, 1903.

Opposing electrodes which have adjustment with relation to each other to vary the distance between them and have also adjustment to carry one of them across the opposing surface of the other are inclosed in a vessel containing the water. Current passing from this to the other heats the water.

754,457. Telephonic Relay or Repeater. Isidor Kitsee, Philadelphia, Pa. Application filed July 7, 1899. Renewed April 25, 1902.

The relay consists essentially of a galvanometer, the needle or needles of which are provided with means to vary the resistance of a local circuit through the action of the incoming current. The local circuit contains the primary of an induction coil, the secondary of which is connected to a second line wire, the coil of the galvanometer being connected to the primary telephonic circuit, and the needle or needles placed in the recess of the coil. (See cut on next page.)

754,465. Automatic Electric Heat Regulator. Daniel N. Leib, Elkhart, Ind., assignor to the Automatic Heat Regulator Company, Elkhart, Ind. Application filed April 10, 1902.

A thermostat is arranged to close an electrical contact at a [illegible] cuit energizes an electro[illegible] nace damper.

754,496. Limiting Device for Electric Circuits. Charles W. Potter, Denver, Colo. Application filed February [illegible]

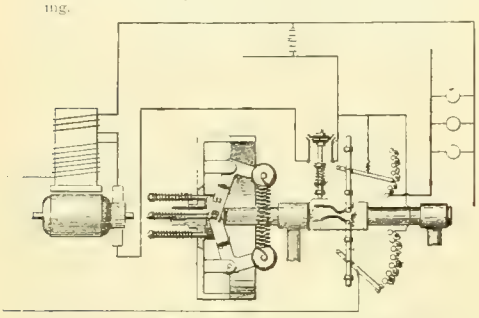
its armature slightly greater than the pull of the coil. A coil of high resistance is located below the low-resistance coil and has its hollow core concentric therewith, while means are operated by the armature of the series coil to shunt the high-resistance coil on the mains. Means operated by the shunt coil in turn disconnect the series coil. A supplemental armature in the top of the high-resistance coil maintains connection on the mains.

754,595. Automatic Circuit-breaker. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical and Manufacturing Company. Application filed June 18, 1903.

Separable co-operative contacts, a latch for restraining the contacts in normal position, means actuated by locally stored energy for operating the latch, a trigger restraining the latch-operating means, a member pivoted concentrically with the trigger for operating the trigger, and electromagnetic means for tilting the trigger-operating means are the essential features.

754,534. Thermostatic Gas-detecting Means. James E. Baldwin, East Williston, N. Y. Application filed September 10, 1902.

A local circuit supplied by a battery is so arranged as to be closed upon turning the valve of a gas jet in such a manner as to allow the gas to escape. Closing this circuit energizes an electromagnet which closes another circuit through an incandescent lamp giving a warning.



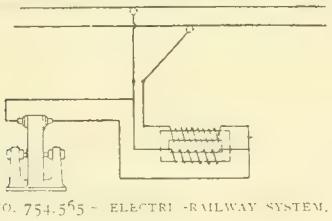
NO. 754,429 SYSTEM OF ELECTRICAL DISTRIBUTION.

754,555. Automatic Fire Alarm. Mason K. Fred, Pleasanton, Texas. Application filed March 9, 1903.

A source of electrical energy is connected direct in a closed circuit with the alarm. A wire formed of fusible metal extends throughout the room or rooms to be protected and is also connected in closed circuit with the battery. Artificial resistance is connected in the line between the alarm and the point of connection of the fusible wire with the battery, the resistance being greater than that offered by the fusible wire.

754,505. Electric Railway. Rudolf A. E. Huber and Hans H. C. Behn-Eschenburg, Zurich, Switzerland, assignors to the firm of Maschinenfabrik Oerlikon, Oerlikon, near Zurich, Switzerland. Application filed December 23, 1901.

Alternate-current line sections have different voltages which supply an alternate current motor on the car. A continuous-current generator is coupled to the alternate-current motor. Motors operated by the continuous current generated, and transformers to bring the voltages of the sections of line to the voltages required by alternate-current motor, are on the car. (See cut.)



NO. 754,505.—ELECTRIC RAILWAY SYSTEM.

754,602. Bottle-filling Machine. Emer H. Parker, Evanston, Ill. Application filed December 7, 1903.

An electrically controlled device governs the opening and closing of the valve admitting the liquid to the bottle.

754,622. Electric Clock. David W. Thompson, Chicago, Ill. Application filed December 5, 1895.

The clock escapement is operated by electromagnets.

754,637. Electromagnetic Gun. Kristian Birkeland, Christiania, Norway. Application filed January 2, 1902.

A number of solenoid windings surround the barrel of the gun with means for supplying current to the windings. A series of circuit-closers are arranged to close the circuit of the respective windings. The projectile moves inside the gunbarrel and progressively generates a counter-electromotive force in the solenoid windings. Progressive opening of the circuit-closers of the respective windings, each at that moment when the induced counter-current in its corresponding winding is substantially equal to the current produced by the direct electromotive force forces the projectile out of the barrel.

754,656. Electric Furnace. Charles A. Keller, Paris, France. Application filed January 17, 1902.

Vetrical electrodes in two parallel series pass through the roof of the fusion chamber, the lower extremities of these electrodes being situated in the interior of the chamber of fusion and their upper extremities, exterior to the chamber of fusion, being carried each by a suspension mechanism by the aid of which they are capable of being vertically removed. (See cut.)

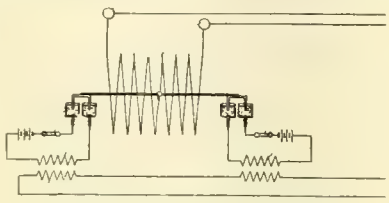
754,660. Rheostat. Lamar Lyndon, New York, N. Y., assignor to the National Battery Company, Buffalo, N. Y. Application filed August 8, 1902.

Several resistances are electrically connected and bridged in circuit across the line, together with a receiving device with which the resistances are adapted to be connected either in parallel or partly in series and partly in parallel.

754,666. Induction Coil. Reuben Miller, Jr., Pittsburg, Pa. Application filed January 7, 1904.

Combined with two or more induction coils arranged in parallel are an electromagnet in series with the primaries of each induction coil and an interrupter controlled by the magnet in series with each of the primaries.

754,681. Electromagnetic Device. Eugen K. Müller, Zurich, Switzerland. Application filed September 20, 1902.



NO. 754,457.—TELEPHONE REPEATER.

Two coils, one movably mounted relative to the other by yielding means connecting the supports of the two coils, co-operate with a member mounted on the second coil, the two coils being adapted to be connected with a source of alternating electric current and so wound that their magnetic fluxes will be opposed.

754,689. Electrical Selective Apparatus. Frank D. Pearne and Charles L. Krum, Chicago, Ill., assignors to the Pearne Electric and Manufacturing Company, Chicago, Ill. Application filed February 3, 1902.

A line circuit with two independent, separate branch circuits contains a relay. Means controlled by the relay close either of the branch circuits which is locked by a pair of locking magnets, one controlled by each of the branch circuits. A shunt around the circuit-controlling means is arranged to be closed by the operation of the locking magnets through the selected branch circuit.

754,692. Rheostat. Claude R. Pitrat, Amsterdam, N. Y., assignor to the Magneto Electric Company, Amsterdam, N. Y. Application filed August 8, 1903.

The rheostat embodies an electromagnet having pole pieces, a contact arm including a pair of parallel members and a keeper mounted between the members to co-operate and be self-adjustable with respect to the pole pieces.

754,694. Electric Pocket Lamp. Angelica E. Post, Boston, Mass. Application filed December 30, 1903.

A small incandescent lamp is contained in the end of a flat oblong case in which is placed the battery for the lamp.

754,748. Electric Stop Motion for Warping Machines. John Cocker and Charles Denn, Philadelphia, Pa. Application filed January 30, 1902.

An electric circuit is provided with a fixed terminal formed of a metallic rod, spaced metallic strips being placed below the rod and connected to it. A second terminal in the form of a revoluble metallic roller is arranged below the strips with means for continuously revolving the roller. Circuit-closers in the form of rods, having at their upper ends eyes by means of which they are suspended from the yarns and intermediate of their ends loops to receive the rod, are other features of the invention.

754,756. Process of Separating Ores from Magnetic Gangue. Thomas A. Edison, Llewellyn Park, N. J. Application filed May 29, 1903.

Treating nickeliferous ores composed essentially of pyrrhotite and a smaller proportion of a non-magnetic nickel compound consists in grinding the ore to a sufficient fineness to free the non-magnetic particles. With this is mixed a predetermined and larger bulk of a coarser non-magnetic material. The mixture is subjected to the action of a magnetic separator, whereby the non-magnetic nickel compound and added coarser material will be rejected as tailings. The non-magnetic nickel compound is finally separated from the added coarser material.

754,762. Electric Socket Support. Edwin R. Gill, New York, N. Y. Application filed March 14, 1902. Renewed December 23, 1903.

As a means for conveying current to electric lamps, two insulated conductors, carry two separable clamping members applied to opposite sides. A piercing and conducting point on each member is adapted to penetrate the insulation on one of the conductors.

754,778. Trolley Wheel Retainer. James A. Kilpatrick, Niles, Ohio. Application filed December 19, 1903.

Combined with a trolley pole is a trolley wheel and a pivotally mounted retainer frame with means tending by gravity to normally hold the frame horizontal. Retainers carried by the frame normally extend across the conductor wire.

754,804. Speed-regulating Magnetic Clutch. Charles A. Pratt, Oak Park, Ill. Application filed December 7, 1903.

Two transmission disks mounted in substantially parallel planes are supplied with transmitting mechanism adapted to communicate power from one of the disks to the other, also magnetic mechanism adapted to move one of the disks toward the other and means to vary the position of the transmitting mechanism with reference to the disks so that the speed of rotation of one of the disks with reference to the other is varied.

754,858. Storage-battery Tray. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Storage Battery Company, Orange, N. J. Application filed November 28, 1902.

A tray for supporting a series of cells has on its bottom a series of blocks or pedestals, one for each cell, a stud on each block and an insulating skirt between each cell and the corresponding supporting block, the skirt being formed with a struck-up socket engaging a recess in the bottom of the cell.

754,859. Reversible Galvanic Battery. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Storage Battery Company, Orange, N. J. Application filed November 28, 1902.

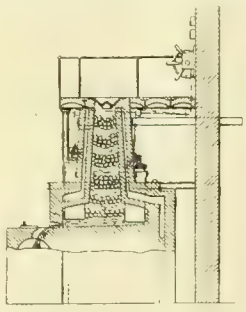
In a reversible galvanic battery are electrode plates carrying perforated pockets containing the active material, the pockets projecting beyond the face of the corresponding electrode plate. Insulating separating tubes are arranged longitudinally between the plates and guided by the pockets and made of material which is unaffected by electrolytic action in the electrolyte.

754,863. Electrical Plug and Receptacle. Gilbert W. Goodridge, Bridgeport, Conn., assignor to the Bryant Electric Company, Bridgeport, Conn. Application filed October 9, 1903.

A plug receptacle consists of an insulating body having holes through it, with a plain metal single tube in each of the holes, carrying a binding screw at its rear end and a securing pin passing through lateral openings in the body and secured in the tubes.

754,868. Fire and Water Proof Insulating Covering for Metallic Surfaces. John A. Heany, Philadelphia, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va. Application filed May 10, 1902.

A waterproof cohering adhesive mass formed of gluey substances is applied as a coating to the conductor. Flocculent asbestos is agglomerated with the coating. A covering is formed of the waterproof gluey substances combined with fireproofing materials agglomerated with the asbestos and the gluey coating of the conductor to form an insulating mass in which the materials and asbestos are thoroughly intermingled and firmly bound.



NO. 754,656. ELECTRIC FURNACE

754,904. Wireless Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring and the Consolidated Wireless Telegraph and Telephone Company, Philadelphia, Pa. Application filed June 11, 1902.

In a wireless signaling system is a freely-oscillating circuit, an inductance winding included in the circuit and a radiating circuit connected to the terminals of the winding.

754,935. Ringing and Listening Key. Charles H. North, Cleveland, Ohio, assignor to the North Electric Company, Cleveland, Ohio. Application filed September 14, 1901.

Several contact-making springs closely mounted in parallel, vertical planes are operated by a lever pivotally mounted above the springs. An interposed roller part carried on the lower end lies between the springs, which it is adapted to flex into and out of contact when oscillated by the lever.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on March 22, 1904:

359,593. Automatic Electric Air Brake. J. Fairfield Carpenter, Berlin, Germany.

359,607. Electric Railway. Isaac W. Heysinger, Philadelphia, Pa.

359,619. Combined Volt and Ampere Meter. Roderick Maciae, Baltimore, Md.

359,686. Municipal Signal Apparatus. Bernice J. Noyes, Boston, Mass.

359,687. Municipal Signal Apparatus. Bernice J. Noyes, Boston, Mass.

359,688. Municipal Signal Apparatus. Bernice J. Noyes, Boston, Mass.

359,689. Individual Call for Municipal Telegraph Systems. Bernice J. Noyes, Boston, Mass.

359,690. Electric Battery. Karl Pollak, Berlin, Germany.

359,713. Electric-lighting System. Frederick A. Cheney, Troy, N. Y.

359,726. Electrical Conductor. Edward B. Johnson, New York, N. Y.

359,738. Underground Conduit for Powerful Electric Currents. George B. Pennock, Brooklyn, N. Y.

359,739. Regulator for Electric Currents. Joseph A. Powers, Troy, N. Y.

359,748. Dynamo Electric Machine. Nikola Tesla, Smiljan Lika, Austria-Hungary.

359,770. Regulator for Dynamo Electric Machines. Charles L. Buckingham, New York, N. Y.

359,805. Electrical Synchronal Escapement. James F. McLaughlin, Philadelphia, Pa.

359,812. Insulator for Supporting and Holding Electric Wires. Henry Pennie, Brooklyn, N. Y.

359,816. Terminal for Telegraph Lines or Cables. William H. Sawyer, Providence, R. I.

359,823. Electric Fire and Burglar Alarm. Siegfried Taussig, Prague, Bohemia, Austria-Hungary.

359,824. Electric Current for Telephones and Fire and Burglar Alarms. Siegfried Taussig, Prague, Bohemia, Austria-Hungary.

359,876. Process for Preparing Secondary-battery Plates. Abraham V. Meserole, New York, N. Y.

359,877. Secondary Battery. Abraham V. Meserole, New York, N. Y.

359,894. Dynamo Electric Machine. Robert J. Sheehy, New York, N. Y.

359,900. Charging and Discharging Secondary Batteries. Eli T. Starr, Philadelphia, Pa.

359,901. Mechanism for Charging Secondary Batteries. Eli T. Starr, Philadelphia, Pa.

359,976. Electric Lamp Frame. Thomas H. Brady, New Britain, Conn.

359,981. Secondary Battery. William Main, Brooklyn, N. Y.

359,982. Coupling for Electric Conductors. Frank C. Plume, Thomaston, Conn.

359,984. Telephone Signal. Charles R. Swain, Peekskill, N. Y.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, APRIL 2, 1904 No. 14

Electric Power Plant on the Avancon River at Bex, Switzerland.

By Franz Koester.

The power plant herewith described is designed for the purpose of utilizing the waterpower of the Avancon River and converting it into electricity. The electric power is used for a number of purposes—for lighting the town of Bex and its numerous hotels (Bex being a favorite stopping place for travelers in the Bernese Alps), for industrial establishments, and also for the electric road and a rack railroad which runs from the railroad station at Bex to the towns of Gryon and Villars. The dam runs entirely across the river from bank to bank, but is only 34½ feet long.

At right angles to the river and close to the dam a supply conduit 4,696 feet long leads to a collecting reservoir, in which is connected the penstock (1,318.5 feet long) which leads to the power house, and also an overflow pipe, which leads from the reservoir to the river. The power house is arranged to accommodate six turbo-generator units. The period of high water in the river, during which time the average flow is 1,600 liters a second, lasts for from eight to nine months, the flow during the remainder of the year averaging about 800 liters a second. The Avancon River is fed from the glaciers of the Muveran Mountain and the Dent de Mordes Range and from many small mountain streams. The dam, water canal and penstock are constructed on the basis of a flow of 1,600 liters a second, and the power house is so arranged that should the occasion arise, two additional turbo-generator sets may be added. The gross fall from the dam to the power house is 557.6 feet and the net or useful fall is 531.3 feet.

FIG. 1. ELECTRIC POWER PLANT ON THE AVANCON RIVER AT BEX, SWITZERLAND

Taking into account the friction losses in the penstock and using an efficiency of 75 per cent. for the turbines, the plant develops in winter 1,300 horsepower and during the rest of the year 2,400 horsepower. The dam is built of concrete and masonry and is 9.84 feet high, the water overflowing for the greater portion of its length. The supply conduit is built at right angles to the river, as previously stated, the bottom of the conduit being 25 inches above the river bed, in order to keep sand from entering the conduit. The conduit is provided with an inlet sluice, which is usually kept open. After entering the conduit the water passes through a grating and enters a water chamber 72.1 feet long and 9.84 feet wide. Immediately before the entrance of the conduit leading to the penstock is an overflow which allows the water to return to the river. At the conduit entrance is a rack of iron bars, to prevent foreign matter from being carried in with the water, and there is also provided a regulating sluice which indicates, by means of a scale, the amount that it is opened.

It is possible to operate the combination of all these sluice gates so that throughout the entire year the water which enters the conduit is entirely free from gravel and foreign matter and no sand or stones can collect in the conduit or basin. The water chamber is built of concrete and masonry, the concrete being used where an underground flow of water was encountered. The bottom of the chamber rests on solid rock, thus obviating the necessity of pile foundations. A small wooden building, connected to the bank by a bridge, is provided over the reservoir, and from this is operated the sluice.

The supply conduit is built of cement and runs underground throughout its length of 4,696 feet. It is 3.93 feet high and 2.6 feet wide at the widest part. Its cross-section is elliptical, and its area is 8.3 square feet, the thickness of the walls varying from five inches to 7¾ inches. The conduit for 1,132 feet of its length is built in a tunnel and surrounded with gravel. For the remaining 356 feet of its length it is laid in a trench on the mountain slopes, the bottom resting in gravel. Of the total length, 1,065 feet is made up of curves which have radii varying from 65 to 325 feet.

The conduit is divided into eight sections, in each of which is located a slime collector 9.8 feet square and 6.56 feet deep, the bottom of the collector being 19 inches below the bottom of the conduit. At this point a sluice gate for cleaning is provided, and also a manhole for the same purpose. The speed of the water in the conduit is 9.18 feet a second. The conduit terminates in a reservoir, which is for the purpose of purifying the water and also assists greatly in regulating the pressure on the turbines. The reservoir is cylindrical in form, 26.2 feet in diameter and 11.8 feet deep, and is constructed of armored concrete. The reservoir rests upon a foundation of tamped concrete from 7¾ to 11½ inches thick, the walls being from 3.8 to 4.6 inches thick. It has a capacity to the overflow of 1,712 cubic feet. The water passes from the reservoir into the penstock through a fine grating. The entrance to the overflow conduit, which is built of concrete, is 8.8 feet above the bottom of the basin and is provided with a sluice gate.

A small wooden house is built above the reservoir, from which the sluice gates are operated. The penstock follows the steep and changing slope of the Ravine Mountain to the power house, where it terminates in a tee. It is 1,318.5 long and 2.95 feet in diameter, and is built of sheet steel, the pipe lengths running from 19 to 23 feet. The lengths are double riveted and the flanges are angle iron. The thickness of the steel is divided into 10 sections, according to the pressure of the water, and varies from three-sixteenths to nine-sixteenths inch. The penstock is supported by iron saddles built in concrete foundations, there being two such saddles to each 19.6 feet length of pipe. At bends or changes of grade the foundations are securely anchored and contain nearly 82 cubic feet of concrete. The expansion joints, of which there are six in the entire length of the penstock, are of cast iron in the stuffing-box form, and are packed with hemp. At all flange connections is provided a hard-rubber gasket, which has been found to be very satisfactory. The speed of the water in the penstock varies from 3.28 to 4.92 feet a second ordinarily. At full capacity the speed is 8.2 feet, according to the load on the power house. A gauge controls the pressure of the water in the penstock.

Owing to the impossibility of arranging a natural overflow from the reservoir, it was necessary to build an artificial one, which consists of an underground conduit built of armored concrete of the Malgarini system. The pipe is circular in cross-section and its diameter is 23.2 inches; it is large enough to carry off the overflow water from the reservoir without creating any pressure in the pipe. As the drop of this pipe is considerable, in order to keep it from moving, it is imbedded at intervals throughout its length in concrete foundations, and at two points, where there is a sharp turn, a large concrete foundation, in which there is a chamber for breaking the force of the water, is built and provided with a manhole. The total length of this overflow conduit is 996.9 feet.

The power house is built on the river bank at the foot of the mountain slope, a retaining wall being built up from the river above the power-house foundations. It is 93.4 feet long inside and 31.5 feet wide. Fig. 1 is an exterior view of the power house Fig. 2 is a sectional drawing showing the arrangement of the machinery. The dimensions are given in meters. On one side is a switching room 30 feet long and 10.4 feet wide. At one end of the power house is a building for the employes, this having three stories and a basement, a portion of the building being used as a shop.

The penstock joins a tee in the power house, which branches both ways at right angles. This tee is located in a trench under the floor, the trench being covered with plates of checkered iron and readily accessible. Each branch of the tee is 28½ inches in diameter, and a throttle valve is inserted in each branch near the junction with the penstock. These valves are operated from the generator room by means of a spindle and gearing. The penstock in the turbine house is furnished with a discharge valve, which enables the reservoir and penstock to be emptied in 15 minutes' time. Smaller pipes lead from the branches of the tee to the turbines, there being two such pipes in one branch and four in the other to agree with the arrangements of the machines. The plant is also equipped with a five-ton traveling hand crane, which is suspended 16.4 feet above the floor.

Six high-pressure turbines, manufactured by Escher, Wyss & Co. of Zurich, Switzerland, are installed in the power plant. One of the turbines is shown in Fig. 3. These turbines run at a speed of 600 revolutions a minute and furnish 400 horsepower each. Deducting the friction losses in the penstock and in the branch line the net head available at the turbines is 508.2 feet. The turbines are of the spoon-wheel type and are enclosed in cast-iron

casing and revolve on a horizontal shaft. The speed is governed by a flyball governor, which in turn acts upon an hydraulic regulator and controls the admission of the water to the turbine wheel. The turbines are guaranteed to show a speed variation of three per cent. or less with a 25 per cent. change in load, and with 100 per cent. change in load a speed variation of eight per cent. or less is guaranteed. Tests on these turbines when fully loaded have shown a speed variation of five per cent. when the load was entirely thrown off. The turbine shaft is equipped with a flywheel. In order to guard against shocks and the influence on other turbines when the load is suddenly thrown off from one machine, each turbine is provided with an automatic

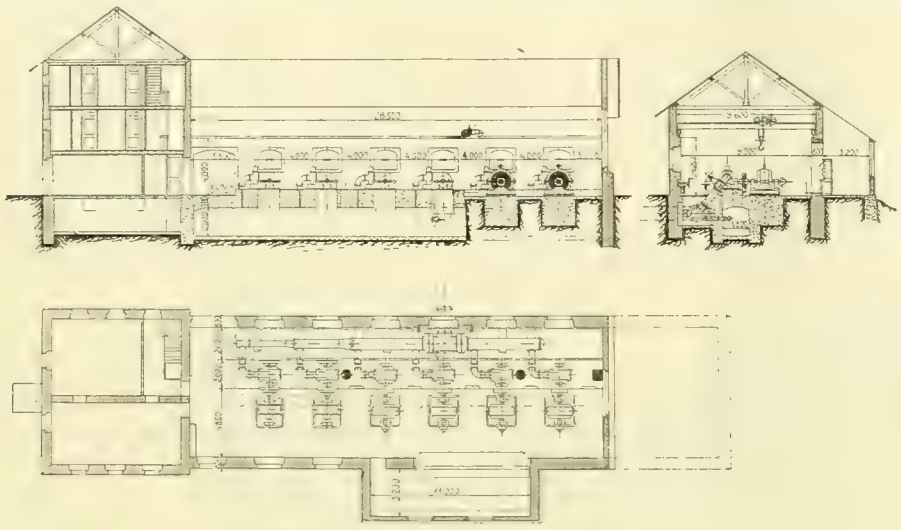


FIG. 2. SECTIONS AND PLAN OF POWER HOUSE AT BEX, SWITZERLAND.

safety discharge valve, which allows the excess water to escape and reduces the pressure acting on the turbine. The safety valve is normally closed by means of a weighted lever, which is connected to a piston operating in a dashpot so that the valve opens quickly when it operates and closes slowly.

In spite of the fact that the penstock is equipped with neither air chamber nor safety valve, tests have shown that a change from full load to no load on the turbines causes a variation in pressure of three per cent. in the penstock. The water before entering the turbines passes through a by-pass gate valve in the branch line from the penstock to each turbine.

Two of the turbines, which are connected to direct-current generators, are provided with two flywheels each, these being 45.9 feet in diameter and 1,980 pounds in weight. One of these flywheels is

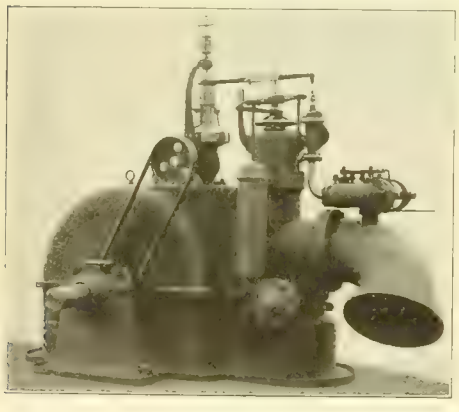


FIG. 3. TURBINE WATERWHEEL OF 400 HORSEPOWER AT BEX, SWITZERLAND.

on the shaft between the turbine and the generator and acts as a coupling, the other wheel being on the shaft outside the turbine. The remaining turbines are connected to alternating-current generators by means of insulated flexible couplings. The dynamos are mounted on a continuation of the turbine shafts, the direct-current machines furnishing power for railway service. The alternators furnish power for lighting and manufacturing purposes. The dynamos, which are of the usual type, were manufactured by the Cie de L'Industrie, Geneva.

The Chicago and Milwaukee Electric Railroad Company has at last secured a right-of-way through Zion City, by which to connect Kenosha, Wis., and Waukegan, Ill. The deal involved unusual difficulties on account of the declared principles of the followers of Dowie that "it is contrary to our principles to sell the property of God."

Thawing Ice in Water Pipes by Electric Heat.

Mr. R. S. Kelsch, general superintendent of the Montreal Light, Heat and Power Company, contributes the following to the discussion in relation to the use of electricity in thawing ice in water pipes:

"Owing to the unusually severe winter just passed, the method has been employed on a large scale in Montreal. The water pressure in Montreal varies from 70 to 110 pounds, and on account of the general winter conditions in this vicinity, the water pipes and services are placed seven to eight feet below the street surface. Notwithstanding this depth, there has been reported during the last winter over 1,000 frozen water service pipes, and in some instances water mains as large as eight inches in diameter have been frozen solid.

"In the early part of the winter a few water services were thawed out by excavating, and the cost varied from $30 to $40 a service. This method was abandoned and the city Water Department applied to the Montreal Light, Heat and Power Company for current to thaw out the pipes, and seven teams with sleighs, 30 to 40-kilowatt transformers, rheostats, reels of wire, etc., were prepared to send out, and each equipment was rented to the Water Department, and placed in charge of one of its employes. The water company furnished a man to make the necessary connections to the power company's system.

"The number of pipes thawed out by the different equipments varied from 15 to 30 a day, the average being about 20. The amount of current necessary for a service was about 210 amperes each, which accomplished the purpose in from six to 20 minutes.

"The eight-inch pipe required the services of three equipments, which were sent from the station at 8:30 a. m., traveling a distance of 4½ miles, and were back at the station at 11 a. m. The eight-inch pipe was 700 feet in length, and it required 1,000 amperes for 40 minutes.

"The past winter has been so severe that it was found necessary to use this process throughout the section of Canada, but I believe that the wholesale method found necessary in Montreal this winter has not been employed elsewhere heretofore.

"The average cost to the city has been about $1.50 a service, as against $30 to $40 a service by excavating."

Mr. W. F. Kingan, manager of the Edison Sault Electric Company, sends this: "Many articles have appeared in the technical press and local papers regarding the thawing of water pipes by electricity. The Edison Sault Electric Company of Sault Ste. Marie, Mich., has been engaged each winter for the last six years in thawing service pipes for the city electrically, and the means and apparatus which we have always used seem simpler and better than any of which we have read. We merely employ a 25 or 30-kilowatt capacity transformer, which is mounted and left on a sleigh, and also several wire reels. These reels are turned by means of a crank and mounted on swivels, so that they always lead in the direction in which the wire lies. We attach the primary of the transformer to the secondaries of our system, and the secondary of the transformer direct to the pipe we desire to thaw. This reduces the voltage of the secondary of the transformer to a low figure and gives a large current capacity. We use no resistance of any description, and as the transformer is oil-filled the case does not get even blood warm, hence we incur no danger. The average time for thawing five-eighth-inch or three-quarter-inch service pipes is about 10 minutes. We charge a flat rate of $5 for the service."

Death of Chester D. Crandall.

By the death of Chester D. Crandall the commercial side of the electrical industry has lost a man highly respected and universally esteemed who was also a kindly, cultivated gentleman. Entering the electrical field at the age of 25, Mr. Crandall's pleasing personality and excellent business qualities were at once recognized, and it was not many years before he became active in the management of one of the largest institutions in the electrical industry. This was the Western Electric Company of Chicago, of which Mr. Crandall was manager for many years. For over a year he had been in poor health, which developed into Bright's disease, finally affecting his heart and resulting in his death on March 22d. Although Mr. Crandall owned a beautiful home at 2821 Sheridan Road, he died at the Virginia Hotel, where, for the last six months, together with his wife and one child, he had made his home.

Chester D. Crandall was born in Jefferson County, New York, on December 28, 1854. After preparatory schooling he entered the University of Rochester, graduating in 1879 with honors. He accepted a position in Chicago with the Western Electric Company in July, 1879, where he remained until August, 1881, when he was chosen secretary and treasurer of the Gilliland Electrical Manufacturing Company of Indianapolis, Ind., which had been purchased by the Western Electric Company. In March, 1882, Mr. Crandall resigned to accept the position of secretary and treasurer of the Missouri and Kansas Telephone Company. Here he remained until March, 1889, when he again entered the service of the Western Electric Company, being later appointed manager, and which position he held at the time of his death. Owing to his protracted illness, he has, however, not been active in his duties for over a year.

CHESTER D. CRANDALL.

Besides his duties as manager of the Western Electric Company, Mr. Crandall became interested in the development of several electrical enterprises. The principal one was the developing of a valuable waterpower in Mexico, which now transmits electrical current to Puebla. An American corporation was formed to develop this project, and Mr. Crandall was made president. He continued in this capacity until about six months ago, when he resigned on account of his health.

Mr. Crandall was of a gracious and affable disposition, and he had many friends. His straightforward and considerate traits commanded the esteem of his friends and the confidence of his business associates. His death is keenly felt. He was a prominent Mason and a member of the Union League Club, the Chicago Athletic Association and the Glen View and Edgewater Golf Clubs. He was also an associate member of the American Institute of Electrical Engineers.

The funeral services were held in the Church of the Atonement in Edgewater on March 25th. Interment was at Rose Hill. The pallbearers were the following-named gentlemen: Honorary—A. L. Dewar, George P. Barton, Charles A. Brown, John Young, B. E. Sunny, W. R. Patterson, A. L. Greene, J. W. Johnston. Active—H. R. Hixson, E. F. Keefer, A. McEwen, W. M. Carpenter, C. E. Scribner, A. L. Tucker.

Sahulka Electropneumatic Railway System.

Dr. Johann Sahulka, professor of electricity in the Technical High School of Vienna, Austria, is the inventor of certain improvements upon electropneumatic railway systems which will be of interest to those who have been following the development of the system of B. J. Arnold first publicly announced by Mr. Arnold in an address before the American Institue of Electrical Engineers on June 19, 1902, and which was more fully described in the Western Electrician of January 2, 1904. Mr. Sahulka's United States patent was applied for on April 18, 1903, and issued March 22, 1904.

The principle of the Sahulka system, which, like the Arnold system, makes use of a pneumatic accumulator, consists in providing the driving shaft

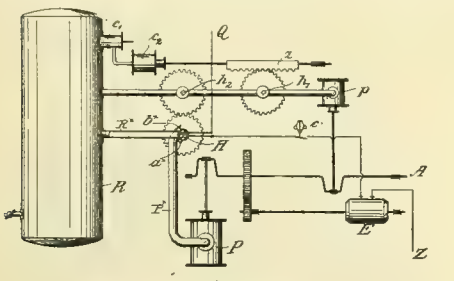


FIG. 1. SAHULKA ELECTROPNEUMATIC RAILWAY SYSTEM.

with two separate motors connected with each other only by means of the driving axle, an electric motor and a compressed-air motor, both acting upon the driving shaft. The compressed-air motor only comes into action at starting and at such parts of a railway track where no line conduetors are provided, eventually, also, on short sections of track where increased power is required. The electric motor, on the other hand, is working all the time or at any rate during the time that full speed is maintained. Since, during the greatest portion of the working time full speed will be maintained, the compressed-air motor as a rule will merely act as a starting motor, the electric motor constituting the main working motor. In place of a single electric motor and single compressed-air motor, groups of motors may be used, and compressed air may be replaced by any other form of power. The electric motor may be either a continuous-current motor or a single or polyphase motor of any system. The pneumatic and the electric motors can be controlled by separate controlling mechanisms or by a common controller.

The system of Sahulka has, in common with that of Arnold, the arrangement of a pneumatic accumulator mounted upon the vehicle. The principal difference between Dr. Sahulka's system and Arnold's according to the Viennese inventor, is that in the latter the constantly running electric motor is, so to speak, the sole "working" motor, the compressed-air device being regarded merely as a coupling device between the electric motor and the car axle, the coupling permitting a variation of the transmission of speed between the working motor and the axle. In the Sahulka system the compressed-air motor and the electric motor act as entirely independent driving motors actuating the carriage axles, these motors being in connection with each other only by means of the driving axle. This system may therefore be characterized as a "mixed electrical and pneumatic system of driving," wherein, however, the electric motor acts as the main working motor. The system may be employed for stationary power plants, as well as railways, and numerous advantages are alleged to be secured, chief among them being the great simplification in the construction of driving and regulating devices and the dispensing with line conductors or third rails within the limits of railway stations. There is no tendency on the part of the vehicle to continue moving when stopped.

In the Sahulka system only a single compressed-air engine is required, which needs to work as a motor exclusively. Another simplification is that the electric motor may be connected with the circuit at only periods of full speed, thus dispensing with all starting rheostats. Moreover, all line conductors can be abolished in stations. On account of the simple character of the controller devices it is deemed possible for the system to be used for trains operated according to the multiple-unit system. Finally, in sections of the track where there are no line conductors for the supply of current, the system presents the advantage that no special trouble need be taken in looking out for the spot at which the line conductors recommence.

The system, when applied to mountain railways, permits of recovering energy in the form of electrical energy and compressed air during the downhill trip, the speed being then controlled automatically.

To recover compressed-air energy, an arrangement can be used by which the compressed-air engine is put to work as a compressor in descending. In all the various modifications of the system only a single controller crank is required, and in all cases the electric motor alone supplies power to the axles during the greater part of the trip, so that this motor must be regarded as the principal motor, the compressed-air motor merely as a supplementary starting motor.

Fig. 1 is a diagrammatic view of one form of the apparatus. The motors (E) and (P) transmit power independently of each other to the car axle (A). From this latter is driven the small compressor (p). In starting, the motor (P) alone comes into action, and it is only when a certain rate of speed has been attained that the controller (H) completes the circuit for the motor (E) and throws (P) out of action. The motor (E) has no starting rheostat and works alone until the next stoppage has to be made. In order to avoid the necessity of the starting motor (P) having to drive the car axle (A) and compressor (p) simultaneously, the tap (h^2) may be connected with the controller (H), the result then being that the compressor (p) does not begin to work until (P) has been disconnected and (E) is running.

When the car is started for the first time, the accumulator (R) must be fully charged, which is done from an outside source. During the trip (R) is always kept charged, and even after being at rest for several hours there will always be enough pressure in (R) to insure the starting of the car. There is no difficulty in recharging (R) after work has been suspended for some time, since the accumulator (R) may be comparatively small, as its sole task consists in supplying the compressed air required for starting. Should (R) be quite empty, it could be recharged by attaching the car to another and drawing it along some distance. In this case the controller (H) of the drawn car must be set in the cut-off position and (h^2) would have to be omitted.

In view of the fact that the controlling mechanism acts automatically in the manner already described this system is suitable to application to trains containing several cars (multiple-unit system). In this case no modification is required to control the motors of all cars by the controller (H) of the leading car except that corresponding through pipes for the compressed air and through conductors for the current must be provided.

As can be seen in Fig. 2, the accumulators (R′) (R^2) are connected with a compressed-air pipe (D^3) and the motors (P′) (P^2) with the compressed-air pipe (D^4), these pipes being connected in each carriage with a pipe communicating with the controller (H′) (H^2). The brake pipes ($b^{x'}$) (b^{x^2}) issuing from the controller are also connected with a through-pipe (d). By means of the trolleys the current is

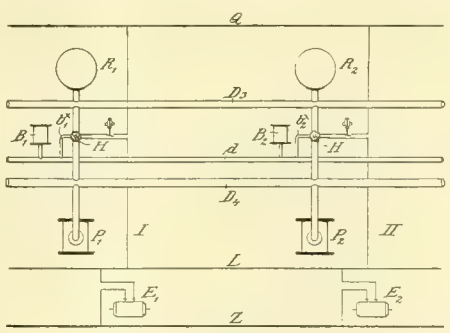


FIG. 2. SAHULKA ELECTROPNEUMATIC RAILWAY SYSTEM.

led from the line conductor (Q) to (H), and from thence a conductor leads to the through-wire (L), the motors (E) being coupled in circuit between this latter and the return conductor, in this case represented by the rails (Z). The compressors (p) are not shown in the figure, but they act automatically independently of (H′). In all the cars except the leading one the controllers are set in the position (o), the supply of compressed air and current to all the motors (E′) (E^2) and (P′) (P^2) being solely controlled by the controller in the leading car. In this arrangement the trolley of the leading car also conveys the current for all the motor carriages. If it be desired to avoid this, it will then be necessary to provide in addition a through conductor connected up with all the trolleys. Thus it will be evident that when a monophase alternating current or a continuous current is employed two through pipes for compressed air and two through conductors for current will be sufficient; but one of these conductors may consist of the rails. When polyphase currents are employed, the number of the through conductors is increased by one.

It is obvious that there may be different modifications of the system, but in all the motor (P) invariably runs empty all the time the normal car speed is maintained. It may be disconnected from the car axle by means of disconnectible couplings. It is also possible to provide each car with a separate switch, enabling the motor (E) to receive current when the circuit has been interrupted by the controller (H) or the centrifulgal governor (c). Should a short length of steep gradient have to be ascended, the switch will enable the car to be driven by electricity and compressed air conjointly.

Electric Snow Fighting in New Hampshire.

Prediction was freely made in New England when the electric railways began to reach out into new and more sparsely settled districts, and long stretches of cross-country road were opened, that "a good old-fashioned winter, with as much snow as we used to have, would put the electrics out of business for

ELECTRIC SNOW FIGHTING IN NEW HAMPSHIRE.

weeks." It was furthermore declared, and that often, that the electric system could never take the place of the steam road for more than five miles out in the country. The equipment could not stand the service nor make the time necessary, it was confidently predicted.

During the winter just past the Boston and Maine electric branch, between Concord and Manchester, N. H., 18 miles, was "up against" an old-fashioned winter for three months, and, while it has not been an easy task by any means, Superintendent A. H. Albin has kept things moving with as little delay as the steam roads with their 100-ton locomotives.

The fine cars built at the Concord shops of the Boston and Maine railroad have proved comfortable and speedy, and with the exception of one day in the middle of February, when a veritable blizzard raged, and which held up the steam roads, the electric line made schedule time. What it had to contend with from snowdrifts can be imagined by the accompanying picture of a cut at Head Hill, which was deep enough to have been tunnelled and let the cars through. The Concord and Manchester has one of the largest and heaviest plows that has been built, but a bucking plow could not clear itself in such piles as laid across the tracks after this blizzard.

A big double-truck Ruggles rotary plow, in service on the Manchester Traction Company's line, was sent against the drifts, however, and proved itself equal to the occasion. At the place shown in the illustration the snow was piled 25 feet high and it was necessary to stand on top of the plow and cut the snow down into the knives in order to prevent tunnelling.

The Manchester Traction Company had its share also of "the beautiful," and on its Goffstown line had to cut many rods nearly to the tops of the cars.

Motor Suspension for Mining Locomotives.

A very desirable feature in electric locomotives for mining use is a short wheel base and the consequent reduction in the size of the complete locomotive. In order to secure this advantage, it is necessary to make the motors as compact as possible and to reduce to a minimum the distance between the center of the armature shaft and that of the driving axle.

It is a usual practice when climbing grades in mines to use sharp sand on the rails in order to increase to a maximum the friction between the driving wheels and the rails, the result being that the wheels wear so rapidly as to necessitate frequent replacement. In order to facilitate such replacement or the replacement of axle bearings, it is desirable that the motors be so suspended and of such construction that the driving axles may be easily and expeditiously removed by disturbing a minimum number of parts.

Improvements described in a late patent issued to Robert Siegfried of Pittsburg are designed to accomplish this result and to meet the peculiar conditions which are imposed by the shape of the locomotive frame. The specific objects of these improvements are: First, to provide electric-railway motors of such construction that they shall occupy a minimum amount of space and shall have a minimum distance between the centers of the armature shafts and those of the corresponding driving axles, and at the same time shall be easily accessible and removable from the truck by disturbing a minimum number of parts; second, to provide each motor with a flexible and pivoted suspension, which, by means of a link motion between the motor and its suspension rod, permits at all times of a vertical straight-line motion of the locomotive journal boxes; third, to provide an axle cap in one piece to cover the driving-axle bearings and all portions of the driving axle between the bearings, the cap being easily and expeditiously removed without opening the motor or disturbing the other parts, and, fourth, to so support the gear case that its lower half may be removed simultaneously with the axle cap.

Fig. 1 is a side elevation of two motors as they appear when mounted in running position on the locomotive truck, only parts of the latter being shown. Fig. 2 is an end elevation of one of the motors in running position looking at the suspension end.

The two motors (4) and (5) are reversely arranged, so that the gears (not shown) and cases (6) necessitate an offset relation of the two with reference to the central plane of the locomotive or truck. This offset or staggered arrangement of the motors permits of a simple and convenient arrangement of supporting means for the adjacent ends. Each motor frame is provided with a lug or nose (7), to which is pivotally attached the bifurcated lower end of a suspension rod (8), the upper end of which is screw-threaded and provided with a nut, which rests upon a bar or plate (10). The suspension bar (11) constituting a part of the locomotive frame, is bolted to the side plates and has a depressed middle portion (12), and between this portion and the plate the suspension rods are surrounded by supporting and cushioning springs (13).

Each suspension rod is provided with a shoulder (15), and upon the two shoulders rests a bar, between which and the suspension bar (11) are also located three coil springs (17). (See Fig. 2). The holes through the suspension bar, which receive the suspension rods, are of larger diameter than the rods in order that the latter may be free to swing or move laterally within certain limits.

It will be observed that each motor frame is split along a line which passes through the center of the armature shaft, but is located above the center of the corresponding driving axle, this arrangement being such as to permit of removing the motor from the axle or the axle from the motor without opening the motor casing. It is usual in motors of this type to split the frame symmetrically with respect to the field-magnet poles—that is, on a line midway between the poles. In order to reduce to a minimum the distance between the centers of the armature shaft and the driving axle, this motor is split unsymmetrically. Advantage is taken of the usually unoccupied space between the field-magnet coils adjacent to the axle, by making the axle-bearing housings to project into the space. The axle bearing is entirely separated from the inside of the motor by means of a wall, so that it is impossible for oil to run into the motor and injure the insulation of the field-magnet coils. It will be understood that the plane of division of the motor frame may be below instead of above the axle, if desired.

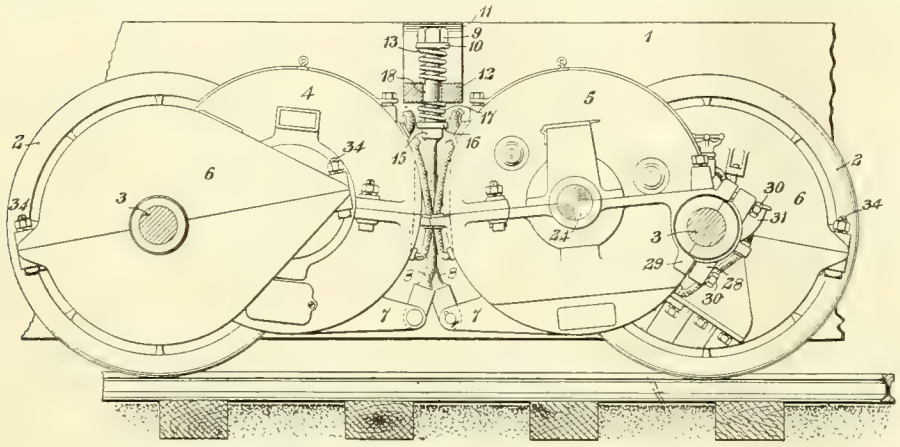


FIG. 1. MOTOR SUSPENSION FOR MINING LOCOMOTIVES.—SIDE VIEW

Each axle cap (28) is formed in one piece, which extends throughout the entire length of the axle, and therefore serves effectively to exclude all dust and dirt. The bearing housing (29), of which the cap constitutes a part, is divided at a suitable angle with reference to the vertical plane, so that when the motor is tilted and the axle cap removed, the axle may be readily withdrawn from its bearings. The axle cap is fastened in position by means of eight tap bolts (30). The axle cap is also provided with a lug, which may be cast integral with it and have such location and dimensions as to provide a support for the gear case (6), the lower half of the latter being securely fastened by means of a corresponding lug. A more rigid support is thus provided for the gear case than would be possible if it were secured to an axle cap covering only one bearing. To remove the gear case it is only necessary to remove the bolts securing its upper half to its lower half, the lower half being then removable simultaneously with the axle cap (28).

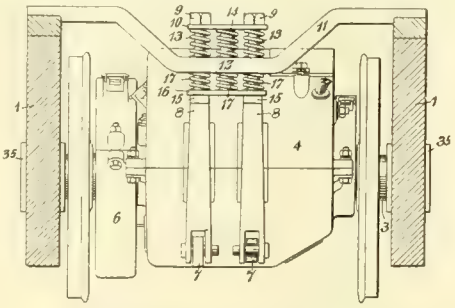


FIG 2. MOTOR SUSPENSION FOR MINING LOCOMOTIVES. —END VIEW.

The journal boxes are mounted in guides, with which the sides of the locomotive frame are provided, so as to move vertically in them, springs being interposed between the boxes and the frame.

It will be seen that the means described for supporting the inner ends of the motors are such as to permit of a free straight-line motion of the journal boxes in their guides and that the construction and arrangement of bearing housings and gear cases are such as to permit of the ready removal of the axles and gear cases.

Alderman Leachman has presented to the Chicago City Council an ordinance creating the Signal Corps of the Police Department. Its object is to make the telephone and telegraph operators members of the Police Department.

New French Oxygen Generator.

An electrolytic product which promises to be of some interest has been invented by George F. Jaubert, a prominent scientist of Paris. This substance when placed in water gives off pure oxygen in large quantities, and the action is quite similar to the production of acetylene by carbide of calcium. Certain metals, like sodium and potassium, have the property, when heated in a current of air, to combine with the oxygen, and in this way a series of oxides is obtained which contain from one to four atoms of oxygen and which possess different properties. While the lower oxide dissolves in water without giving rise to any other phenomenon than that of simple hydration, the higher oxides have the property of being decomposed by cold water with a violent disengagement of pure oxygen. Mr. Jaubert has discovered an electrolytic method for producing these higher oxides, which he calls "oxyliths," and is now able to manufacture them at a low cost. For this purpose a large hydraulic plant has been erected in the Isère district of France, which uses a fall of 5,000 horsepower. The oxylith obtained by this process is a granular, whitish body which comes in pieces of two or three ounces. It is also used in the form of powder or compressed into tablets or blocks. When the oxylith is placed in contact with water

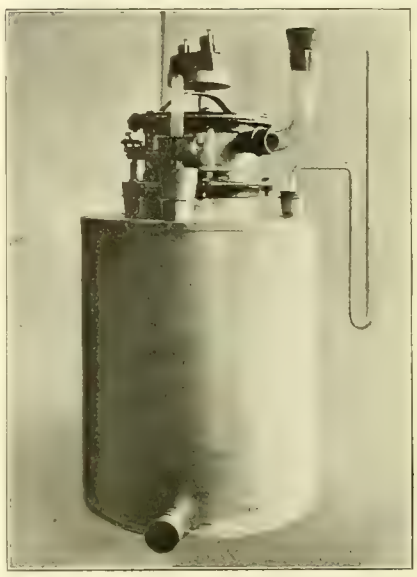


FIG. 1. NEW FRENCH OXYGEN GENERATOR.

the oxygen is immediately given off, but when the water is removed the action stops and there is no overproduction. This makes it easy to construct a suitable automatic generator similar to the acetylene generators, and one of these is here illustrated, which have been designed by the Compagnie Universelle d'Acetylene.

The apparatus, of small output, shown in Fig. 1 and in section in Fig. 2, consists of a sheet-iron reservoir (A) containing water and surmounted by a hopper (B), in which is placed the oxylith in powder. The bottom is closed by a ball valve which distributes the powder as needed. On the top is stretched a flexible membrane of rubber, and passing through it is a rod connected to the ball; the rod has a platform (E) on the top to contain weights. At the start, as the interior pressure is zero, the weights push down the valve and a certain quantity of powder falls into the water. The gas is then given off, and when the pressure becomes sufficient the diaphragm is pushed up, through the side tube (F), and the valve is closed. As the gas is used the pressure lowers, letting in a fresh quantity, and so on.

Another apparatus uses the oxylith in blocks of about two inches cube, which are placed in a perforated support and the water acts on them from below. This form is designed for intermittent work, as for oxy-hydrogen light, and the material is economized by placing it in the compartments at different levels. The water gradually rises and generates the gas, and at the end the blocks which are untouched are removed to be used again.

A process of this kind by which pure oxygen can be produced easily and quickly is likely to prove of considerable commercial value. It has many advantages over the use of gas in cylinders, as it is chemically pure, and there is but a small weight to be transported. The residue, which is a pure caustic lye, can be utilized as a by-product. The electrolytic plant is now turning out a considerable quantity of this product, and it is being introduced commercially at a low price. The inventor has been making some experiments at Paris with the use of oxygen in connection with petrol motors, and he proposes to use the motors for submarine boats and run them when submerged, thus doing away with the electric motor and accumulators, which are now used for the purpose. To accomplish this he renews the exhaust gases coming out of the motor by passing them through an oxygen generator of the above type, which restores the quantity of oxygen which has

been removed during the combustion, and the same gas can be sent back to the motor to be used again, forming a closed cycle out of connection with the air. In this way the motor can operate indefinitely in an enclosed space, such as a submarine boat, if it has a supply of gasoline and oxylith, the quantity of the latter being relatively small. The French government is taking an interest in the new method and if successful it would lead to the suppression of accumulators in the submarine boat. The latter take up a large space and, besides, give off gases which vitiate the air. By the new method a large quantity of energy can be stored up in proportion

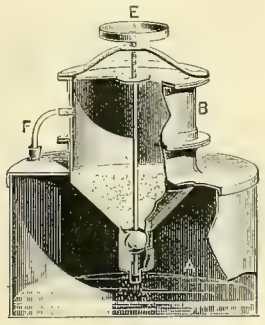


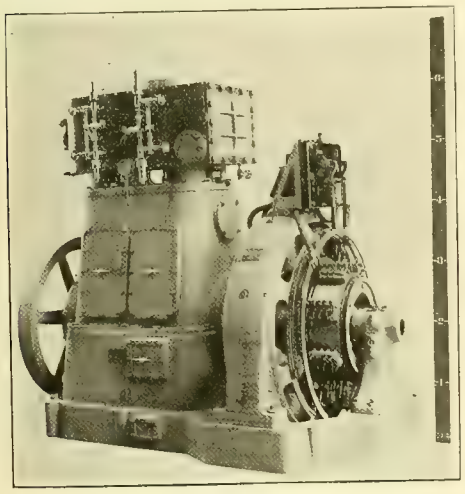
FIG. 2. SECTIONAL VIEW OF NEW FRENCH OXYGEN GENERATOR.

to the weight, by using gasoline, and this would greatly increase the range of the boat. The oxylith is also valuable in renewing the air of a confined locality, such as in the former case, and it is found that a quantity of oxylith equal to 100 or 150 grammes is sufficient to keep up the respiration of a person for one hour. For a crew of 10 men the quantity is but two or three pounds.

Electricity on Vessels of the United States Navy.

Renewed attention is directed to the equipment of naval vessels by the opening scenes of the Russo-Japanese war, which have demonstrated once more the practical value of sea power. This power depends a great deal, of course, on the man behind the gun, but largely also on the gun itself and the apparatus by which it is sustained, defended and operated and made efficient. It is rather strange that the American navy put off so long the adoption of electricity on ships for motive power, when the value of the electric current was so generally recognized on land. A few years ago steam was doing all the work on all kinds of naval vessels, but at last electricity obtained a foothold, and since then it has been playing a most important part in the power department of the ship. Now every government vessel built has more or less electrical machinery.

At first electric light was used for illuminating the ship; then came the searchlight, and this was followed by electrically operated ventilating, hoisting, turret-turning machinery, etc. Even now steam



80-VOLT, 32-KILOWAT GENERATING SET USED ON NAVAL VESSELS.

is operating all steering gear on our naval vessels. But this will not continue altogether, for the Navy Department is experimenting in this line with electrical apparatus; and it is thought at the department that the experiments will be successful.

From statistics for the year 1903 it is found that the United States has six first-rate battleships and five building, with two proposed; also six second-rate and one fourth-rate battleship. There are nine armored cruisers building and two proposed; 10 monitors (complete), two cruisers of the fourth rate, one of the fifth, 11 of the sixth and seven of the seventh rate, with six of the last-named building. Gunboats number 20, with one building; torpedo-boat destroyers, 20, two building; torpedo boats, effective, 24; submarine torpedo boats, eight. This gives a total of 144 vessels. Of course there are others, but those mentioned are in the "effective" class, and most of them are benefited in some manner by electricity.

All the United States warships built after, and including, the Kearsarge and Kentucky have electric turret-turning gear. The Brooklyn also has two of its turrets electrically operated. The Maine (in commission) and the Tennessee, Pennsylvania and Washington (building) use electricity for boat hoisting and other purposes. In recently built vessels the electric drive is used for hull ventilation, ammunition hoists, turret turning, rammer motors, elevating gear, torpedo air compressors, deck winches and boat cranes.

In a report of the Bureau of Equipment it is stated that the increased demand for electrical energy for operating the numerous auxiliaries now installed and the consequent increase of the capacity of generators has led to a marked improvement in the dynamo rooms of naval vessels. In the older ships, with electric installations mainly for lighting, and motors of small capacity for auxiliary purposes the generators were usually installed with limited floor space and inefficient ventilation. With the demand for increased output special attention has been paid to this feature of the installation, and the generators in the larger vessels are now in more than one dynamo room, with special auxiliary condensers to handle the exhaust steam, and hatches trunked to the upper deck for better ventilation.

The rapid increase in the demand for electric power and the favor with which this means of drive is received are illustrated by a comparison between the electric plants of the Indiana, one of our first battleships commissioned, and the Kearsarge, commissioned in 1900. In the former vessel the capacity of the electrical plant was about seven watts per ton of displacement. In the Kearsarge the corresponding capacity is about 57 watts per ton.

For a better idea of a big battleship's electric outfit the attention of the reader is directed to the Missouri. The electric plant of this fine 12,500-ton ship consists of four 50-kilowatt and four 32-kilowatt generating sets, with 80 volts pressure at the terminals. There are motors for the ship's main ventilating system, four portable electric ventilating sets and 12 bracket fans. The lighting outfit comprises 770 incandescent fixtures, and there are four 30-inch projectors, two night-signaling sets and two diving lanterns. And there are motors for ammunition hoists, turret turning and loading of turret guns. The Missouri comes pretty close to being an "electric ship."

Three protected cruisers, St. Louis, Milwaukee and Charleston, are building; the contracts call for delivery early in the present year. The electric plants of these 9,600-ton vessels are elaborate and consist of two 100-kilowatt and two 50-kilowatt generating sets, 1,000 electric fixtures, 12 inclosed arc lamps, six 30-inch projectors, two double-truck lights, two night-signaling sets, two diving lanterns, six portable one-quarter-horsepower ventilating sets, 40 one-twelfth-horsepower desk and bracket fans and six one-sixth-horsepower bracket fans. With these are all necessary wiring accessories, switchboards, etc. The new standard voltage of 125 volts is used for this class of ships.

The new monitor class of ships, as seen in the Arkansas, Nevada, Florida and Wyoming, is well equipped electrically. These mentioned have each four 32-kilowatt generating sets of 80 volts pressure at terminals, 260 incandescent lamps, two 24-inch light projectors, besides electrically driven ventilators, a signaling set and lanterns. The interior system of communication consists of the usual engine telegraphs, engine and rudder indicators, steering telegraphs, voice pipes, telephones, call-bells, alarm gongs and thermostats.

The nine torpedo-boat destroyers launched in the years 1900, 1901, 1902 are very much alike in their electric equipments. The generating set of each is of five kilowatts, with 80 volts pressure at the terminals. Torpedo-boat generating sets (one each) run from 2.5 kilowatts to five kilowatts, using 80 volts.

Submarine boats are as full of "works" as a watch and are almost as nicely adjusted in this particular as the timepiece. This is necessary for a craft that must dive like a duck, swim like a fish and also act as a surface runner. And the electric outfit is most important in her power department.

U. S. S MAINE, WHICH HAS MODERN ELECTRICAL EQUIPMENT.

For illustration, the Adder, Moccasin or Shark can be taken. The electric plant consists of a storage battery of 60 cells and appurtenances and a 70-horsepower motor for delivering continuously 70 horsepower at 800 revolutions per minute at 120 volts, and required maximum at 110 volts. This motor may be operated as a dynamo for battery charging when required. A 10-horsepower motor drives a rotary pump. The incandescent lamps are operated at 60 volts.

The Navy Department will have an interesting exhibit at the St. Louis fair, showing various types of war vessels in small model form and giving an exhibition of work on a big warship by means of a large working model. A biograph and screen about 25 by 15 feet will be a part of the navy's show, wherein ships will appear maneuvering at sea, firing guns and otherwise going through their paces.

The War Department will also exhibit at St. Louis with camp, field and hospital things that pertain to the army, and coast and harbor defense apparatus. The destruction of a hostile vessel in a harbor will be illustrated by means of a tank containing a submarine mine, with electric connections at a shore station and a ship model.

In viewing this the blowing up of the Maine in Havana harbor may be recalled. An accompanying illustration shows the new Maine, which, with its 12,500 tons displacement, 16,000 horsepower and 20 guns in the main battery, is one of the finest ships in the navy.

A peculiar accident happened recently to the electric plant of the city of Brantford, Ont. It appears that muskrats burrowed through the embankment skirting Lake Mohawk, whence the electric plant obtains its power, causing the earth to cave in and effecting a large breach, which put the plant out of business. An auxiliary plant was set up, but local factories run by electricity were forced to close pending repairs to the embankment. The pranks of the muskrats cost the electric company upward of $5,000.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3 00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

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American Electrochemical Society (annual business meeting), Washington, D. C., April 7th, 8th and 9th.
Iowa Electrical Association (annual meeting), Savery House, Des Moines, April 20th and 21st.
National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.
Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.
International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.
American Electrotherapeutic Association (annual convention), St. Louis, September 12th to 16th.
Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

A WORTHY ticket has been placed in nomination by the board of directors of the American Institute of Electrical Engineers. It is headed by Mr. John W. Lieb, Jr., of New York, who is recommended for the presidency. Mr. Lieb is associate general manager of the largest central-station company in the country, and, if elected, as he undoubtedly will be, will be the first active central-station man to serve as president of the Institute. There is no particular significance in this fact, although it is one of some interest, especially as a Chicago central-station man was nominated as one of the new managers. Mr. Lieb is not only the manager of a great central-station property but he is also an electrical engineer of international reputation. In addition, he belongs to the notable band of "old Edison men" who are old, not in years, but in affectionate regard for a great figure in the latter-day development of applied electricity. The Institute directors have made an excellent choice in Mr. Lieb, who is sure to give the society a progressive, sound and clear-headed administration during a year which promises to be an important one in its history.

ELECTRIC power is slowly coming into its own on naval vessels, but there still remains a large field for its use on freight and passenger steamers and even on large sailing vessels. A paper was recently read on this subject by Mr. D. K. Roberts before the Bristol (England) section of the Institution of Mechanical Engineers. The author advocated the adoption of electric power on cargo steamers for driving all the auxiliary machinery, the power to be generated in the central power plant. He propbsed to substitute for the 10 steam winches an equal number of electric winches of eight or 10 horsepower, the current to be conveyed to these winches by means of flexible cables. He estimated that the additional cost of electric over steam winches would be about $5,000, but the advantages gained would outweigh this consideration. In the discussion some doubts were expressed as to the possibility of making motors sufficiently watertight to stand the heavy seas washing over them on deck, and it was thought by some that it would be necessary to make the winches portable and run them into dry quarters during a rough voyage. Replying to this point, one speaker referred to 12 motors, which, at the beginning of the Boer war, were abandoned in a mine, and after being submerged under 500 feet of water for two years were taken out and simply stove dried. Out of the 12, only two were found to be unsuitable for regular work again. Mr. Roberts, in reply, referred to the street-railway motors at Cardiff, which, it is said, are submerged on any wet night, yet no trouble arises from this cause. To these examples might be added many others in American practice, resulting from flooded power houses and other causes, where the electrical machinery has been restored to usefulness. A prolonged soaking is not to be recommended for an electric motor, but in almost every case the machine, if thoroughly dried out, can be made to give good service. Therefore, an occasional drenching of a hoisting motor on the deck of a ship ought not to be such a serious matter as to preclude the admitted advantages of the flexible, convenient and economical transmission of power which electricity affords.

SOME interesting statistics are contained in the annual report of President Fish of the American Telephone and Telegraph Company, given on another page. One statement that arrests attention is that to the effect that about 3,263,000,000 telephone connections were made through the Bell exchanges alone in the year 1903. This enormous number of conversations gives some idea of the telephone traffic of the United States—over 10,000,000 for every weekday, without taking the Independent companies into account. The Bell companies employed 53,795 persons and had 1,609 exchanges, 1,525,167 stations and 3,779,517 telephones in use on January 1st. During the year they spent over $35,000,000 for new construction.

On the subject of competition the remarks of the president of the parent Bell company are of much interest of course. He speaks of the well-known fact that some of the opposition companies have attempted to do business at rates that were too low. Bell companies are well schooled in the matter of maintenance and depreciation, he says, and he makes the interesting statement that the average allowance for maintenance of those companies in 1903 was over 30 per cent. of the gross revenue. On the whole, he takes a roseate view of the danger to Bell interests from competition—a view that is not shared, it is needless to say, by the Independent telephone men.

It is pointed out that "there is an element of permanency in the apparatus and equipment of today which did not characterize that in use a few years ago." This is true of both classes of apparatus. It would be interesting to inquire how much of this improvement is due to the pressure of competition. That a great deal of this betterment is due to the presence of another Richmond in the field there can be no doubt.

President Fish's review makes instructive reading for telephone men of all classes.

WHAT are the duties, moral and legal, of telephone companies, in relation to the use of their instruments and circuits for improper ends, such as the transmission of race-track betting news for gambling purposes? As a general proposition, of course, the telephone company should co-operate with the authorities in endeavoring to stamp out, so far as may be possible, the gambling evil. But, as has been shown in Chicago, where the question has been brought up, several delicate questions are involved.

How is the company to know that a telephone is used for illegal purposes? In a letter to Mayor Harrison Mr. A. D. Wheeler, president of the Chicago Telephone Company, who is himself a lawyer, puts the case plainly. "As it is a criminal offense in this state to tap or listen in on a telegraph or telephone wire and divulge any message, you will appreciate," he says, "the difficulties attending action by us, in view of the further fact that we are obliged to furnish telephone service to all citizens applying for the same and complying with our lawful requirements. The legal difficulties for this company in this matter are increased by the fact that it does not itself transmit or disseminate racing information, as is said to have been done with the tickers and is done by the daily publication, circulation and sale upon the streets of the city of racing forms and racing news and incitements to betting on races."

General Manager Hibbard of the same company has promised that he will terminate the contracts and remove the instruments in all cases where the police or the courts have closed gambling places. This puts the responsibility where it belongs. Telephone contracts should be drawn in such a way that they may be canceled at once if the apparatus of the company is put to illegal uses. But of course the company must have sufficient authority for its belief that improper use is made of the telephone, else it may involve itself in an embarrassing lawsuit. Probably the action of the police would be a sufficient warrant for such action, but it will be well for any company interested to take competent legal advice before assuming that such is the case.

The company cannot arbitrarily discriminate in giving its service. It should be careful that in any action of its own or in co-operating with the authorities it does no injustice, for the principle of strict impartiality in giving telephone service is very valuable to the community, so important has the telephone become as an adjunct to business and social life. It would be an alarming state of affairs, for example, if one subscriber could go to the company and offer it sufficient inducement to deprive a business rival of telephone service. Fortunately, such a thing is unheard of. Here in Chicago the local Bell company unhesitatingly serves Independent telephone manufacturers and the Independent exchange company. And this is as it should be, of course. Telephone and other business men are rightfully jealous of any infringement of the great principle of equality in telephone service. It is this fact which will impel any company to be sure of its ground before terminating a contract, even on such a grave charge as that of public gambling.

The question is an important one to all exchange companies, in large cities especially, and should be given careful attention, even if the emergency has not yet arisen.

Electrical Exports for February.

The electrical exports from the United States for the month of February amounted to a total value of $881,587 as compared with $662,143 for the corresponding month in 1903. This gives an increase of $219,444. February's figures also show a gain of $51,452 over January of the present year. An interesting fact in February's report is the substantial gain shown by the goods classified as electrical machinery. A classified comparison is as follows: Electrical machinery—February, 1903, $416,039; February, 1904, $510,707. Electrical appliances, including telephone and telegraph instruments—February, 1903, $246,104; February, 1904, $370,880. The increase of $94,668 in electrical machinery over the figures for February, 1903, is gratifying, especially when it is considered that this class of goods has for a number of months shown a slight decline. Electrical appliances show a gain of $124,776, about the normal increase.

Classified according to destination the principal buyers of electrical machinery from the United States for the month of February were the following: Japan, $119,856; British North America, $90,100; United Kingdom, $84,593; British East Indies, $81,284; Mexico, $53,685; British Africa, $15,725; Brazil, $11,287; British Australasia, $5,582; Cuba, $3,962; France, $1,886; Hongkong, $1,205; Philippine Islands, $1,069; Germany, $1,013.

Considerable significance attaches to the fact that Japan heads the list of importers of our electrical machinery, especially as that country is at present engaged in a war with Russia. Probably never before has Japan headed the list for any one month, this position being usually held by the United Kingdom. The average monthly exports of electrical machinery to Japan for the last two years has been in the neighborhood of $40,000. In February, 1903, it was only $7,194 as compared with $119,856 for February of the present year.

Mr. Lieb Nominated for President of the Institute.

At last week's meeting of the American Institute of Electrical Engineers in New York city the board of directors placed in nomination the following ticket containing the names of the proposed officers to be voted on at the annual election in May:

For president—John W. Lieb, Jr., New York.

For vice-presidents—W. E. Goldsborough, St. Louis; John J. Carty, New York; Samuel Reber, Washington, D. C.

For managers—Henry G. Stott, New York; Louis A. Ferguson, Chicago; J. G. White, New York; S. S. Wheeler, Ampere, N. J.

For treasurer—George A. Hamilton, New York.

For secretary—Ralph W. Pope, New York.

The diectors' nominations are usually equivalent to an election. Mr. Lieb, the probable president, is now a vice-president of the institute. He is third vice-president and associate general manager of the New York Edison Company and one of the best known of the central-station managers and engineers of the country. The gentlemen named for the other offices are all well known.

The holdover officers are:

Vice-presidents—W. S. Barstow, New York; Ralph D. Mershon, New York; Calvin W. Rice, New York.

Managers—Charles A. Terry, New York; Townsend Wolcott, New York; Gano S. Dunn, Ampere, N. J.; E. H. Mullin, New York; Samuel Sheldon, New York; George F. Sever, New York; A. H. Armstrong, Schenectady, N. Y.; W. C. L. Eglin, Philadelphia.

Southwestern Electrical Associations.

The Southwestern Gas, Electric and Street Railway Association and the Southwestern Electrical Association will meet jointly in annual convention at Dallas, Texas, on April 26th, 27th and 28th. The association headquarters will be at the Oriental Hotel, while the meetings will be held in the auditorium of the Commercial Club. Plans have been perfected for the consolidation of the two associations, and will be submitted to the members for their approval. The territory of the Southwestern Electrical Association includes Indian Territory, Oklahoma, Kansas, Arkansas and Texas, while the Southwestern Gas, Electric and Street Railway Association takes in Indian Territory, Oklahoma, Arkansas, Louisiana, Texas, Mexico and New Mexico.

Among the subjects to be discussed at the Dallas meeting will be the following: "Advantages of the Combination of Gas and Electric-light Plants," "The Operation of the Single-phase Motors from the Central-station Standpoint," "Framing of City Franchises for Public-service Corporations," "Combination of Public Utilities in Small Cities," "Water Purification Processes and Their Values," "Economics of the Meter," "Benefits and Evils of Telephone Competition," "Accidents on Street Railways and Damage Suits," "Central-station Accounting," "Electricity and Risks, Requirements of the National Board of Underwriters in the Southwest," "Development of Interurban Railways in the Southwest," "The Development of the Modern Gas Plant."

Hawaiian Electric-light Franchise.

The committee on territories of the House of Representatives to which was referred the bill in connection with the supplying of electric light for Honolulu has reported favorably with some slight amendments to the franchise which has been granted to the Hawaiian Electric Company by the Hawaiian government. The life of the franchise, which was the main point of contention, is placed at 35 years, and the company has the right to manufacture, sell, furnish and supply electric lights, electric current or electric power in the district of Honolulu. It is provided that the company may not at any time charge in excess of 16 cents a kilowatt-hour, but it is given the right to charge each consumer of electricity for lighting the minimum sum of $2 a month, and each consumer of electricity for power $1 a month per horsepower. The service is to be under the supervision of the superintendent of public works.

The Honolulu Electric Company was incorporated on October 13, 1891, with a capital stock of $20,000. On May 8, 1893, it was granted an exclusive franchise to supply electricity in the city of Honolulu for a period of 10 years upon the payment to the government of a royalty of 2½ per cent. of the gross receipts. This required an increase in the plant, and the stock was therefore increased at various times until on July 25, 1901, it was $500,000, all paid up except $75,000 paid to the People's Ice Company for property furnished. On November 1, 1903, the company furnished lights to 1,689 consumers with a total connected load of 29,671 16-candlepower lamps. At the same time it was supplying power service to 62 motors of a total capacity of 479½ horsepower to different industries in Honolulu, such as elevators, electric fans, dentists' motors and a conveyor of goods on the wharf.

The territory in which this company operates comprises the district of Honolulu, the population of which is 39,306. The distance from the base of supplies causes this company to have installed in its plant an excessive amount of equipment and to keep on hand at all times an excessive amount of spare parts and supplies. The climatic conditions are such that there is an excessive depreciation upon the equipment, especially upon the poles, lines, transformers, meters and distribution service. This and other causes make the proposed rate of 16 cents seem reasonable.

Canadian Street-railway Returns.

In 1903 the Toronto Electric Street Railway earned $2,172,088. The operating expenses left the net earnings at $1,000,000. The total capitalization being about $10,000,000, the street railway is thus earning about 10 per cent. on its stock and bonds, but as the interest on the bonds is fixed, the common stock is earning more than 10 per cent. The city of Toronto gets certain payments from the railway on account of "paving charges" and a certain percentage of the gross receipts. This percentage grows with the receipts. On the first million it is eight per cent.; on the second half million, 10 per cent., and so on until three millions are reached, when it becomes 20 per cent. of all gross receipts over that amount. It is expected that in 1904 the amount paid to the city will equal the dividends paid to stockholders. In addition the fares are low as compared with most United States cities, being from 3⅜ cents to 4⅛ cents, according to class of tickets.

Montreal has an agreement similar to that in Toronto, but less favorable. The railway there pays four per cent. on the first million; six per cent. on the next half million, and so on, until three millions are reached, when the payment is 15 per cent. In Hamilton, Ont., the railway company pays 7½ per cent. on gross receipts over $175,000 up to $200,000, and after that eight per cent. in addition to a mileage. Halifax, N. S., gets four per cent. on gross receipts and $1,000 license fee. The city of Ottawa, Ont., gets no percentage of gross receipts, but receives a mileage of $450, which increases to $1,000 in the case of permanently paved streets. In St. John N. B., the situation is much the same as in Ottawa, and in Victoria, B. C., and other Canadian cities much the same system obtains. Considering the recent and rapid development of electric street-railway service, Canadians think their cities have displayed considerable wisdom in dealing with franchises as compared with cities in the United States. The street-railway charter in the city of London, Ont., expires in 1925; Halifax, N. S., 1916; Montreal, P. Q., 1922; Ottawa, Ont., 1920; St. John, N. B., 1934; Toronto, Ont. 1921; Winnipeg Man., 1927; Hamilton, Ont., 1928; Victoria, B. C., 1938.

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During the year of 1903 in St. Louis there were 308,505 running feet of trenches dug and 1,114,615 duct-feet of wires buried underground by the various service corporations under the supervision of the lighting department.

Allis-Chalmers Personnel.

As the plans of the Allis-Chalmers Company develop, bringing under its broad scope the manufacture of machinery and apparatus for steam, gas, electricity and waterpower, some changes were made in the original plans made public at the time when the company first announced its intention of entering the electrical field. The acquisition of the Bullock Electric Manufacturing Company of Cincinnati seems to have brought about several changes in the list of men who will conduct the affairs of the company.

As previously stated, Mr. B. H. Warren, formerly second vice-president of the Westinghouse Electric and Manufacturing Company of Pittsburg, is the new president of the Allis-Chalmers Company. He enters upon his duties with a wide range of experience. Mr. Warren is a Bostonian. He graduated in the engineering corps of the United States Naval Academy in 1874. Later he became mechanical engineer for the Hancock Inspirator Company of Boston, for which company he was also manager for four years and superintendent for six years at the London office. From this time until 1896, when he became assistant general manager of the Westinghouse company, he was engaged at various times as manager of the Yale & Towne Manufacturing Company and as secretary and treasurer of the Pratt & Whitney Company. Mr. Warren is a member of a number of engineering organizations, including the American Society of Mechanical Engineers, the Society of Naval Architects and Marine Engineers, the Society of Naval Engineers and the Engineers' Club. At present he is in Chicago, but later will establish his office in the Empire Building, New York city.

B. H. WARREN, PRESIDENT ALLIS-CHALMERS COMPANY.

Other newcomers on the Allis-Chalmers staff are Mr. A. M. Mattice and Mr. Arthur Warren. Mr. Mattice has been engaged to act as chief engineer of the company and will have his office in Milwaukee. He is an engineer of acknowledged ability, and to accept his new position has resigned as chief engineer of the Westinghouse Machine Company and as chief consulting engineer of the Westinghouse Electric and Manufacturing Company.

At the solicitation of Mr. Adams, chairman of the executive committee of the Allis-Chalmers Company, Mr. Arthur Warren becomes chief of publicity in the new department of publicity of the company. Mr. Warren was until February last manager of the Westinghouse Companies' Publishing Department, in which position the originality, breadth and scope of his work attracted much attention. He is a forcible and graceful writer and a former journalist of wide experience. He will have offices in Chicago, Cincinnati, Milwaukee and New York, with headquarters in the first-named city.

It may now be definitely stated that John F. Kelly and William Stanley, both prominent electrical engineers will not be connected with the Allis-Chalmers Company, as had been planned before the Bullock plants were acquired. Mr. Kelly found that he would be unable to give the amount of time required as chief electrical engineer of the Allis-Chalmers Company, and will devote himself entirely to the John F. Kelly Engineering Company. Mr. Stanley will confine himself to experimental work. Other men who left Pittsfield and went to Milwaukee will be given positions in the Bullock plants in Ohio and Canada.

Lighting the Welland Canal.

The Canadian government has determined not only to light the Welland Canal by electricity instead of by gas but by the same power to operate the gates, valves, bridges and sluiceways of the canal. The order for the poles for carrying the wires has been given. There will be 2,000 cedar poles and about 200 steel poles. The steel poles will only be erected at angles along the route where a double pressure has to be supported. The electricity will be furnished by the Cataract Power Company of Hamilton, Ont. The whole canal will be lighted instead of merely the locks, as at present. Some 550 arc lights will be distributed between Port Dalhousie and Port Colborne, a distance of 27 miles. At each of the 25 locks there will be six arc lights, while along the banks of the canal there will be one light in every 400 feet. In addition, there will be a special equipment of arc lights for the piers at the head and foot of the canal.

HIGH-TENSION TRANSMISSION DISCUSSED.

The American Institute of Electrical Engineers held a successful meeting in Carnegie Hall, New York city, on March 25th. Four introductions of discussion relating to the general subject of high-tension transmission were read and discussed by those present, while several written discussions were prepared by absent members. The following are abstracts of some of the introductions and discussions, and it is possible that reference will be made in a future issues to some of the points not brought out in the present abstract.

The Relative Fire Risk of Oil and Air-blast Transformers.

BY E. W. RICE, JR.

I think it will be admitted that in general that type which contains the greater quantity of inflammable material will occasion the greater fire hazard. The inflammable material in an air-blast transformer of, say, 1,000-kilowatt capacity, will amount to about 800 pounds; in an oil-cooled transformer of the same capacity the amount will be about 7,300 pounds. While this comparison cannot be taken as a measure of the relative fire risk, it is an indication to be considered, especially in view of the fluidity, the low temperature of ignition, and high calorific value of oil.

While the quantity of inflammable material in an air-blast transformer is, as stated, relatively small, it has an extended surface exposed to a large volume of air, and therefore, if a fire starts from internal causes, such as short-circuit or extreme overload, is capable of rapid combustion. This combustion could be checked by shutting off the flow of air to a transformer by means of a diaphragm automatically closed by the melting of a fusible link, the fusible link so located as to be melted by the first contact with flame, a method similar to that employed for closing fire doors in buildings.

An oil transformer, properly cooled, is probably not particularly subject to ignition of the oil from internal burnouts or arcs. The principal fire hazard in an oil transformer is due to the large mass of inflammable liquid material which, under certain conditions, may become totally consumed.

Considerations of first cost, economy of space simplicity, operating costs, etc., have resulted in placing transformers in the same room with switchboards and other apparatus, such as synchronous converters, motor-generators, etc. The fire risk can be practically eliminated by placing such transformers in a room or rooms separated by suitable fire walls from the other part of the plant. This plan has already been proposed and introduced. An entirely separate building, subdivided again into suitable rooms, may be employed where the maximum of safety is demanded. Much may be done to limit the risk, even when the transformers are placed in the same room with other apparatus, by proper systems of piping for drainage of the oil away from the building, by placing the transformers in a depressed area of concrete arranged for rapid drainage, etc. Of course, any of the methods commonly employed for preventing, limiting or extinguishing oil fires may properly be employed.

Discussion.

Dr. F. A. C. Perrine, Pittsfield, Mass.: As regards the question of the relative fire risk of oil and air-blast transformers, I disagree materially from the conclusions and from some of the premises that Mr. Rice has laid down. In the first place, Mr. Rice says: "I think it will be admitted that, in general, that type which contains the greater quantity of inflammable material will occasion the greater fire hazard." The experience of the Fire Underwriters, and particularly the instructions to the Mutual Fire Insurance Company, shows that that is not generally admitted. On the contrary, the question which is most important is not as to the quantity of inflammable material, but of its disposition. The modern mill construction is a construction which shows a very large quantity of inflammable material, but its disposition is such that the relative exposed surface is small, and all of my experience with fires has indicated that that is the most important point. I think, furthermore, that all the best writers and authorities on the question of fire hazard agree that the disposition of the material is far more important than the quantity of inflammable material. One question relating to the quantity of inflammable material which must be taken into account in all fire risks, is the presence of dust, not only in connection with the apparatus in question, but throughout the building. I have had the unfortunate fate of having been more or less seriously burned out six or seven times, and in the most important fires the disastrous consequences have been due to the accumulation of dust. A very small fire, where there is dust accumulated, will distribute that fire very widely. In consequence, it seems to me, that the fusible link, to be melted on contact with flame, is a very poor protection against fire, because, if flame occurs, we have the consequent danger from dust. In one instance of a wooden shop I had burned down a single flame shot out, followed along dust-covered wires, and set fire to that building in all parts of it, so that the operatives had to escape without their coats, although there were doors at both ends and in the center of the building, showing the importance in all fire risks of avoiding the first evidence of flame. The writer also speaks of the protection that can be obtained by means of systems of piping for draining the oil away from the building and by placing the transformers in a depressed area of concrete arranged for rapid draining. There have been very serious fires, of which I know something of the details, and in which the transformers have suffered. In one case the transformers were installed on a wooden platform, four 500-kilowatt transformers, which contained 14 barrels of oil. The fire occurred by reason of a small arc in the destruction of an intermediate low-potential switch. The fire, by dust and varnish, was immediately conveyed to the woodwork supporting the switchboard and supporting the transformers. When the woodwork burned away the transformers dumped over, with 14 barrels of oil in them, which spread on the floor, and there was little left of the building or the transformers. There was really 56 barrels of oil in all, as each transformer held 14 barrels. The conclusion to which I arrived from these facts is that the safest transformer, as regards fire risk, is the transformer in which the combustible material is so disposed as to present the least surface to fire, and that I believe to be the oil-filled transformer. As regards further protection, I believe it is not an error to provide means for draining away the oil.

Calvert Townley, New York: I think the majority of those who have had to do with transformers will agree with me that the transformer is in itself an extremely low fire hazard, and that the underwriters and the public have, many of them, an exaggerated idea of the risks of electrical installations, believing as soon as you get high pressures you run up the fire hazard, so that all sorts of precautions, some of them almost prohibitive, ought to be employed. With reference to the differences between the points of construction, it is proper for us to separate distinctly in our minds the danger from fire from the two sources, first, the source internal to the transformer, and, second, the source external. If the transformer is not an extreme fire hazard in itself, then the risk from internal trouble is the lower of the two. It has been pointed out that the air-blast transformer has a small amount of combustible material, which is distributed unfavorably to the maintenance of combustion. That is undoubtedly true, and there are very few cases where serious fires have resulted from the use of the air-blast transformer. The chief danger that comes from it, I should say, is the presence of a strong blast of air, which, if a fire should start in the transformer, tends to spread it, not only to the transformer itself, but to adjacent apparatus and the building. That can be provided against if you put the transformer in such a position that the escaping or exhaust air does not impinge on inflammable material, and that is a desirable thing to do.

I think that many of us, particularly those who are not directly interested in the design or use of electrical apparatus, are deceived by the use of the word, "oil"—we connect the idea of oil with a highly combustible material, whereas the oil of 400° F. fire test is not an inflammable material at ordinary temperatures. You can plunge a burning brand into it, and the brand will be extinguished.

Ralph D. Mershon, New York city: I agree thoroughly with Dr. Perrine in regard to the relative fire hazard, and that it is not entirely dependent on the amount of inflammable material, but is dependent more on the location and distribution of material. It also depends on the relative provision that can be taken for coping with fire. The scheme of installing oil transformers in separate rooms does not appeal to me. In the case of high-voltage transformers, it involves an application of wire which I do not like. I am in favor of bare wiring in places of high voltages. The moment you put these transformers in separate rooms, you get in trouble with the high-voltage wire. If the rooms are to be a thorough protector, they must be in the nature of a vault, and that makes the wiring still more difficult. If you surround the transformers with fire walls in a building of ordinary construction, and the transformer gets on fire, the transformer goes, and the oil gets away from you by the melting of the case; and I do not know what is going to happen to the roof; it may result in bringing the roof down upon the transformers.

Paul N. Nunn, Telluride, Colo.: It seems to me that with an expensive generating station or substation, that the amount of oil involved in perhaps 10,000 kilowatts of oil transformers and the facts which are of record as to the fires which have been caused and the accidents which might have caused fires, those who are designing these buildings and arrangements today cannot afford to overlook the danger of the oil which is being used. It is true we have not anything better and will continue to use the oil transformer, for the present undoubtedly; but, personally, I am in sympathy with the spirit of those remarks which have been made, the general effect of which is that we are going foolishly far in discussing the risk of the oil transformer. I believe that the risk is very great, and my personal experience within the last eight years has not been such as to warrant me in feeling that I can afford to overlook that risk or fail to employ all reasonable precautions, and some which eventually would be called unreasonable, to guard against the risk. We have lost two sub-stations entirely, everything except the brick walls, and while I do not believe we have evidence that these fires originated in the transformers themselves, it was the oil in the transformers which caused the loss. The loss was not limited to the transformers, but was much heavier on account of other apparatus. It seems to me that the air-blast transformer is in some respects far better, but it is my understanding that the manufacturers of transformers are not prepared to supply air-blast transformers for the higher potentials; and I would like to ask if some ingenious experimenter cannot devise a non-combustible, non-inflammable gas which may be circulated through transformers and then through cooling coils under pressure, perhaps, allowing the further use of air-blast transformers instead of oil.

P. M. Lincoln, Pittsburg, Pa.: In the air-blast transformer we have present constantly and unavoidably both the essentials necessary to start and maintain a fire, the insulation of the transformer being the combustible, and the cooling air the supporter of combustion. Further, this condition of affairs is one that cannot be avoided in the air-blast transformer, no matter how much care be exercised nor what method of installation be adopted. It is a condition inherent in the air-blast transformer. The only thing needful, therefore, to start a fire in the air-blast transformer is simply a sufficient amount of heat at any point. In this respect, however, the air-blast transformer does not differ from any other combustible, except that under normal conditions the supply of air is by forced draft. On the other hand, when we come to examine the oil-insulated transformer, we find a structure in which the combustible and the supporter of combustion are capable of being segregated by a fireproof wall. Relative fire risk is not simply a question of the relative amount of inflammable material, as Mr. Rice intimates, but it must also involve the question of the probability of a fire being started. The oil transformer, although it contains a considerably larger amount of inflammable material, has the advantage of the ability of segregating this inflammable material so that it can be made almost impossible for a fire to start within the transformer and can also be shielded from a fire without the transformer. My only personal experience with a transformer fire has been with an air-blast type. That experience leads me to doubt the practicability of Mr. Rice's suggestion of a possible link in connection with a damper to shut off the air. In the case I have in mind not only was it necessary to close the damper in that transformer, but also to shut off the air, and finally to turn a hose on the burning transformer.

The Use of Group Switches in Large Power Plants.

BY L. B. STILLWELL.

Instead of attempting a generalization, therefore, we may consider more profitably the arguments for and against the group switch in the case of a typical plant, and then glance at some of the modifications of function and circumstance, which in the case of other plants would affect our conclusions. The group switch first appeared in the plant of the New York Street Railway Company at Ninety-sixth Street, but as the writer had nothing whatever to do with the design of that plant, he selects for consideration the plant of the Manhattan Railway Company. In this plant two complete sets of main bus bars are used [see diagram on next page]. Switches are provided by means of which each of these sets may be divided into two independent sets of bus bars, to each of which four alternators and four groups of feeders may be connected. Eight group switches are provided, through each of which current is supplied to a set of auxiliary bus bars, to which in turn the individual feeders are connected through their respective switches. One of the eight feeder groups is used to supply power to auxiliaries in the power house. The other seven groups supply power, respectively, to the seven sub-stations which receive power from this central source. All switches in the high-pressure alternating-current circuits are of the motor-operated oil type.

The arguments in favor of the group switch as used in the plant of the Manhattan Railway Company, are:

(1) It affords an additional means of opening a feeder switch that fails to open its circuit, when operated for that purpose. The advantages of the group switch in respect to this function today appear materially less than they did five years ago, for the reason that the power-operated oil switch within the period named has demonstrated a high degree of reliability. However, it cannot be assumed that the feeder switch is invariably reliable, and, therefore, judgment of the weight of the argument in favor of the group switch, based upon its use as a reserve for the feeder switch, becomes a question of judgment of the chances of failure of the feeder switch on the one hand and the seriousness of total interruption of power supply on the other.

(2) It affords means of reducing aggregate load upon the power house in case of necessity, more rapidly and otherwise less objectionably than the usual method of cutting off individual feeders. It will sometimes happen in the operation of a power plant that it becomes necessary suddenly to shut down one of the generating units. If the load carried at the time be such that the shutting down of the generator implies reduction of the external load, this can be accomplished most conveniently by operating one or two group switches.

(3) Where duplicate main bus bars are used, it facilitates transfer of load from one set to the other,

in case it becomes necessary suddenly in operation to make such transfer. As bus bars and connections are now installed in our best plants, this necessity does not arise frequently; nevertheless, it is liable to occur, and obviouly half a dozen group switches may be used to affect the transfer in much less time than would be required were five or six times that number of individual feeder switches used.

(4) The grouping of the external feeder circuits in group units bearing a simple fixed relation to the generator units establishes a symmetry and proportion most useful to the operator, particularly in times of emergency. In the case of the plant under consideration, at times of full load, the power passing through each group switch is substantially equal to the output of one generating unit. This relation, of course, does not exist under partial loads, but under such loads it is not difficult usually to keep in service generating capacity exceeding the load by a margin sufficient to make it possible to shut down one generator without cutting off feeders; and in cases where this margin of capacity is not kept in service it is, nevertheless, a more speedy and certain operation to cut off the necessary number of groups of feeders than it would be to cut off a proportionate number of individual feeders.

The arguments against the group switch are: (1) It introduces additional apparatus and, therefore, in itself increases the risk of interruption due to failure in switch insulation, etc. The successful operation of many plants, particularly in America, has been interfered with by the introduction of too much switch gear and too many safety devices, automatic and other, these additions in themselves being responsible in some cases for more trouble than they prevent; and it is to be noted that the group switch implies the auxiliary bus bar. Here, again, it is impossible to dogmatize, for, as the result of additional experience, the judgment of today may be reversed five years from now. As an expression of personal opinion, however, I may say that if the group switch and the auxiliary bus bars be reasonably well insulated and installed, the interruptions originating in this additional apparatus should be almost negligible in the case of such a plant as that which we are considering.

(2) The group switch and its bus bars imply, of course, an increase of cost of the plant. In case of the Manhattan plant, this increase is about 10 per cent. of the cost of the switch gear and measuring apparatus, and about four-tenths of one per cent. of the cost of the plant. To put it another way, the cost of the group switches and bus bars for the plant approximates $20,000 and the annual cost, assuming this to be 10 per cent. of the investment cost, is $2,000, which is about two-tenths of one per cent. of the annual cost of operating the entire plant, including sub-stations.

Discussion.

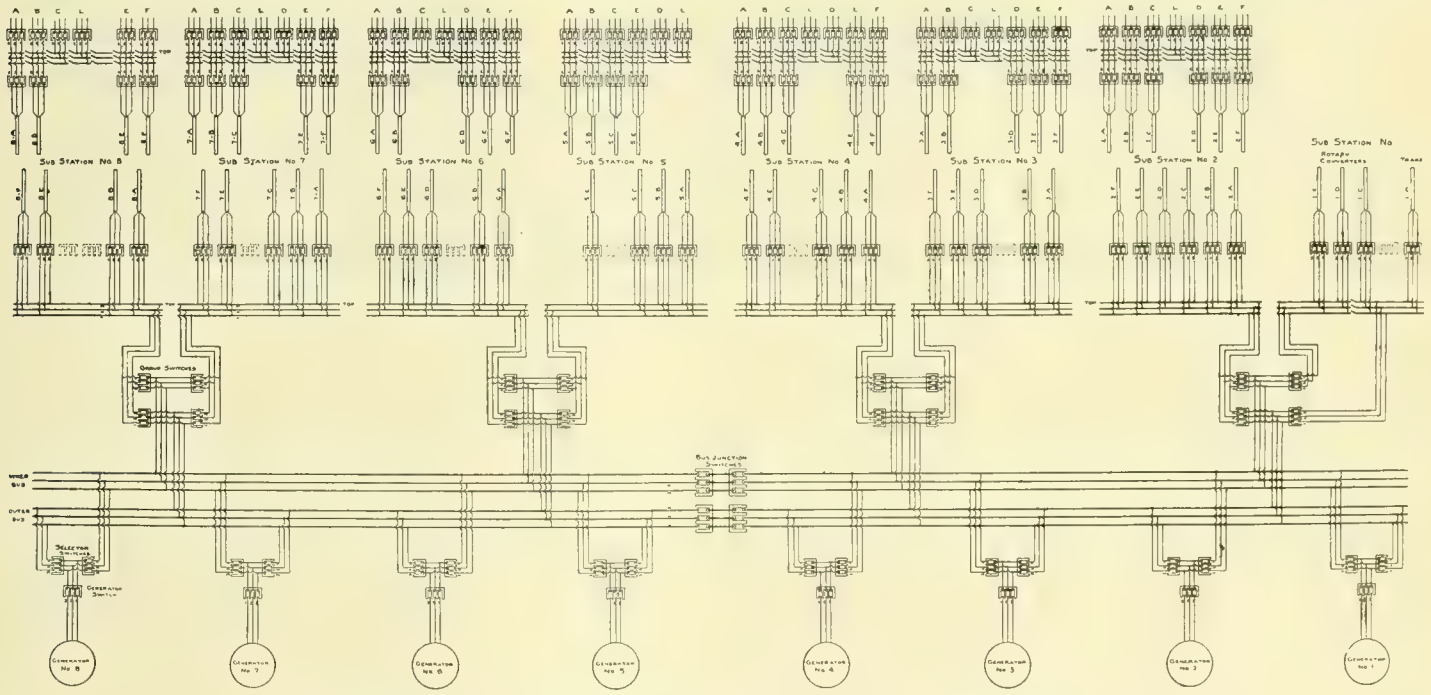
Alex Dow, Detroit: In the matter of the present discussion, I think that two of the papers at least are subject to criticism in that they treat as a matter for argument an established condition—a thing so generally accepted that to make it a matter of argument is foolish. On the Pacific Coast you will find the air switches carefully tied up, and this certainly seems to be a convincing demonstration of the establishment of the oil switch, when you find in large transmission systems the air switches tied up—a six-foot air brake useless and a nine-inch oil brake substituted.

As to group switches, the drawing shows a condition which is doubtless normal in some plants, but not normal to the general condition. These machines in the drawing are in multiple. The general condition in the greater number of plants throughout the country, large and small, of the class referred to, where the group switch would be a possibility, is that the machines run each on its group of feeders and the group-switch condition is established by separating the generators. The exception to that is the Pacific Coast practice, where, with long lines, high frequency, considerable inductance in the line, either natural or artificial, the conditions permit the running of everything on the same set of mains in multiple. The general condition, however, is the separation into groups. I think the condition of the group switch is as well established and generally accepted as the oil switch; perhaps not so long established, but as completely established.

Henry G. Stott, New York city: I think the subject of fire risks has been pretty well threshed out. In regard to the use of group switches, they can be looked upon in this way: If a man has a very elaborate house, expensive ornaments, silverware, vases, etc., he wants to get as much insurance as he can, both fire and burglar insurance. I look upon the group switch as burglar insurance. Some of the switches may possibly steal on you and not break the arc. In that way, the more expensive your plant is the more elaborate you can afford to be in the precautions you take against shutdown, due to any cause. A shutdown of any plant is very disastrous, and the larger the plant the more disastrous the results of a shutdown on the financial standing of a company. As a matter of fact, in an operating experience of more than two years with about 160 oil switches, we have never had a case where they failed to open the circuit. We have had short-circuits, in which there was developed about 100,000 kilowatts, and in no case have we had an oil switch which failed to open. It would require a great deal of courage to advise leaving out group switches in plants of that size. I therefore look upon it as a question exactly the same as the man with an expensive house and fine ornaments looks on insurance—he wants all he can get. I look upon group switches in that way.

As to Mr. Dow's statement as to the operation of plants in multiple, I do not know of any plants of any size that are not operated in multiple. The New York Edison Company splits the bus bars in two, but the two sections are operated in multiple.

Ralph D. Mershon: In regard to Mr. Dow's remarks, it seems to me that the whole tendency is toward multiple operation, and if I understood Mr. Dow, he seems to think it is not. The reasons given by Mr. Stillwell for the use of group switches I have no doubt had great weight at the time when the plants referred to were designed. That was at a time when the oil switch had not won its spurs so thoroughly as it has now, and it seems to me in the present state of the art some of the reasons do not stand very well. It seems to me the oil switches which are constructed today are at least as reliable, if not more so, than the apparatus which they control. I am speaking now of moderate voltages, up to 10,000 volts. If that is the case, it does not seem to me that one is justified in putting a number of switches in series. If switches are more reliable than the apparatus controlled, in my opinion, the extra switches are not justifiable. As regards the ease with which the load can be thrown off the power house, that can be taken care of by having tripping arrangements which will operate a group of switches. They can all be tripped at once. As regards the transferring from one set of bus bars to another, so far as I can see that shows a great advantage for the group switch if the transference can be made quickly. If you have to take some time to do it, I do not see why a selector switch cannot be used for the oil switch.



GROUP SWITCHES IN LARGE POWER PLANTS. ARRANGEMENT IN MANHATTAN RAILWAY PLANT, NEW YORK.

Oil Switches for High Pressures.

BY E. M. HEWLETT.

This paper naturally compares the oil-break switch with the air-break switch. In treating this subject the following points appear to be the main points for consideration:

1. Abnormal rise in pressure: Owing to the fact that in oil switches the circuit is opened at the zero point of the wave, the rise of pressure found in the air-break switch is not experienced. This point is of particular importance in high-pressure, long-distance lines, and in cables carrying considerable energy.

2. Capacity: Experience has proved that oil switches may be designed to break circuits of practically unlimited capacity.

3. Length of arc: Owing to the smothering action of the oil on the arc, the length of arc under oil is only a fraction of its length in air.

4. Insulation: The insulating qualities of the oil decrease the distance required to prevent leakage and arcing.

5. Size of switch: Owing to the fact that the arc length is materially decreased and the value of the oil as an insulation reduces the creeping surface, an oil switch can be made very much more compact than an air switch.

6. Remote control: The design of the oil switch lends itself readily to operation by control from a distance.

7. Arc confined: The fact that the arc is ruptured under the oil within the switch has two advantages; first, switches can be placed close together without danger of short-circuit; second, in case of emergency, confusion is avoided, as there is no visible arc to disconcert the attendant.

8. Station arrangement: The flexibility of the oil switch places no limitations on the station arrangement, permitting the circuits and buses to be arranged in the most advantageous manner.

9. Isolation of phases: The possibility of complete isolation of the phases in a reasonable space is easily secured by the use of oil switches.

Discussion.

Cummings C. Chesney, Pittsfield, Mass.: The following notes are offered in order to outline the more important features and essential elements which have made some of the later switches successful, but without any attempt to describe any particular make of switch or describe any particular switch design. On American high-tension transmission lines there are four general types of switches now in use: (1) Switches designed to break the circuit in the open air. (2) Switches designed to break the circuit in an enclosed air space. (3) Switches designed to break the circuit with the aid of an enclosed metal fuse. (4) Switches designed to break the circuit under oil.

Type No. 1.—The large amount of space required by this switch in order to be certain that the arc will be broken makes its use impossible except in rare instances, and then it can be used only with safety when the line potential is comparatively low, for the reason that a circuit containing inductance and capacity may have very high voltage oscillations set up in it by an open-air arc, unless the current is broken at zero value.

Type No. 2.—This switch is a decided improve-

ment over Type No. 1, as far as the amount of space occupied is concerned, but its effect on circuits containing inductance and capacity is very little different, so that there will be the same oscillatory rises of potential and the same destruction of the insulation on opening the circuit.

Type No. 3.—Two forms of this switch have been more or less used. In the first form, the fuse is connected in parallel and in the second the fuse has been connected in series with the current-carrying parts of the switch. The first form is limited to low-voltage circuits, because of the absolute unreliability of the enclosed fuse on comparatively high potentials when the circuit is fed from large central stations. The second form operates through the severing of a metal fuse within an enclosing tube filled with powdered carbonate of lime, or some other non-conducting powder.

Type No. 4.—This type of switch has within the last year been almost universally recognized as the only switch to be used for high-tension work, for the reason that it can be made in a compact form at a fair cost, and, when properly built, will with certainty and safety disconnect from the generating system any circuit under any condition of load, even to a low-resistance short-circuit. Contrary to the general expectations, it has been shown by a number of experiments that the opening of a circuit by an oil switch is not a quick break; the oscillograph shows the effect of the oil is to allow the arc to continue for several periods and then to break the current, as a rule, at the zero point of the wave. The result of the breaking at this point is that the opening of any circuit with oil switches is rarely accompanied by destructive rises of potential.

Of the two types of oil switches used on 20,000, 30,000 and 40,000-volt circuits, one—the plunger type—breaks the arc in a vertical plane; the other breaks the arc in a horizontal plane. The latter form has been used more particularly by one or two of the larger Pacific Coast long-distance power-transmission companies. Some time ago the writer had an opportunity to thoroughly test such a switch on the circuit of the Bay Counties Power Company. This particular switch was built by the engineers of the Bay Counties Power Company.

The switch was of the three-pole type and was arranged to break simultaneously the three legs of the three-phase circuit. During the regular running of the plant it had given satisfactory results under rather trying conditions. In order more thoroughly to test the arc-breaking qualities of the switch, one pole was connected across one leg of the main transmission line and the line short-circuited at the full line potential. The short-circuit was then opened by one pole of this switch. As the switch was hand-operated, there was no record of the exact time length of the short-circuit, but it was not over one second. These experiments were repeated a number of times at both ends of the 150-mile line of the Bay Counties Power Company. Each time the circuit was opened without disturbance of any kind, and, as far as it could be determined, the short-circuit was opened equally as well at either end of the line. During these experiments the Bay Counties company was supplying its regular customers, and was operating a line potential between 45,000 and 46,000 volts. All of the alternating-current generators at both power houses were in operation and amounted to about 11,000 kilowatts. The mechanical construction of the switch is extremely simple. The contact arm is mounted on an insulator at the end of a vertical operating rod. The outer ends of the contact arm carry fingers, which make contact with terminal blocks on the ends of the studs which pass through the porcelain insulators to the line. Each pole had two breaks in series, each about nine inches long. The switch is operated by rotating the operating rod which moves the contact arm through an angle of about 90 degrees. The oil tank was 28 inches in diameter and there was about five inches of oil over the contacts. During the test the cover of the switch was off, so that the breaking of the arc could be observed. At each break there was a small arc formed at the terminal blocks, but there was only a very slight elevation of the surface of oil immediately over the arc.

On the assumption that the oil switch in the present state of the art is the only switch to be used for high-tension work, the following points of construction will bear consideration after the particular form of oil switch has been selected:

(1) Rating.—The performance of the switch under abnormal conditions of a low-resistance short-circuit should be considered, as well as the capacity of the switch under normal operating conditions.

(2) Oil.—Any good paraffin oil will answer, but it should have about the following characteristics: Flashing point, 215° C.; fire test, 250° C.; specific gravity, .865; acid, none; alkali, none; evaporation, negligible.

(3) Insulation.—The insulator and insulating bushings should be either glass or porcelain. The switch should stand a breakdown test between the live parts and the metal case and framework of at least twice the working voltage. The external terminals should be far enough apart, or sufficiently well insulated, so that there can be no possibility of the current striking across through the air from terminal to terminal.

(4) Location.—Oil switches should be placed at a distance from the switchboard and away from the generating and transforming apparatus. Each pole should be placed in a separate fireproof cell, so that by no possibility could an arc or explosion in one cell be communicated to another cell or to the neighboring machinery.

(5) Method of operation: All switches should be either magnetically or electrically controlled from a central switchboard, and all the poles of a switch should be operated simultaneously. It is also desirable to equip each switch, especially if it is automatic, with a time-element attachment, so that the circuit cannot be opened for at least a second after the operating mechanism is set in motion.

Dr. F. A. C. Perrine, Pittsfield, Mass.: I would like to describe some experiments that I tried last fall with three oil switches. These three switches were connected up at Mission San Jose, in California, 98 miles from the power plant of the Standard Electric Company, and the experiments were carried on during the night, so that we could have command of the entire generating station, four 2,000-kilowatt machines. Three switches were arranged with a single handle controlling them all, so that they opened simultaneously. The three-phase line was first connected through the switches and the three-phases short-circuited at the other side of the switches, putting each switch in series with the brake. The line operated at 40,000 volts. We opened and closed these switches about six or eight times that night. Then the work was shut down until the next night, when we could connect the switches operating as a short-circuit between the wires of each phase, so that each switch formed a short-circuit on the phase, the three switches short-circuited the entire line. That is very much more severe service. On a second occasion the three switches were connected in the same way. The line was short-circuited and the switches were opened several times—first opening the switches as quickly as we could open them after they had been closed, and afterward holding them in short-circuit. The switches operated successfully, the machines held the speed, and the voltmeter showed the voltage was held up. The gaps were set 4½ inches, so that from line to line the gap was nine inches. The arc in almost every instance when we opened the switch went across the lightning arresters, and finally the lightning arresters were destroyed, the pole head was destroyed, and the No. 0 ground wire was entirely fused. The superintendent of the station said that the appearance in the station was as though the sun had come down in the back yard. The interesting thing was that those switches did not fail to open the circuit on any one of the experiments, and the experiments were only discontinued on account of the danger to the generating and transformer apparatus, due to the apparently high voltage by reason of the current jumping across nine inches of open-air space.

Terminals and Bushing for High-pressure Transformers.

BY WALTER S. MOODY.

It is much better to have the high and low-pressure terminals at opposite ends of the structure, for it is almost impossible to keep safe distances between the terminal and connecting coil leads when all are at one end. In a shell-type structure, having its coils in vertical position, this requires one set of coil terminals to be at the bottom of the case, but to bring these safely to the top is not as difficult as to separate high and low-pressure conductors that are at the same end of the windings.

In an oil-immersed transformer the insulation of the terminals on the coils presents little difficulty, as it is simply necessary to have all leads rigidly spaced a safe distance from each other and from the coils and covered with sufficient waterproof insulation to prevent any moisture penetrating the coil around the terminals before the oil is put in.

In air-blast transformers, however, the case is different; here all terminals must be covered with an insulation integral with that on the coil itself to a distance from the coil that provides sufficient surface insulation, even when the lead is well covered with dust and dirt.

The best location for the main terminals naturally varies with the type of transformer and its pressure; for the air-blast type the air chamber forms a convenient and natural location for the low-pressure wiring, and the terminals of these are therefore usually located in the base of such transformers and made accessible by doors in the side of the base. For pressures not exceeding 25,000 volts the high-pressure wiring can also be placed in the air chamber without making the air chamber of excessive cross-section, so that all transformer terminals are in the base and exposed wiring is avoided. Heavy rubber-insulated cable is to be avoided in such construction, however, for should the rubber take fire from short-circuit or other causes a draft of air will carry the fire along the duct and into the transformers with great rapidity.

The insulation of main high-pressure terminals below 40,000 volts offers no special difficulty; porcelain or glass bushings can readily be obtained that are safe for this pressure, even if the conductor has no insulating covering. For higher pressures the problem is more difficult; if no insulation is used on the conductor the bushings become expensive and so large that there is scarcely room on top of a moderate size transformer for as many terminals as are often required. The following are some of the more common forms of bushings that have been used: Wooden tubes, hard-rubber tubes, glass and porcelain tubes, both single and concentric and numerous forms of molded porcelain bushings.

The practice is to locate the internal terminals just under the oil and make them as accessible as possible either by the removal of the transformer top or through an auxiliary cover on the top of the case. It is better that each of these terminals be separately supported by glass or porcelain insulators, for a single support, such as a slab of marble, is almost sure to collect sufficient semi-conducting material to cause trouble sooner or later.

Usually the low-pressure terminals present no special difficulties; when transformers are connected in multiple and deliver 500 amperes or more, special caution should be taken that all joints are soldered or that terminals are of such construction as to have extremely low-contact resistances. Taper plugs and receptacles are perhaps the most reliable form of contact for the purpose.

Discussion.

Ralph D. Mershon: In Mr. Moody's paper there is one point in regard to the terminals for high-voltage transformers with which I thoroughly agree. I do not think the marble terminal board has any place in high-voltage transformers. I think the leads should be brought out to porcelain insulators located underneath the oil, each to its separate insulator. I have known of a number of cases in which trouble occurred on the marble terminal board, and I think it is bound to occur sooner or later, and when it does occur it is at times difficult to remedy. A marble terminal board scored by a discharge and afterward apparently made perfectly clean by scrubbing will not stand the normal voltage when again put into service, and the only way in which it can be made to stand it is to take a piece of steel and chip out the marble where the discharge occurred. I do not think if a discharge occurs across the marble terminal under these conditions it is possible to put it back into shape without actually cutting the marble out.

C. E. Skinner, Pittsburg, Pa.: In the case of oil-insulated transformers the pressures have already gone as high as 55,000 volts in actual service, and higher voltages are now being seriously considered. These higher voltages present a very formidable problem to the designer, and this difficulty is sometimes still farther increased by the requirements for the transformer case to be able to withstand considerable mechanical pressure.

A very interesting example of bushing trouble occurred on a 55,000-volt line, where the bushing consisted of a glass tube with a five-eights of an inch wall incased in a very heavy wooden bushing for mechanical protection, the glass and wooden bushing being set in a wooden cover. The static discharge over the surface of the glass tube scored the tube to a depth of 1-32 to 1-16 of an inch, making the surface very rough, and finally a breakdown occurred directly through the tube, shattering the tube into many pieces. This shows that glass has a time factor at very high voltage.

Discussion in Chicago.

At the meeting of the Chicago branch of the Institute for the discussion of the same subjects, held on March 29th, there was a fair attendance, the honorary secretary, Peter Junkersfeld, presiding. The introduction on "The Relative Fire Risk of Oil and Air-blast Transformers" was read by James Lyman and was followed by a short discussion. Ray Woodmansee then read the introduction upon "The Use of Group Switches in Large Power Plants." The remaining two introductions upon oil switches and transformer terminals and bushings were read by George N. Eastman and Mr. Hill, respectively. The general topic of the evening was then opened for discussion. One of the questions which was brought up was the relative merits of iron doors and doors of wood and glass for oil-switch compartments. The question of the use of a number of high-tension switches in series, each with relatively small gap, instead of a single switch with large gap, was also discussed at some length. In this discussion P. Junkersfeld, E. O. Sessions, W. G. Carlton, W. A. Blanck and George N. Eastman took part.

Electrical Supervision in Washington, D. C.

The bill for the regulation of electric wiring in the District of Columbia passed the Senate and is now in the hands of the committee of the District of Columbia on the House side. This bill makes it unlawful for any person to act as an electrical-wiring contractor, or to engage in electrical construction or installation, who has not been licensed, or who is not working under the supervision of some person so licensed. The bill makes it unlawful for any person, firm or corporation to operate, as owners or lessees, any electrical-generating plant in the District without first securing a permit. The District commissioners are authorized to appoint an electrical board of three members and are expected to prescribe the necessary rules and regulations governing all wiring and apparatus for the utilization and production of electric current for lighting, heating and power. Electrical contractors are required by the bill to obtain a license and to file in the office of the commissioners a bond with satisfactory sureties in the sum of $2,000 for the faithful performance of all work undertaken, so that it would be in con-

formity with the requirements. The bill authorizes the commissioners to appoint an electrical engineer at a salary of $2,500 a year, an assistant at $2,000 a year, and two electrical inspectors at salaries of $1,200. The bill is very full in all its provisions for accomplishing the purpose in view.

A New Engineering Enterprise.

Many friends in Chicago and elsewhere will be greatly interested in the announcement that S. G. McMeen, now with the Western Electric Company, and Kempster B. Miller, now with the Kellogg Switchboard and Supply Company, are about to open an office as consulting electrical and mechanical engineers and as patent solicitors. As individuals they will also practice as experts in patent causes. Their office will be at 1442 and 1443 Monadnock Building, Chicago, and will be opened on April 25th, or thereabouts. Both of these gentlemen are engineers of prominence—alert, energetic and experienced, and well liked. For several reasons they should make a particularly strong combination. They have a large number of admirers, who will wish them well in their venture.

Samuel G. McMeen has been engineer in charge of telephone-exchange equipments for the Western Electric Company for the last two years. After leaving Purdue University he was for 17 years connected in various capacities with the Central Union (Bell) Telephone Company. Nine years of this time was spent in the company's headquarters in Chicago and eight in the field, in Ohio, Indiana, Illinois and Iowa. He became assistant engineer and then chief engineer of the company, and had a wide experience in the operating, constructing and engineering departments. This practical training will be of great value to Mr. McMeen in his consulting work. He has lately completed a study of the telephone conditions of the City of Mexico, preparing complete plans and specifications for an extensive underground-conduit and cable system for that important capital. Mr. McMeen has a keen, active, practical mind, and his friends greatly enjoy his society.

S. G. M'MEEN. KEMPSTER B. MILLER.

Kempster B. Miller is the well-known author of "American Telephone Practice." In the telephone field he has been associated with the Independent rather than the Bell interests, but he has made for himself an enviable reputation, not only for technical ability, but for conspicuous fairness and honesty as well. He is a Cornell man, of the class of '93. His experience has been varied and valuable. He has been connected with the Kellogg Switchboard and Supply Company for the last four years. Previously for one year he was with the International Correspondence Schools, and he prepared the textbooks of that institution on the subjects of "Telephony" and "Telegraphy." Before that he had served as chief electrician of the Western Telephone Construction Company, and for a time was connected with the Westinghouse Electric and Manufacturing Company. Earlier in his career he served in the United States Patent Office for three years, in charge of the class of telephony in the electrical division, while at one time he was draughtsman and inspector of drawings in the draughting room of the Thomson-Houston Electric Company at Lynn. Mr. Miller has served as expert in many important patent causes, and his ability in analysis of this sort is marked and well known.

Sale of Current for Railway Operation.

The Chicago Union Traction Company and the Consolidated Traction Company have jointly contracted with the Lake Street Elevated Railroad Company to furnish the latter with electric current for the operation of its system at the following prices per kilowatt-hour: Current from the Hobbie Street station, one cent; from the Western Avenue power house, 1¼ cents, and from the Cicero and Proviso plant, two cents. The arrangement is for one year, at the expiration of which time the Lake Street company will be in a position to get its current from other sources.

Motor Equipment for World's Fair Launches.

One of the most pleasing features at the World's Columbian Exposition in 1893 was the electric-launch service. The little boats darted noiselessly about over the lagoons, offering an excellent means of transportation and at the same time a pleasant resting place to the tired sightseer. At the World's Fair in St. Louis this summer similar craft will be prominent and a large number have already been ordered.

The Hertner Electric Company of Cleveland, Ohio, has recently filled an order for 30 special automobile motors and controllers to be used on the launches at the exposition. The boats are now being constructed by the Truscott Boat Manufacturing Company of St. Joseph, Mich., and have seating capacity for 30 persons. A 140-ampere-hour, 88-volt Willard battery will furnish the motive power.

The motors are of the standard 2½-horsepower automobile type. They are multipolar, with forged steel yokes and laminated poles. Ball bearings are used and are constructed so as to take care of the end thrust as well as the radial pressure. The mechanical and electrical design throughout is calculated to produce the highest possible efficiency. Fig. 1 is a view of one of the motors.

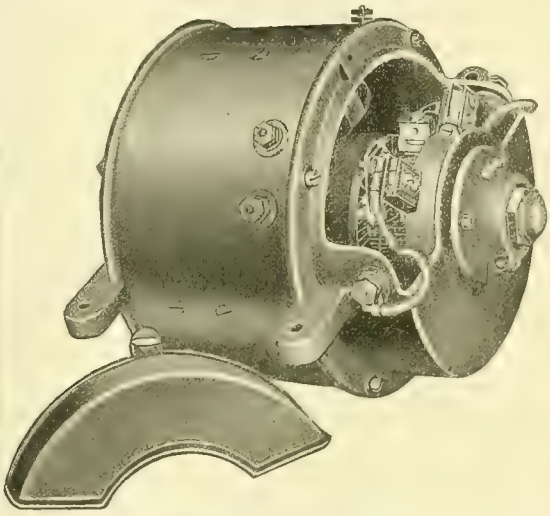


FIG. 1. ELECTRIC LAUNCH MOTOR

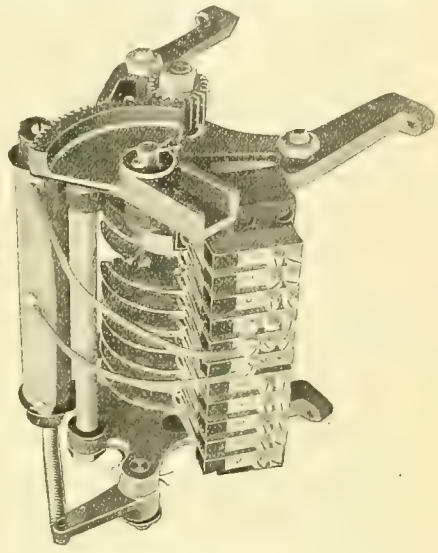


FIG. 2. CONTROLLER USED WITH ELECTRIC LAUNCH MOTOR.

By the use of heads of special design the motors are made water-tight up to the level of the bearings, the upper part of the front head being left open so as to expose the commutator and brushes; a removable cover is provided which will keep out dust and water. By means of four lugs cast on to the sides of the heads the motors are supported in the boats and are lined up to the stuffing box through which the propeller shaft passes.

The controllers, Fig. 2, are provided with three forward speeds and two reverse. The first speed forward throws the motor on 44 volts, with resistance in series with the armature. The second speed cuts out the resistance and the boat moves at about a 4½-mile rate, the motor making 600 revolutions. For emergencies the battery is thrown in series so that the motor operates on 88 volts, and the boat has a speed of about 6½ miles an hour. The backward speeds are on 44 and 88 volts, similar to the second and third forward speeds. When the controller handle is in the "off" position the battery is series connected and can be charged off a 110-volt circuit.

Storm Affects Electrical Service in Chicago.

A wind and rain storm of unusual violence swept over Chicago and vicinity during the night of March 24th, doing much damage. The storm was especially severe in East Chicago, Hammond and Indiana Harbors, just across the line in Indiana. These suburbs were plunged in darkness. The plant of the Hammond Illuminating Company was struck by lightning and all power cut off. The plant furnished electricity for the entire Calumet region.

In parts of Chicago much damage was done to electrical interests. The wind blew down the wires and poles along the car lines running south of Chicago, and the Evanston line was unable to run cars for four hours while the storm was at its height. At Evanston and Rogers Park the telegraph, telephone and electric-light wires were blown down.

The Postal Telegraph-cable Company lost 70 50-foot poles in South Chicago, and at one time during the night only one wire of the company was available out of Chicago, and messages to New York had to be sent by way of St. Louis. By 10 o'clock on the morning of the 25th, however, this company's lines were in good working order again. The service of the Western Union was also affected. The Chicago Telephone Company was especially fortunate. Less than 10 poles were lost and very little hindrance to traffic occurred.

Lamp Manufacturers Meet in Cleveland.

Under date of March 26th the Cleveland correspondent of the Western Electrician writes as follows: "A meeting of lamp manufacturers was held at the Hollenden Hotel, Cleveland, on Saturday, to adjust troubles growing out of patents held by the General Electric Company. It is said that some companies had infringed, and suits had been brought to prevent the further manufacture of lamps under them. With the adjustment of this matter, by which all companies will pay royalties for the right to manufacture certain kinds of lamps, also goes an agreement on prices, the standard being fixed at the figures used for the sale of the Edison lamp. Further than this no combination was effected, it is said. Competition will lie in the quality of goods placed upon the market. All suits that have been started will now be dropped, and the companies will go upon the market without fear of involving customers. The companies represented at the meeting were: National Electric Lamp Company, Sterling Electrical Manufacturing Company, United States Incandescent Lamp Company, Franklin Electric Manufacturing Company, Brilliant Electric Company, Banner Electric Company, Standard Electrical Manufacturing Company and the Downward Light Electric Company."

Chicago Freight Tunnels in Use.

The tunnel system of the Illinois Tunnel Company in Chicago has been put into service to a limited extent. No contracts for the transportation of merchandise are yet in force, as the track and power-transmission systems are not sufficiently completed for general use. Sections of the tunnel, however, are now in use, and contracts for service in the future are being signed.

The first service given by the system is that of removing excavated material from sites to be occupied by downtown buildings. The material from the site of the new Chicago Savings Bank, which will be excavated about 40 feet below the sidewalk, will all be removed by the tunnel cars. Instead of excavated clay being hauled by wagons it will be lowered by caissons to cars of the tunnel company, switched underground to the lake and transferred to Grant Park. By that means the sidewalks and streets will be kept clear of dirt wagons.

Congressman Mann has secured the adoption in the House of Representatives of his amendment to the postoffice appropriation bill providing $100,000 for the Chicago postoffice to pay for the use of the tunnels for the transportation of mail. The condition is attached: "Provided the service is as good as an efficient wagon service." It is believed the tunnel service can be performed for the amount now paid for wagons. The change is supposed to mean a great improvement in the mail service, as it was found by the commission of experts that a great deal of time could be saved in handling both the outgoing mail and the incoming mails.

The board of county commissioners of Spokane, Wash., has under consideration the petition of the Spokane Southern Traction Company, asking for a franchise to extend its railroad system from the southern limits of the city to Moran Mountain, and from a terminus at that point to the eastern boundaries of the city. The enterprise, which involves a large expenditure, will be commenced just as soon as the consent of the board is obtained. The electric line will be of standard gauge and the cars will carry freight, mail and passengers. Surveys for a distance [illegible] by the company.

Annual Report of the American Telephone and Telegraph Company.

At the annual meeting of the American Telephone and Telegraph Company, held in New York city on March 29th, President Frederick P. Fish, for the directors, reported to the stockholders as follows:

The results of the business for the year 1903, as shown by the treasurer's statement, were:

Gross revenue	$16,545,652.50
Expenses, including interest and taxes	5,980,707.70
Net revenue	10,564,065.04
Dividends paid	8,61[illegible]150.75
Carried to reserve	726,13[illegible]
Carried to surplus	1,217,374.37

The following were the corresponding figures for the year 1902:

Gross revenue	$13,277,457.33
Expenses, including interest and taxes	5,442,185.14
Net revenue	7,835,272.19
Dividends paid	6,584,403.75
Carried to reserve	522,246.71
Carried to surplus	728,621.73

The net output of telephones during the year 1903 was 629,197, making the total number in the hands of licensees 3,779,517.

The number of exchange stations at the end of the year was 1,525,167, an increase of 247,184.

The total mileage of wire for exchange and toll service was 3,958,891 miles, of which 677,229 miles were added during the year.

Including the traffic over the long-distance lines, the daily average of toll connections was about 258,000, and of exchange connections about 9,876,000, as against corresponding figures in 1902 of 239,700 and 9,323,000; the total daily average for 1903 of connections both toll and exchange reaching 10,134,000, or at the rate of about 3,263,000,000 per year.

The total amount added to construction and real estate by all the companies constituting our system in the United States during the year 1903 was:

For exchanges	$24,060,900
For toll lines	8,866,009
For land and buildings	2,441,800
	$35,[illegible]68,700

The amount added in 1900 was $31,619,100; in 1901, $31,005,400, and in 1902, $37,336,500.

The expenditure by this company in 1903 for the construction equipment and supplies required for its long-distance lines was $4,365,614, making the total investment in long-distance lines and equipment up to the close of the year $26,861,805.

The development and course of the business of the company during the year have been satisfactory and the returns, as indicated by the foregoing figures, clearly such as to meet all reasonable expectations. In view of the general business conditions of the country, the increase in the number of subscribers and in the amount of telephone business done shows that the efforts of your company and of the companies associated with it to give a service of substantial value are appreciated by the public. The increase in gross and net revenue and in the amount carried to reserve and to surplus after the payment of interest and dividends is a satisfactory indication that the investment that has been and should be made from year to year to build up a comprehensive telephone system that is adequate to the needs of the community will receive a proper return.

In former reports to the stockholders the necessity for developing and extending the facilities of your company to meet the demands of the public throughout the United States has been recognized and asserted. The history of each year emphasizes the soundness of this policy. Not only have the specific returns from such extensions proved to be adequate, but the strength and earning capacity of the company in all parts of the country are definitely increased by such development. No new toll lines are built, exchanges established, or telephones installed without bringing in additional revenue from the construction already existing as well as from the new construction. The conditions of modern business require communication over such large areas and with so many people that the public immediately responds when it has the opportunity of telephonic communication with new territory or with new subscribers; for the value of the service to users generally largely increases with the extent of territory covered and the number with whom connections may be made. Your company and its associated companies are in a position to supply the comprehensive service required, and a proper return for the investment will surely reward their efforts to meet the demand that is made upon them. The extent of development required will vary from time to time with general business conditions. But even when those conditions are least favorable, extension of telephone facilities will still be called for, inasmuch as each year a larger proportion of the community recognizes the importance of the telephone in social and business life, as is shown by the constantly increasing number of Bell telephones in proportion to population.

Equally important is the matter of good service. Our companies are thoroughly impressed with the necessity of maintaining the Bell service at the highest practicable standard, and every effort is made to produce this result. The constant and intelligent study of operating methods that has been going on from the beginning and the many successive improvements in apparatus have resulted in a definite control of this problem, the effect of which is everywhere shown in improved service. The complicated equipment required to make it possible to establish intercommunication between any two of hundreds of thousands of telephone users has now been standardized to a large extent. Standard methods of operating have been devised and put into practice. The result is not only an increased efficiency and better service, but also marked economy in maintenance and operation. Improvements in cables and devices to be used in connection therewith and greater engineering knowledge have made it possible to develop underground construction to a constantly increasing extent, and the field for underground work is now believed to be capable of an ultimate extension beyond anything that seemed possible to the engineers of a few years ago. This results in economy of operation and also, by reducing to a minimum the danger of accident to the outside construction, in an improvement in the service. It is safe to say that there is an element of permanency in the apparatus and equipment of today which did not characterize that in use a few years ago. The time will never come when further improvements may not be expected, both in methods of operating and in apparatus. There is no doubt, however, that the telephone service has now been so far standardized in these respects as to be on a par with many industries that are much older and which have had the intelligent and careful study of experts for a far greater period of time.

The work of perfecting the Bell service is not complete; but in view of the zeal and intelligence with which it is being pushed throughout the country there is every reason to expect that the high standard now definitely established and already attained in many places will characterize the service generally.

In the report to the stockholders for the year 1902 reference was made to the significant fact that many of the competing telephone companies were beginning to realize that the rates adopted by them were too low and were seeking to raise those rates. This movement has continued with added force during the year 1903. The competing companies in almost every city of any size in the country in which they have established exchanges have found sometimes as the result of a bitter experience that the cost of doing the business was far greater than they anticipated. This has resulted in an increasing number of efforts on their part to raise their rates to a point nearer the Bell standard.

In particular they have learned that charges for maintenance and depreciation, which were lost sight of during the promotion stage of their business, were necessary expenses which must be taken care of before there was any question of earnings applicable to interest on bonds or dividends on stock.

The lesson has not even now been thoroughly learned, and not unfrequently the prospectuses of competing companies practically ignore those expenses. It is common for them to present figures showing that the entire cost of carrying on the business is from 45 to 60 per cent. of the gross receipts that may be expected. The history of the business shows conclusively that an attempt to operate a telephone plant on any such basis is doomed to failure.

This matter of maintenance and depreciation is constantly before the eyes of our companies. The system of accounts, which is practically uniform for all the Bell organizations, forces them fairly to face this expense from month to month and from year to year. Before there is any question of profits, each company recognizes the necessity of reserving from its earnings such amounts as experience has shown to be adequate to keep its property in repair and replace it when worn out or destroyed. The sum properly to be charged varies to some extent in different parts of the country on account of climatic conditions and the character of the plant employed, but the average allowance for maintenance of the Bell companies for the year 1903 was over 30 per cent. of their gross revenue.

As was stated in the report to the stockholders for the year 1902, the competition to which our companies are subjected is embarrassing chiefly to the extent to which it leads the public to believe that service can be given at rates that are too low to permit good service and a reasonable profit. The situation is now more favorable than ever before in this regard, and will continue to improve as the competing companies and the public become more correctly informed as to the conditions of the business. On the whole, it seems every year less probable that competition will have any substantial effect upon the prosperity of the Bell companies.

The developments of the last year also show that the feeling that it is better for the community that there should be one comprehensive system of telephonic communication instead of several, which was referred to in former reports, is clearly growing in all parts of the country.

It is an interesting and significant fact that many telephone companies which have started exchanges and to some extent toll lines in various parts of the country, independently of the Bell companies but in territory which the Bell companies did not occupy, have by contract with our operating companies taken the Bell telephones and become connected with our system on terms favorable to both parties. There are now over 120,000 of such sub-licensee stations connected with the lines and exchanges of the Bell companies, and the movement in that direction is gaining.

Generally speaking, the business of your company and of the companies associated with it is on a sound basis, and, with good management and a proper development to meet the demand, the continued prosperity of the Bell organizations seems secured.

The suit of the Western Union Telegraph Company against this company, which has been pending since the year 1884, and which was decided in favor of this company by Judge Lowell, sitting as master, and by Judge Colt in the Circuit Court of the United States, has been decided adversely to this company by the United States Court of Appeals for the first circuit.

The decision is to the effect that, under a technical reading of the contract made by the predecessor of this company with the Western Union Telegraph Company and its associated companies in the year 1879, this company may have to account to the Western Union Company for a certain percentage of some of the stocks and bonds which it received from its licensee companies prior to 1896, when the contract expired.

That the validity of this decision is doubtful is shown by the fact that Judge Lowell and Judge Colt took a contrary view, and at the proper time every effort will be made to secure a revision of the decision of the Court of Appeals. Meanwhile the matter has been referred to a master, who will report as to the amount, if any, which this company should pay the Western Union Company under the decision of the Court of Appeals, and his report, when made, will be subject to revision by the courts. Even if there should be any ultimate recovery against us—which, as we are advised by counsel, is by no means certain—it is not believed that the amount recovered will be relatively large. It certainly will not be large enough to impose any appreciable burden upon the company. Certain classes of the stocks in question are expressly excluded from the accounting by the opinion of the Court of Appeals, and there are many considerations which, in the opinion of our counsel, will reduce substantially the amount, if any, that may be recovered in the case of the remaining stocks.

Your directors desire to express their appreciation of the zeal and intelligence with which the employes of this company and the officers and employes of the operating companies are co-operating to bring about the best results in our business. There is an excellent spirit throughout the organization and everywhere a harmony of effort and aspiration which is most satisfactory.

Appended to Mr. Fish's report are several tables, from which the following figures are taken:

Instruments in the hands of Bell licensees, under rental on December 31, 1903	3,779,517
Increase of such instruments for the year 1903	629,197
Similar increase in instruments for the year 1902	624,714
Miles of pole lines (toll lines of all Bell companies) on January 1, 1904	130,178
Miles of wire (toll lines of all Bell companies) on January 1, 1904	975,702
Average daily number of toll connections	257,618
Number of Bell exchanges on January 1, 1904	1,609
Total miles of wire of Bell companies on January 1, 1904	2,983,189
Of which there was under ground (in miles)	1,618,691
Total circuits on January 1, 1904	798,901
Total number of employes, same date	53,795
Total number of stations, same date	1,525,167
The estimated number of exchange connections daily in the United States, made up from actual count in most of the exchanges, is	9,876,402
The number of daily calls per station varies in different exchanges, the average throughout the United States being 6 5-10.	

The issued capital stock of the company on December 31, 1903, was $154,179,300; bonds, $28,000,000. Ledger balances—debtors and creditors—were $224,381,524.89 on that date.

Telephones Used for Gambling Purposes.

The discussion between city officials and officers of the Chicago Telephone Company in relation to the removal of telephones used for the transmission of race-track betting news still continues. Speaking on this subject, a telephone man said: "It is well known that under no existing law can telephones be held to be gambling devices. The city officials and some of the newspapers are calling upon the telephone company arbitrarily to cut off service from persons and places designated by the mayor, although it is perfectly clear that the company would have no legal right to do so, and would immediately bring upon itself liability to suits for damages and involve itself in other forms of litigation."

President Arthur D. Wheeler of the Chicago Telephone Company returned to the city last week after a vacation absence and found the agitation in progress. Those who know him are confident that he may be relied upon to do all which the company legally may toward the suppression of the gambling evil.

Telephone Bids in Toronto.

The Bell Telephone Company of Canada has offered the board of control of the city of Toronto, Ont., $20,000 a year for an exclusive franchise of five years, the price of telephones to remain at $50 and $30, for business and residence service, respectively, as at present. The Stark Telephone Company offered to furnish telephones at $6 a year, with a charge of one cent a call up to $15. The Canadian Telephone and Telegraph Company offered to furnish telephones at $36 and $24. The board has taken time to consider these bids.

Ohio Telephone Notes.

The Cleveland Telephone Company has arranged a new schedule of rates for measured service to compete with the Cuyahoga Telephone Company, which has completed improvements and is now giving excellent service. The schedule is as follows: One-party business telephones, $15 a quarter for 300 calls, with a rebate of $1.50 for prompt payment; two-party business telephones, $12 a quarter for 225 calls, with a rebate of $1.50 for prompt payment; one-party residence rate, $11.25 a quarter, rebate of $1.50, with privilege of 200 calls; two-party residence rate, $9 for 150 calls, with rebate of $1.50. The prices have not only been reduced, but the number of calls increased, so that the service is considerably cheaper than formerly. The officers of both companies say there will be no fight between them, but the business will be solicited upon the merits of the service.

It is stated upon reliable authority that the United States Telephone Company will have a line in operation between Dayton and Richmond, Ind., within two or three months. This will connect the system with the New Long-distance Telephone Company of Indianapolis, and through it with all points in the west and southwest reached by the other long-distance companies that recently entered into an agreement to operate together so far as needed to give good service.

Mayor Mills of the village of Norwood has vetoed the ordinance granting a franchise to the Norwood Citizens' Telephone Company. He gave as his reason that the franchise does not bind the company, by bond or forfeiture, to erect and operate a plant within a reasonable time. It was referred back to the solicitor and the committee on legislation.

The Ohio Telephone and Telegraph Company is said to be planning to get into Lorain, although a franchise was refused some time ago. The plan contemplates an arrangement with the Western Union Telegraph Company, by which wires will be strung on its poles to reach a number of subscribers who have made long-term contracts. Then a small exchange will be installed in a drug store, and the company will again apply for a franchise.

J. S. and D. A. Yoder of Toledo and others interested in the H. A. Ashbrook company have purchased the Wood County Telephone Company from the Federal Telephone Company. The finances have been arranged and improvements and extensions will be made on the plant at Bowling Green.

Arrangements have been completed for an interchange of service between the Stark County Telephone Company and the Bergholtz and Eastern Ohio Telephone Companies. Negotiations are also under way between the Stark and the Harrison County companies.

The Brown County Telephone Company of Georgetown, incorporated two weeks ago, has planned to build lines connecting about 25 towns in the southwestern part of the state.

Probate Judge Nippert of Hamilton County heard the motion of the city of Cincinnati a few days ago asking that the petitions of the Fitzsimmons, Interstate, Queen City and Cincinnati telephone companies for franchises be made more definite and complete. The city contends that the companies should set out what streets, alleys and highways they desire, so that there should be no misunderstanding between them after franchises are granted. Objections are made to granting a blanket franchise. The attorneys say there is no use of this, as the city has the right to say how the streets shall be used, even when franchises are granted.

The Maumee Valley Telephone Company of Perrysburg, recently incorporated with a capital stock of $15,000, to take over the local exchange at that point, has the following-named officers: President, Jacob Davis; vice-president, A. C. Fuller; treasurer, Norman L. Hanson; secretary and general manager, R. R. Hilliard. The exchange now has 220 subscribers and contracts have been made with a majority of the farmers for a distance of five miles about the town. Lines connecting it with Waterville and Haskins will be built. Connections will be made with the Maumee Bell Telephone Company at Maumee.

Stockholders of the Orange Telephone Company of Texas have elected J. H. Pfeffer, president, and F. D. Pfeifer, manager.

The Marshallville Telephone Company of Marshallville, Wayne County, has changed its name to the Marshallville-Rittman Telephone Company.

An addition sufficient to accommodate 2,000 more subscribers will be made to the plant of the Home Telephone Company at Toledo. Although the rates for service have been increased, the company is making from 30 to 50 new contracts a week. C.

Telephone News from the Northwest.

The Fullerton (N. D.) and Rosebud Rural Telephone Company has been formed. E. S. Thomas is president and F. O. Alin, secretary.

A. G. Chase has asked for a franchise for a telephone system at Faribault, Minn. It is believed that he is acting for the Tri-state Telephone Company.

The business men of Sheyenne, N. D., have formed a local telephone company. J. W. Richter is president and N. K. Mattson, secretary.

The Enterprise Telephone Company has been granted a franchise at Slayton, Minn.

The Northwestern Telephone Exchange Company has brought suit against the city of Winona, Minn., to determine the company's rights as to the use of streets. The company demands that the city be restrained from interfering with the extension, repairs or renewal of the telephone plant in that city.

The council of Duluth, Minn., contemplates forbidding the moving of old buildings. There is more or less friction engendered between the housemovers and the telephone companies.

The Union telephone exchange at Prairie du Chien, Wis., has been sold to J. W. Callaway of La Crosse, Wis., for $7,000.

The Elkhart (Iowa) Mutual Telephone Company has incorporated with a capital stock of $10,000. A. P. Besser is president and O. F. Mathis, secretary.

The Verdigre Telephone Company has been organized at Verdigre, Neb.

The Hamilton County Independent Telephone Company has let the contract for a new switchboard at Webster City, Iowa, to the Sterling Electric Company. It will have a capacity of 1,800 telephones. R.

Indiana Telephone Items.

The Daleville Telephone Company, capitalized at $10,000, has filed articles of incorporation. The company will operate a telephone system in Daleville and community. C. H. Forrest, R. C. Stone and F. D. Rushing are the principal incorporators.

The Central Union Telephone Company took steps during the last week toward the building of a local system in Lebanon to compete with the Lebanon Telephone Company. The arrival of several carloads of poles and supplies was the first intimation of the company's purpose to inaugurate a local system under a franchise granted by the City Council years ago. The city authorities are inclined to allow the courts to determine whether the old franchise is still in existence.

An important meeting was held in Richmond on March 24th for the purpose of arranging for long-distance Independent service between Richmond and Dayton this spring in order to make the circuit complete between St. Louis and the East in time for the World's Fair business. It is understood that the United States Telephone Company will put in the gap between the two cities, as it operates the line between Dayton and Pittsburg. Connection will be made at Richmond with the New Long-distance line and the Kinloch line west.

A franchise has been granted the Oakland Independent Telephone Company by the Oakland City Council for a term of 25 years. The Independent company will put in a modern plant at once and will compete with the Bell company, which now has a plant in Oakland.

The Madison and Delaware Counties Telephone Company has bought the Independent telephone exchange at Summitville and will at once improve the plant and add a new and modern switchboard.

The unprecedented floods throughout Indiana during the last week greatly damaged telephone property and interfered with the service. In many localities lines were broken down and long-distance service impaired. The New Telephone Company and the Bell Telephone Company lines were considerably damaged by the water that flooded the cable ducts. F.

Southeastern Telephone Developments.

An unusual situation exists in New Decatur, Ala., where three telephone companies have recently had their franchises revoked. It is expected that the next move will be an injunction against the city. The Morgan County Telephone Company (Independent) is now in sole possession of the field. There was a rate war between the Morgan company and the Southern Bell when the Morgan company started up a year ago.

The electrical committee of Meridian, Miss., has reported favorably on the movement to grant a franchise to an Independent telephone company, no names being given. The Cumberland Telephone Company also offered to grant any reasonable demands that would tend to keep down the friction which would be probable in case of two companies.

The Mocksville Telephone Company of Mocksville, N. C., has been chartered at the above-named place by L. G. Horn of Mocksville and others.

The Troy Telephone Company of Greenwood County, S. C., has been commissioned, with $800 capital, by A. J. Davis and others.

The directors of the Anderson Telephone Company of Anderson, S. C., have decided to increase the capital from $10,000 to $30,000. This company owns numerous other lines in the county and has a long-distance agreement with the Bell company.

The Edgemoor Telephone Company of Chester County, S. C., has been chartered, with $25,000 capital. H. B. Heath is president and J. D. Glass secretary and treasurer.

It is reported that the Southern Bell Telephone Company will soon build a line from Statesville to Newton, Hickory, Morganton and Lenoir. L.

Michigan Telephone Matters.

The Mio Telephone Company of Mio has been incorporated with a capital of $2,000.

The People's Telephone Company of Detroit, which is in possession of a site occupied by a partially built telephone exchange, is asked to vacate the premises, owing to a defective title.

Isabella County is the seat of war between the Union Telephone Company and the Michigan State Telephone Company. The Union company has quite an exchange at Shepherd and has done most of the business, the old Michigan (Bell) Telephone Company maintaining only a toll station there. The new Michigan State Telephone Company has lately sent representatives to Shepherd with a view to soliciting new business necessary to enable it to establish an exchange. There has been considerable dissatisfaction with the service rendered by the Union company. The new company will cut rates and promises Sunday and night service, which the Union company has not given. Free exchange throughout the county, including Mt. Pleasant, is also promised.

The Merchants and Manufacturers Exchange of Port Huron has induced at least 500 telephone users to order out their telephones if the Michigan State Telephone Company insists on raising the rates. It has been suggested that Port Huron and Detroit join in petitioning the governor for a special session of the Legislature to fix telephone rates. The special-session question has also come before the Detroit Common Council in the shape of a recommendation that such action be at the discretion of the mayor.

The Michigan Telephone Company of Battle Creek has completed its new exchange and has cut over the last telephone from the old exchange. Considerable money has been spent by the company in the construction of conduits and most of the poles around the city will be taken down. W.

Independent Long-distance Telephone Developments.

Recent developments in Independent telephone movements as regards long-distance connections are interesting. Only a week ago the probable merging of some of the principal Independent long-distance telephone companies in Ohio, Indiana, Illinois and Missouri for long-distance co-operation was reported. This merger would form a chain from Cleveland to St. Louis, taking in the Kinloch company. During the last week the Interstate Telephone and Telegraph Company (Independent), which operates principally in Northern Illinois, has placed the order for material for the construction of a toll line from Aurora to the city limits of Chicago. Although no contract has been drawn, it is understood that when this line is completed it will be met in Chicago by the Illinois Tunnel Company and connected to the automatic system. Although the Interstate company was not included in the merger mentioned, it is likely that some arrangement will be made for the use of its proposed line into Chicago.

Along with these developments comes the report of the organization of the United States Telegraph and Telephone Company by Chicago men. This company, it is said, will employ the duplex system of telephoning and telegraphing over the same wires. The Chicago and Milwaukee Telegraph Company, which, about a year ago, considered plans for handling market and stock reports between Milwaukee, Chicago, Kansas City and St. Louis, is said to be included in the deal, as also the National Telegraph News Company, the Orthwein Brothers of St. Louis and the Sempire Clock Company. Among the names connected with the new company are those of Henry E. Weaver, Harry Rubens, H. L. Turner, H. B. Critchfield and Col. G. W. French.

Mr. Critchfield, who, it is stated, will probably be the president, is counsel for the Automatic Electric Company, which manufactures the instruments for the automatic telephone system operated by the Illinois Tunnel Company. At the last meeting of the Interstate Independent Telephone Association, it will be remembered, Mr. Critchfield, on behalf of the Illinois Tunnel Company, assured the members that that company would do all in its power to establish long-distance connection with all Independent companies having good equipment. In view of the fact that the reported new United States company proposes to adopt the duplex system, some interesting developments in long-distance Independent service may be in store.

GENERAL TELEPHONE NEWS.

E. V. Combe is building a telephone line from Sierra de Almoya, Mexico, to Vaca Station, situated on the Mexican Central Railroad.

Extensive improvements are to be made to the local telephone system at Merida, Mexico, which was recently badly damaged by fire.

The new 3,000-station automatic exchange recently installed by the Automatic Electric Company for the Lincoln Telephone Company at Lincoln, Neb., was put into service on March 15th. The equipment was installed within six weeks after the building was completed.

The Michigan State Telephone Company has elected a new secretary in the person of Walter I. Mizner, who will succeed E. T. Hance, who has been acting for the company during its formation period. Mr. Mizner is a son of General Mizner and comes from the American Car and Foundry Company.

ST. LOUIS EXPOSITION NOTES.

A complete gold-reduction plant, including stamp mill, concentrating tables, amalgamation plates, cyanide tanks and retorts, is now being installed in the gulch just south of the Mines and Metallurgy Building. This plant will represent the highest type of practice in the Black Hills, where ore of very low grade is treated. It demonstrates clearly that ore running less than $4 a ton can be successfully treated if present in large quantities. Such conditions are found in the Homestake Mine in the Black Hills, where the ore assays only $3.53 to the ton, i. e., one-sixth of an ounce of gold to one ton of rock. The stamp mill will consist of five 1,000-pound stamps dropped into Homestake mortars, and the pulp will be passed over amalgamation plates. About 1,500 tons of ore will be used during the exposition, which will be brought from the Black Hills. The entire installation will be a facsimile of a modern western plant, with the exception of galleries for visitors.

The filling of Arrowhead Lake with water has begun, and in a few days water will also be turned into the grand basin and series of lagoons. Arrowhead Lake, located just north of the Philippine exhibit, will contain about 9,000,000 gallons of water, and will be used as a home for the lake-dwelling tribes of the Philippines and also as a place to exhibit the operation of the Philippine watercraft. Arrowhead Lake also serves a decided utilitarian purpose, in that it is a reservoir from which water will be drawn for the high-pressure fire service of the exposition.

President Francis has received a letter from the White House, informing him that President Roosevelt will be ready at his desk in Washington to close the electric circuit that will start the machinery of the World's Fair about noon, St. Louis time, on April 30th. The letter, which was in answer to one addressed by President Francis to Mr. Loeb, secretary to the president, reads: "My dear Mr. Francis: I have your letter of the 19th instant, and have taken the matter up with the president. He will be glad to press the button to start the machinery of the exposition in motion on Saturday, April 30th, about 1 p. m., Washington time, as you request. I presume you will advise me as to the exact time."

One of the most interesting working exhibits in the exposition will be that of Platt Bros. & Co. of Oldham, England, located in the western end of the Palace of Varied Industries. This firm is the largest manufacturer in the world of machinery for making cotton, wool, worsted and other textile fabrics, 1,400 hands being employed in its works. The exhibit is a complete cotton manufactory, taking the product from the boll to the thread. The cotton, as it is brought from the fields, mixed with seed, is brought in at the western end, where it enters the cotton gin, in which the seed is separated from the fiber. Then a "Creighton opener" removes the sand and dust, after which the cotton is taken to the "scutcher," which forms it into coils or "laps." It then goes to the carding machine, then to the combing machine, and finally to the spinning mill, from which it emerges as thread on bobbins. This firm will also exhibit a complete line of the machinery for which it is noted, but the thread mill will undoubtedly be one of the attractions of this building.

The following letter from President Francis to the director of works indicates that the exposition will be complete in its physical aspect on opening day, if the combined efforts of every department, and the employment of some 20,000 workingmen will accomplish anything. "To the Director of Works: This is to direct that no building permits be granted for structures to be begun after April 1st. It is the determination of the management that all buildings on the grounds, except the live-stock coliseum and the live-stock sheds, shall be finished before the opening day, April 30th. You will also inform the contractors that all buildings now in the course of construction, and all that may be begun before April 1st, must be finished and ready for occupancy not later than April 29th. If any sites have been assigned upon which building has not begun, you will inform the state or country or concessionaire or exhibitor to whom such assignment is made, that if construction is not begun before April 1st, the building permit will be revoked on that day. When the gates are opened on April 30th it is the determination that all structures upon the grounds shall be entirely finished, so that visitors may understand and see that this universal exposition is ready, in accordance with the announcements that have been officially promulgated."

The tests of railway apparatus at the World's Fair will be carried on over two level tracks, one 1,400 and the other 2,000 feet in length. Tests will be made on operation, acceleration, braking, coasting and motor-heating, and in all probability some tests will be made to ascertain wind resistance. In case the tracks inside the grounds are insufficient, tracks outside but near St. Louis will probably be secured. Four engineering committees have been appointed: Committee on tests of city and suburban equipments, M. G. Starrett, New York city; D. F. Carver, Jersey City, N. J.; W. S. Twining, Philadelphia. Committee on interurban equipments, A. L. Drum; Charles Jones; C. A. Alderman, Springfield, Ohio. Committee on heavy traction equipments, F. J. Sprague, W. J. Wilgus and F. R. Stater, New York city; Bion J. Arnold, Chicago. Committee on new electric-railway systems, Bion J. Arnold; P. M. Lincoln, Pittsburg; W. B. Potter, Schenectady, N. Y.

The lagoons surrounding the Palace of Electricity are spanned by five bridges, and the names of these bridges have just been approved by the executive committee. The De Soto Bridge connects the east end of the Palace of Electricity with the east end of the Palace of Varied Industries. The Davy Crocket Bridge connects the north main entrance of the Palace of Electricity with the south main entrance of the Palace of Varied Industries. The Caronado Bridge connects the west end of the Palace of Electricity with the west end of the Palace of Varied Industries. The Bienville Bridge connects the Palace of Electricity with Machinery Hall. The Jefferson Bridge connects the south entrance of the Palace of Electricity with Cascade Gardens.

Mr. William Caryl Ely, president of the American Street Railway Association, with a number of the officers of the association, and others prominent in the street-railway field, spent several days at the exposition last week.

Status of the Union Engineering Building Project.

At the meeting of the American Institute of Electrical Engineers held in Carnegie Hall, New York city, on March 25th, President Bion J. Arnold of Chicago presided. After the opening business he remarked that Mr. C. F. Scott, chairman of the general engineering and building committee, had some good things to report.

Mr. Scott: Probably there is but very little to add to what you already know. A year ago, on the 14th of February, Mr. Carnegie addressed a letter to four engineering societies and the Engineers' Club, stating that he would be pleased to give $1,000,000 for the erection of an engineering building. Three of the societies and the club accepted shortly afterward. The other society, having a building of its own, considered the matter quite seriously, and finally at the beginning of the present month decided that it preferred to remain where it is and not share with the others the proposed building. As Mr. Carnegie's idea had been a broad one, as the sentiment in his mind had been the bringing together of all engineers into a co-operation, which co-operation he stated to us several times was one of the unique things in American work, which put Americans ahead in the race for industrial supremacy, he was naturally very much aggrieved when he did not find the unity which he anticipated, and he felt that the enterprise was probably at an end. He seemed to regret that more than anyone else.

The matter was then taken up on a new basis. The representatives of the other societies and the club assured Mr. Carnegie that they were ready to proceed. He questioned their ability—whether they had taken the proper action in ascertaining the sentiment of their members and boards of directors under the new condition, and said he would like to have copies of the resolutions which had been adopted relative to the subject. He suggested that the boards of directors convene again and take new action; he also asked for financial statements of the societies concerned. When it was suggested there were other societies which would be glad to share in the building he said: "That is all right, but let us have it in writing." So the committee took up matters as quickly as practicable and meetings of the several boards of directors were held at once. Resolutions reaffirming the previous action were passed; financial statements were prepared; curves showing the increase of membership for the individual societies and the societies in the aggregate were prepared, and letters were secured from the officials of quite a number of other smaller engineering bodies saying they would be glad to share in the building.

These things were presented to Mr. Carnegie and he seemed very glad indeed to find that the way was clear for proceeding. At the last conference which we had with him on Saturday afternoon, March 12, 1904, he said that he would rewrite the original letter on the following Monday morning. He rewrote the letter as follows:

"Gentlemen of the American Society of Mechanical Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers and the Engineers' Club of New York:—It will give me great pleasure to devote, say $1,500,000 for the erection of a suitable home for you all in New York city. With best wishes, truly yours, Andrew Carnegie."

You will note that the amount has increased by 50 per cent. since a year ago. That was done upon representations from the committee on preliminary plans and estimates that such an amount would be about the requirement for providing adequate quarters for the engineering societies as they are now and as they will be in a few years. The committee, composed of three members, representing each of the societies (of which President Arnold, Dr. Wheeler and I represent the Institute) has been at work during the last year in developing the matter, getting out plans of organization and our building plans, our methods of proceeding with reference to selection of architects and the like, so that things are in pretty good shape now for proceeding at once. The ideas of the committee and the ideas of Mr. Carnegie have been very broad—that we are building, not for our present societies, not for our present membership, but making something which is to be a great factor in the progress of the engineering profession in this country. Anyone who looks at the curves of membership for the last 10 years will find there has been a steady increase, becoming more and more rapid during the last three years, that is common to all three societies—the mechanical, mining and electrical; and they are fairly close in membership, fairly close in their financial assets and in their income. We are also looking to the making of provision in the building which will provide accommodation adequate for many other societies, which will provide for all the engineering meetings of various sorts which may be held in New York. The idea is to make it an engineering lyceum.

The general committee has requested that the board of directors of each society shall appoint a library conference committee, so that a general plan of organization of the libraries brought together in this one building may be so formed that our present libraries, aggregating nearly 50,000 volumes, may be the nucleus for a great American engineering library, which may possibly lead the world in engineering libraries. These are some of the possibilities that are ahead, and the committee hopes to carry out its work along broad lines and make provision for the future which may make this building and movement a very great factor in the engineering progress of the future.

President Arnold: It is extremely fortunate for the American Institute of Electrical Engineers that it had at its head as its president last year a man who came from Pittsburg [Mr. Scott] and lives in Pittsburg, the place where Mr. Carnegie lived, and it is also very fortunate that Mr. Carnegie saw fit to treat the engineering societies as a whole so well, and that President Scott during his administration was able to get in touch with Mr. Carnegie. I think the greatest monument to Mr. Scott's memory will be the initiative he took in getting this matter started, and the work which he has done in advancing the movement. We must not, however, forget that others have been associated with him in this matter, and chiefly among those is Mr. Calvin W. Rice, now chairman of the building fund committee, who has a difficult proposition before him to raise the money to buy the land on which the building is to be erected. We would be glad to hear from Mr. Rice.

Mr. Rice: I have a few words to say regarding the responsibilities of those who are to enjoy the privileges of which Mr. Scott has spoken. We must raise $175,000 to enjoy that privilege. It is more than a privilege, because it is your duty to take your part in this responsibility. We must take our part in carrying out the great idea to which we committed ourselves a year ago by letter ballot. This has been reiterated this year, so that the American Institute of Electrical Engineers stands twice committed to assist in carrying out this grand movement in conjunction with the two other engineering societies and the club.

We have so far raised among our own membership $40,000. Your committee, consisting of Mr. J. G. White, Mr. T. C. Martin and myself, has to rely on you and the other members to raise the other $130,000. We propose to issue in a circular form the report of the committee which Mr. Scott has just made verbally, and we hope that every man, particularly those in New York, who come here and have all these privileges every month (I think perhaps we may in this connection refer to the fact that we come here tonight, we go to the Chemists' Club another night, and to the New York Academy of Medicine another night, which shows the necessity of a building in which we can meet regularly) will make especial effort to help this movement. Those in New York, particularly, who can enjoy these privileges regularly, are especially under a responsibility to contribute to the fund, and as an investment I know of nothing better. I ask for your assistance, and we must have it, because you are equally responsible with the committee to make an effort to raise this money.

President Arnold: I want to say the proposition is not perhaps as difficult as Mr. Rice has put it, because we have received promises that we will be assisted considerably in this matter by the electrical industries of the country, so that, if the membership of this Institute will do what it can—and I am sure everyone feels that every member will do what he can—we will undoubtedly raise the amount of money in contributions from our members and from our friends.

Proposed Buffalo-Rochester Electric Railway.

The path of the Buffalo and Williamsville Railway Company, which contemplates the construction of a trolley road from Williamsville (near Buffalo) to Rochester, N. Y., is beset with many obstacles, the worst of which is being encountered in the village of Batavia. It concerns the efforts of the company to increase its capital stock from $750,000 to $3,500,000. The application to the state railroad commissioners for permission to make the increase is being vigorously opposed by the New York Central Railroad. The electric company has already extended its line as far as Batavia, and it was hoped to resume operations so that cars could be running to Rochester by next fall.

On the Dispersion of N-rays, and on Their Wave-length.[1]

By R. Blondlot.

To study the dispersion and the wave-lengths of the N-rays I used methods quite similar to those employed for light. To avoid the complications which would have resulted from the storing of the N-rays I used exclusively prisms and lenses of aluminium, a substance which does not store the rays.

The method employed for studying the dispersion is as follows: The rays are produced by a Nernst lamp enclosed in a sheet-iron lantern having a window closed by an aluminium sheet. The rays emitted by the lamp through the window are sifted by a plate of deal two cm. thick, a second sheet of aluminium and two sheets of black paper, in order to eliminate all radiation but that of the N-rays. Outside these screens and at a distance of 14 cm. from the lamp filament is placed a large screen of moistened cardboard, having a slit five mm. wide and 3.5 cm. high exactly opposite the filament of the lamp. Thus one obtains a well-defined beam of N-rays. This beam is received on an aluminium prism whose refracting angle is 27 deg. 15 min., and one of whose faces is normal to the incident beam.

It is then found that from the other refracting face of the prism there issue several beams of N-rays dispersed horizontally. To show this a slit one mm. wide and one c. m. high, made in a sheet of cardboard, is filled with phosphorescent sulphide of calcium. By shifting this slit one determines without difficulty the position of the dispersed beams, and, knowing their deviations, one may deduce their indices of refraction. This is, in fact, Descartes' method. I have thus proved the existence of N-radiations whose indices are 1.04, 1.19, 1.29, 1.36, 1.40, 1.48, 1.68 and 1.85, respectively. In order to measure with greater accuracy the first two indices I employed another prism of aluminium having an angle of 60 deg. I found for one of the indices the same value, 1.04, and for the other 1.15 instead of 1.19.

In order to control the results obtained with the prism I determined the indices by producing, by means of an aluminium lens, the images of the lamp filament, and measuring their distances from the lens. The lens, which is plane-convex, has a radius of curvature of 6.63 cm. and an aperture of 6.3 cm. The slit of the moist cardboard screen is enlarged in order to leave a circular opening six cm. in diameter. The lens is placed at a known distance of p cm. from the incandescent filament, and the position of the conjugate images of the filament is searched for by means of the phosphorescent sulphide. The following table gives the values of the indices found, both with the prisms and the lens:

Prism.		Lens.		
Of 27 deg. 15 min.	Of 60 deg.	p = 40	p = 30	p = 22
1.85		1.86	1.91	1.91
1.68	....	1.67	1.66	1.67
1.48	..	1.50	1.49	1.48
1.40	.	1.42	1.42	1.43
1.36	.	1.36	1.30	1.37
1.29		1.31	1.31	.
1.19	1.15	1.20	.	
1.04	1.04	. .	..	

Here is another verification of the results: If one takes for the fourth index the mean value 1.42, it may be calculated that for an aluminium prism of 60 deg. the incidence which gives minimum deviation is 45 deg. 19 min., and that that minimum deviation is 30 deg. 38 min. The actual deviation observed is 31 deg. 10 min. With the same angle of incidence the calculated deviation of the radiation whose index is 1.5 amounts to 37 deg. 20 min. The observed deviation is 36 deg. With the same incidence the calculated deviation of the radiation of index 1.67 is 57 deg. 42 min. The observed deviation is 56 deg. 30 min.

I now pass to the determination of the wave-lengths. With the above arrangement for studying the dispersion of the prism of 27 deg. 15 min. one obtains refracted beams, each of which is sensibly homogeneous. By picking out one of these beams with a second screen of moist cardboard provided with a slit 1.5 mm. wide one may isolate a very narrow portion of the beam.

Further, I attached a sheet of aluminium to the movable pointer of a goniometer so that its plane was normal to it. The sheet had a slit only 1-15 mm. wide, lined with phosphorescent calcium sulphide. The goniometer was so arranged that its axis was exactly under the second cardboard slit. On turning the pointer the path of the beam may be traced exactly, and it is found that it is quite unique and unaccompanied by any lateral beam, such as would be produced by diffraction in the case of the great wave-lengths. A grating is then placed in front of the slit in the second moist cardboard, a Brunner grating with 200 lines to the millimeter, for instance. If now the issuing beam is explored by turning the pointer carrying the phosphorescent sulphide one discovers a system of diffraction fringes just as in the case of light. Only the fringes are much closer together and are sensibly equidistant. This already indicates that the N-rays have wave-lengths much shorter than those of the luminous radiations.

The angular distance of the fringes, or, what comes to the same thing, the rotation of the pointer corresponding to the passage of the phosphorescent line from one bright fringe to the next, being a very small angle, is determined by the reflection method with the aid of a scale and a telescope, a plane mirror being glued to the pointer. Besides, one measures, not the angular distance of two consecutive fringes, but that of two symmetrical fringes of a high order; for instance, the tenth fringe on the right and the tenth fringe on the left. From these angular measurements and from the number of lines per millimeter of the grating one deduces the wave-lengths by applying the usual formula.

Every wave-length was determined by three series of measurements taken with three different gratings having 200, 100 and 50 lines per millimeter respectively. The following table contains the results of these measurements:

Refractive Indices.	Wave-lengths.—Grating Employed.— $\frac{1}{200}$mm	$\frac{1}{100}$mm.	$\frac{1}{50}$mm	Mean.
1.04	0.00813	0.00795	0.00839	0.00815
1.19	0.0093	0.0102	0.0106	0.0099
1.4	0.011[illegible]	.	.....	0.0117
1.68	0.0136	. .	.. .	0.0146
1.85	0.0176	0.0171	0.0184	0.0176

Wishing to control these observations by an entirely different method, I had recourse to Newton's rings. Producing these rings in yellow light, for instance, if one passes from one dark ring to the next the variation of optical retardation in the layer of air amounts to one wave-length of yellow. If now, with the same apparatus and the same incidence, one produces the rings by means of N-rays and counts the number of such rings comprised in the interval between two dark rings belonging to the yellow light, one obtains the number of times that a wave-length of N-rays is contained in the wave-length of yellow light. This method, applied to the rays of index 1.04, gave the wave-length 0.0085$\mu\mu$ instead of the 0.0081$\mu\mu$ found with the gratings, and for the rays of index 1.85 it gave the value 0.017$\mu\mu$ instead of 0.0176$\mu\mu$ Although the ring method is inferior to that of the gratings on account of the uncertain position of the dark rings in the optical experiment, due to the necessity of making these rings extremely wide, the agreement of the values obtained constitutes a valuable control.

In the above table I have retained all the decimals which came out in the calculation of the numbers deduced from observation. Although I cannot indicate with certainty the degree of approximation of the results, still I believe that the relative errors do not amount to four per cent.

The wave-lengths of the N-rays are much shorter than those of light, contrary to what I imagined at first, and contrary to the determinations which M. Sagnac ventured to derive from the position of the multiple images of a source produced by a quartz lens, which images he attributed to diffraction. I had already observed that, while polished mica transmits the N-rays, matt mica arrests them, and also that, while polished glass reflects them regularly, ground glass diffuses them. These facts already indicated that the N-rays could not have a great wave-length. If one wishes to study the transparency of a body one must take care that the surface is well polished. Thus, I had at first classed rock salt among the opaque substances, because the specimen which I used, having been cut out of a big block, had remained unpolished. Rock salt is in reality transparent.

The radiations of very short wave-lengths discovered by M. Schumann are strongly absorbed by air. The N-rays are not. This implies the existence of absorption bands between the ultra-violet spectrum and the N-rays. The wave-length of the N-rays increases with their index, contrary to what takes place in luminous radiations.

If the increase of brightness of a small source of light must be attributed to a transformation of these rays into light waves, such a transformation is in conformity with Stokes' law.

1. From the Comptes Rendus, Vol CXXXVIII., pp. 123 12.., January 18, 1904.

BOOK TABLE.

Electrical Engineering Experiments and Tests on Direct-current Machinery. By Geo. F. Sever. New York: D. Van Nostrand Company. 1903. Pp. (5½ by 8½ inches), 64, with 22 illustrations. Price, $1.

The experiments set forth in this book are a part of the regular work of the students in electrical engineering in Columbia University, and they are published not only for the use of students in this branch of engineering but also for the use of those in the active pursuit of the profession. In all there are 10 experiments in the testing of direct-current machinery, taken up in detail exactly as the student is obliged to perform them in the regular laboratory work, including a general discussion of the theory of each experiment, the method of performance, a diagram of connections, tabulation of results, and finally a report upon the results obtained. The book is bound in pamphlet form and contains an introduction upon the plotting of curves, the presentation of the report, and general directions as to the use and operation of the various instruments and machines used in making the experiments; also a table of symbols and one of equivalents.

As an indirect consequence of the Marienfelde-Zossen high-speed electric-railway trials, experiments are being made on a number of German railway lines with a view to investigating the working conditions of a steam-railway service with increased speeds. On the Cassel-Hanover line, for instance, the trains tested have been run as high as 130 kilometers (81 miles) an hour.

Space Telegraphy in the Russo-Japanese War.

In spite of the somewhat discouraging results obtained in the attempts to utilize space telegraphy in the recent war in South Africa, renewed activity in this direction has been evinced by both parties to the present war in the Far East. Naturally from the recent advances which have been made in the art a more important place has been found in warfare for this method of transmitting intelligence.

The Japanese are perhaps in a position at present to use space telegraphy the more effectively. Mr. Chinooh Imay, formerly Japanese vice-consul at Montreal, is reported to have made the following statements: "The wireless-telegraph wizard of Japan is Dr. S. Kimura. He it is who has evolved Japan's wonderful system. In wireless telegraphy Japan is far ahead of even America. The Japanese nation took up its study as soon as it was announced, and no expense was spared in developing it. All of this was done with the idea of war in view. We have kept quiet all these years, excepting to make good use of our improvements, and I think we have succeeded. Our wireless-telegraph facilities explain the seemingly wild reports of victories received at Tokio long before anyone else had heard of them. I know personally that the news of the attack on the ships at Port Arthur was sent to Tokio by the wireless system."

Russia also has been making use of space telegraphy and has recently purchased an outfit of the Telefunken system for use in connection with the transportation of troops across Lake Baikal.

Negotiations are said to be about to begin through Pekin for the purpose of arranging space-telegraph communication with Port Arthur from a small rocky island of Chefu, which was acquired by France after the war of 1884-85, in which France, Great Britain and China were involved. While the difficulties in the way of obtaining information regarding the Japanese fleet and transports by this means are apparent, yet the problem is regarded as entirely new and as promising success if France is agreeable.

Commercial Museum of the Philippines.

A long list of articles suitable for the Philippine market has been prepared by Samuel B. Shiley, director of the Commercial Museum of the Philippines. Prominent in the list are electrical apparatus and supplies. The object of the museum is to aid in the extension of foreign and domestic commerce and to encourage the development of the resources of the Philippine archipelago. The museum collects and exhibits, both in crude and manufactured form, the commercial products of the islands. It also receives and exhibits such products of other countries as are suitable for the markets of the Philippines.

As far as possible the museum will furnish any commercial data called for by importers and exporters of the United States. This service is rendered without charge. Manufacturers and exporters of the United States may place exhibits in the museum free of charge. However, all freight must be prepaid to Manila by the exhibitors. Goods shipped to the museum should be securely packed and addressed to the "Commercial Museum, Manila, P. I." Bills of lading and invoices in duplicate should accompany the shipment.

Mr. Shiley states that thus far the trade-mark of an American manufacturer has proved a good recommendation for any article, and although there is a tendency to buy cheap goods the better class of customers are becoming wise and, in the long run, meritorious goods will win the market. Natives use the best goods they are financially able to buy; still it may be worth while remembering that the majority of them are poor and buy cheap goods. The museum will also give all possible aid in securing suitable agents and dealers in Manila for goods imported from the United States.

Summer School for Artisans.

The fourth annual session of the summer school for artisans held under the direction of the College of Engineering of the University of Wisconsin will be begun at Madison, Wis., on June 27th and continue for a period of six weeks. Five courses of study are offered: (1) Steam, gas and other heat engines, (2) applied electricity, (3) mechanical drawing and machine design, (4) materials of construction, fuels and lubricants, and (5) shop work. The teaching force is taken from the regular faculty of the College of Engineering and the entire laboratory and shop equipment belonging to the college is used by the students in the summer school. The requirements for admission do not extend beyond a working knowledge of English and arithmetic, but the policy is to allow a large amount of individual work so that the student may take advantage of all the preparation he has obtained. As the demand renders it necessary, advanced courses will be established in the various subjects. This school offers to those unable to take a regular four years' course an opportunity of obtaining practical working knowledge of the methods of testing and the use of instruments, together with such theoretical principles in each case as the nature of the subject and preparation of the student may permit. The university issues a bulletin describing the work of the school for artisans, which may be had upon application. Fredrick E. Turneaure is dean of the College of Engineering.

CORRESPONDENCE.

Great Britain.

London, March 19.—Since the commencement of the sittings of the Royal Commission on London Traffic many schemes have been put before it for improving the means of locomotion in the metropolis. Naturally several have been of a somewhat revolutionary character. For instance, one witness came before the commissioners with detailed plans and estimates for the provision of two new thoroughfares running at right angles to each other and affording accommodation for foot passengers, slow traffic, fast traffic, motor-car traffic, tramways, overhead railways and tube railways or subway tramways. These roads were "double deckers" and the cost of construction ran to many millions of pounds. Last week another witness strongly advocated the liberal use of overhead railways, and he also submitted a scheme for the construction of such a line to be carried from the west to the east of London over a canal which already exists. He also suggested another route from the northern suburbs to the city, carried over the existing steam railway—a line which he undertook to construct without in any way interfering with the working of the steam service below. Compared with tube railway construction his estimates were exceedingly low, viz., $600,000 a mile as against over $4,000,000 in the case of the last tube railway, the shares of which were offered to the public.

In considering this subject it is interesting to note that the model of an overhead railway of this description, built upon Mr. Behr's system, which will be sent to the St. Louis Exhibition, is now on view in London. The length of track of this model is 40 feet and it is built on a scale of three-quarters inch to one foot. There is one running rail with two guide rails on either side.

An experimental trip was made on Sunday over the electrified lines of the Lancashire and Yorkshire railway, and it is anticipated that the lines will be put into service in about a fortnight's time.

Reference was made a short time ago to the fact that the electricity works of the Poplar (London) Borough Council were so fully loaded that no further consumers could be connected up, but that one firm requiring a supply had threatened legal proceedings if it was not put on to the mains as requested. As a result, presumably, the borough engineer has submitted a report in which he recommends the provision of two 1,000-kilowatt sets and the necessary sub-station plant, involving an expenditure of over $300,000. It is anticipated that the whole of the plant will be running by the end of September. The committee has recommended that the scheme be adopted, and advertisements inviting tenders for the plant have accordingly been issued.

The Glasgow corporation has just decided to make application for a further loan of $250,000 for the purposes of the municipal telephone undertaking. Its borrowing powers up to date have been $1,500,000, of which only $75,000 is unspent. The money now to be borrowed is for connecting up new subscribers.

A bill has just passed through the House of Commons giving permission to the Dolter Surface Contact Company to lay its system of electric traction in Torquay. The measure was only opposed by the local gas company, which sought special protection from electrolytic action upon its pipes. This question has come up for discussion before committees of the Houses of Parliament, but in only a very few special instances has further protection to that afforded by the Board of Trade regulations been granted. In the case of the Torquay bill, the promoters rather prejudiced themselves by giving special protection to the corporation water mains (but only in order to obtain its consent to the bill, which is necessary under standing orders), and the committee decided that the gas company should be treated in a similar manner.

The tramways department of the Manchester corporation has paid $250,000 out of the tramway profits toward the relief of the rates. This is an increase of $100,000 over the sum similarly set aside in 1902.

The National Telephone Company is inviting public subscriptions for $5,000,000 four-per cent. debenture stock.

A bill has been passed in the House of Commons giving the North Staffordshire Railway Company, which also owns a canal running through the Midlands, power to adopt electric haulage on that canal.

G.

New York.

New York, March 26.—The main interest in legislation at Albany continues to focus upon the Niagara project, which seems likely to pass the Senate, and more than probably will be objected to by the governor. The real opposition to the Lockport and Ontario company's project is said to come from established traction and power interests, which, if the bill becomes law, will be debarred from extending the scope of their operations at the Falls.

Progress is reported with regard to the New York subway system. On Saturday afternoon last week Chief Engineer William Barclay Parsons was able to crawl through the aperture between the sections which meet near Fort Georgie, in the vicinity of One-hundred-and-nineteenth Street. The event marks the completion of the tunneling upon both subway lines on Manhattan. It is hoped to operate passenger cars as far as Fort George by the middle of June, and in another two months thereafter to connect with the Harlem River tunnel.

One of the traction incidents of the week was the burning of a Thirty-fourth Street surface car in front of the Waldorf-Astoria Hotel, the cause of the outbreak being apparently defective insulation. The car burnt vigorously for several minutes, but was at length extinguished by an impromptu bucket brigade. Another car fire this week occurred upon the Lexington Avenue elevated line, the cause in this case being the breaking of a shoe on the forward motor, thus creating a short-circuit. Before the flames could be put out the flooring of the car was burned through in several places.

The electrician at the Lyric Theater was called upon unexpectedly the other evening to play a part upon the stage, but either from bashfulness or a misunderstanding he let go the chance of achieving histrionic fame. In the exciting scene in "The Pit," where Wilton Lackaye reads off the quotations from a "property" ticker, the tape suddenly failed. The actor, as though it were part of the play, went to the O. P. exit and called the electrician by name to come on the scene and fix the tape, but the man of wire was not responsive, and the action of the play had to be delayed until his assistant could be procured to fix the instrument.

The Gustave S. Neu Company has been granted a charter of incorporation this week with a capital of $10,000. The business of the firm is in electrical supplies, and the registered directors are G. S. Neu, Marion Neu and W. L. Frank, all of New York city.

A truckdriver named Samuel McFadden has, during the last few years, brought various actions for personal injury against the local transit companies. In two previous cases compensation has been awarded him, but a new suit against the Metropolitan company came to a sudden close on Monday, when his counsel informed the court that he had been grossly deceived by his client as to the character of the alleged injuries. McFadden is now held under a charge of perjury.

D. W. W.

New England.

Boston, March 26.—The automobile show, which was held in this city last week, was a profitable one for the promoters. A large majority of the exhibitors displayed vehicles having other than electric motive power, but there were a number of excellent types of electrically equipped carriages.

Officials of the Hoosac Valley Street Railway Company and the selectmen of Williamstown have reached an agreement on the question of a route through the college town.

The Leominster, Shirley and Ayer Street Railway Company, which will connect at Ayer with the proposed route of the Lowell and Fitchburg, from Ayer to Concord, whence there is an existing line to connect with the Boston Elevated at Arlington, has had no trouble in projecting its line except at North Leominster, where there has been some hitch over certain rights-of-way desired over private lands. If plans mature as anticipated, a good route from Boston to Fitchburg, over lines aggregating only 47 miles, will be secured.

The directors of the Windsor Locks and Rainbow Street Railway Company have voted to apply for a change in the name of the corporation, making it the Windsor Locks Traction Company. The Connecticut railroad commissioners have approved the plans for the new line between Hartford and Springfield projected by the company.

The Postal Telegraph-cable Company has moved its main office in Boston from 234 Devonshire Street to the new India Building at 84 State Street, nearly opposite the main office of its rival, the Western Union company. The new station is one of the finest in the country.

Among the bills which the legislative committee having the matter in charge has reported upon favorably is one whose passage means much to the Boston Elevated Railway Company, for it provides for compensation to owners of property, on account of noise damage, if said property is on a street in proximity to the road. Heretofore the provision has been for abuttors only. Suits for damages amounting to millions are now pending, and it is estimated that attempts to collect many millions more would be made if this bill should pass both branches of the Legislature. It will encounter vigorous opposition, as a matter of course, from all the railway interests.

B.

Southeastern States.

Charlotte, N. C., March 26.—It is stated that the Georgia Traction Company has been successfully financed and that a line will be built between Athens and Cranesville, Ga. Mr. Van Wey of Toledo, Ohio, is president of the company.

By a new contract with the Consolidated Company of Charleston, S. C., that city will save over $5,700 on lights. This means the substitution of electricity for gas on certain streets. Arc lights are reduced from $97.50 to $80 per year, to be followed the next year by a reduction to $75.

The Birmingham (Ala.) Railway, Light and Power Company on March 21st decided to issue $10,000,000 of 4½ per cent. refunding bonds, to replace $6,000,000 of five per cent. outstanding bonds. One million will be used in the improvement of local properties and the remainder of the bonds will be sold from time to time, as needed.

It is given out that a representative of the Standard Electric Company of Cincinnati, a branch of the Western Electric Company of Chicago, has admitted the possibility of his company opening a branch in Atlanta in the future.

It is thought that at the April meeting of the county commissioners of Fulton County a franchise will be granted for an electric line between Atlanta, Ga., and Bull Sluice. The appliances for the city of Atlanta, Ga., in connection with the big electrical development at Bull Sluice have been bid upon and the bids are being closed by Consulting Engineer J. G. Rossman of the Georgia Railway and Electric Company. The appliances amount to about $75,000. The Westinghouse, General Electric and other well-known companies were among the bidders.

The Old Dominion and Great Falls Railway Company has bought a $23,000 site for its power plant in Washington, D. C. The electrical plant is hardly expected to be complete in three or four months.

L.

Texas and Mexico.

Austin, Texas, March 24.—Colonel Ike Pryor and son contemplate installing an electric-light and power plant at Uvalde, Texas. They are also arranging to establish a large irrigation plant near there.

An electric-light and power plant is to be installed at the State Prairie View Normal School, situated at Prairie View, Texas. Professor Brown of College Station, Texas, is interested.

It is reported that negotiations are in progress for the sale of the properties of the Federal District Street Railway in the City of Mexico to the Mexican Light and Power Company. The present owners of the street-railway system are Wernher, Beit & Co. of London, England. The Mexican Light and Power Company is composed of Canadian capitalists. The proposed consideration for the properties is said to be $18,000,000, Mexican money.

An American syndicate is negotiating for the purchase of the street-railway system at Mazatlan, Mexico. If the transaction is consummated, extensive improvements will be made.

An American syndicate has taken preliminary steps looking to the construction of an electric railway from Marfil, Mexico, to adjacent mines. It will be used primarily for transporting ore. Engineer Van Law, who is now at Guanajato, Mexico, is interested in the enterprise.

The municipal electric-light plant in Vera Cruz, Mexico, is to be sold at auction by the City Council.

The $4,000 bond of Fogarty & Dickinson of San Luis Potosi, Mexico, which that firm deposited with the city of Colima, as a guarantee that it would install an electric-light plant at the latter place, has been declared forfeited by the City Council for failure to fulfill its contract. The contract for installing the plant has been re-let to Ugarte & Garcia of Guadalajara. The proposed plant will cost $150,000. The contract calls for 60 arc and 500 incandescent lights for municipal purposes and 3,000 incandescent lights for business houses and residences.

The Velardena Mining and Smelting Company is installing a 3,000-horsepower electric power plant at Velardena, Mexico. The power will be distributed to the several mines which are operated by the company.

It is reported that John W. Gates, who has large property interests at Port Arthur, Texas, has subscribed to $20,000 of the stock of the company which is being organized to build an electric railway from Port Arthur to the docks. It is said that the construction of the road will soon be commenced. Mr. Gates is now at Port Arthur.

The municipal authorities of the City of Mexico have granted the Federal District Street Railway Company the authority to build a new street-railway line from La Merced to La Reforma, passing through the city.

John W. McKay, who is at the head of the American company which is operating a large meat-packing plant at Uruapan, Mexico, has obtained a concession from the government of the state of Michoacan to use the waters of the Uruapan River for operating a large electric power plant which he proposes to establish near Uruapan. This plant will afford the power for operating an electric railway which Mr .McKay and his associates intend to build from Uruapan to Los Reyes, a distance of 50 miles.

H.

Michigan.

Detroit, March 26.—There is a unique proposition on foot in connection with the building of another electric railway from Battle Creek to Gull Lake. It is proposed to have the farmers lay out their land along the projected line into five-acre farms and to put them on the market. It is claimed that there is a great desire among local mechanics and others doing business in the city to go on small farms and raise fruit, vegetables, etc.

The Common Council of Ann Arbor has complied with the request of the Michigan Milling Company for an electric-light and power franchise. The company will be required to put the wires underground within a radius of about one square mile. There is also an application before the council for the same privileges, from Frank D. Cornwell.

It is probable that the Mt. Clemens Common

Council will pass an ordinance requiring all electric-light, power, telegraph and telephone wires and cables to be put underground in terra-cotta conduits.

A new schedule is to be inaugurated on the Detroit, Monroe and Toledo Short Line, between Toledo and Wyandotte. Cars will be able to run through by April 1st, as the road is fully ballasted and equipped with overhead work as far as Sibleys.

The assessment made by the state tax commission of Michigan on the Detroit United Railways' machinery must, by ruling of the court, be paid.

C. G. W.

Indiana.

Indianapolis, March 28.—Two new interurban traction companies filed articles of incorporation last week. The Union City, Winchester and Muncie Traction Company, capitalized at $10,000, will build a line running from Union City to Muncie. Dr. J. E. Lowes heads the incorporators. The Evansville and Henderson Traction Company, capitalized at $10,000, proposes to construct an electric line from Evansville, Ind., to Henderson, Ky.; A. L. Rich of Cincinnati and J. E. Bohanon of Louisville, who recently purchased the Henderson street-railway system for $250,000, will build the line.

The Lake Shore Railroad Company is contemplating the purchase of the Lake James electric line, which extends from Angolia to Lake James, recently sold at a receiver's sale. The Lake Shore people propose to operate it as a spur, with steam power.

The City Council of New Castle has taken steps to pave South Fourteenth Street at a cost of $30,000, assessing the Indianapolis and Eastern Interurban Company $7,000. This is the third time within a year the company has been caught on paving expenses, and since the paving clause in its franchise was revoked by the old council there is a probability of the courts deciding the question of liability in this case.

Unprecedented floods throughout Central Indiana put a number of interurban lines out of service. A number of washouts stopped traffic, but the principal trouble was in the flooding of power houses and putting the fires out. At Anderson and Indianapolis dikes were built of sandbags to keep the waters from the boilers.

The Town Board of Cicero has granted a 25-year franchise to John Plain for an electric-light plant. Mr. Plain announces that he will at once put in a new and up-to-date electric-lighting system.

The faculty of Purdue University is preparing the exhibits which will be sent to the World's Fair. Among these is a special exhibit relating to electrical engineering in the Electricity Building. Professor Goldsborough is chief of the department of electricity, and the display from the Indiana college is likely to surprise many who are not familiar with the skill and facilities of the electrical department.

The Indianapolis Technical Club, the membership of which is composed of electrical and consulting engineers, has been invited to attend the engineering congress which will be held at St. Louis the first week in October. F.

Ohio.

Cleveland, March 26.—The Johnson bill, intended to turn the Miami and Erie Canal over to the Miami and Erie Canal Transportation Company, for the purpose of operating a steam railroad along the banks, met with defeat in the House of Representatives. By some it is believed that the electric-haulage plan can be worked successfully, and it has been asserted that this is the hope of canal transportation.

Senator Hypes of Springfield has introduced a measure in the Legislature providing that steam and electric railways shall interchange cars of freight, just as steam roads do now in the transaction of business. The bill aims to force steam roads to recognize electric lines in the transportation business.

W. T. Paul has taken the contract for building the new passenger station for suburban lines on the Public Square at Cleveland. Work will be begun on Monday. The station will cost something like $10,000.

The Sandusky Gas and Electric Company of Sandusky has been granted a franchise to furnish natural gas for lighting, heating and power purposes in that city. Barney Mahler of Cleveland is president of the company.

General Manager J. R. Harrigan states that the Newark and Zanesville line will be ready for operation within a few days. The road connects with the Columbus, Buckeye Lake and Newark traction lines at Newark and will give through service from Columbus to Zanesville.

The Cleveland Electric Railway Company has abandoned the plan of selling six tickets for 25 cents and gone back to the old plan of 11 for 50 cents. President Horace E. Andrews made a statement to the effect that the company had lost over $200,000 in the last eight months. The transfer system was no doubt the cause of considerable loss, as well as the reduction in the price of the tickets. A comparative statement shows that the percentage of increase grew gradually less from the time the universal-transfer system was inaugurated in June of last year, dropping from 11.71 in that month to .70 in October. Mr. Andrews contends that people would prefer to pay a fair price for the service and have it thoroughly up to date, rather than have a cheaper fare and poor service. An ordinance is now being prepared with the idea of getting the city officials and railroad company together on some kind of an agreement regarding renewal of franchises and fixing the fare.

The Tower Storage Battery Company of Cleveland has been incorporated with a capital stock of $10,000 by E. Robbins, Thad. Rowland, Jr., and others.

The Ohio Interurban Railway Association of Dayton has been incorporated. The names appearing upon the application are Harrie P. Clegg, E. C. Pring, J. H. Lerrill, R. E. DeWeese, A. W. Anderson, E. B. Gaum and Howard Fravel. This is the association that was organized at Dayton some time ago for the promotion of electric-railway interests and the discussion of matters affecting the management and construction of roads.

Rights-of-way have been secured for a part of the proposed line between Bucyrus and Marion, but nothing has yet been done in Marion County. The plans are to commence the construction work in April and have the line completed by December.

The formal opening of the Cincinnati, Milford and Loveland Traction Company of Cincinnati took place today. B. H. Kroger is the president of the company.

The bill giving police powers to electric-car conductors, both inside and out of the city limits, has passed the House of Representatives.

An ordinance has been passed by the village of Euclid, a suburb of Cleveland, giving a franchise to the Shaker Lakes and Boulevard Street Railway Company.

Police Judge Feidler of Cleveland has declared that the non-union men working at the Westinghouse plant there have a right to carry revolvers to protect themselves against molestation on the part of union men, who are out on a strike.

The Lorain Steel Company will furnish 10 cars of rails to the Southern Construction Company for roads about Defiance.

Georige R. Scrugham has purchased property for an addition to the present interurban station in Cincinnati. It is planned to make a depot to accommodate express as well as freight cars.

It is reported that the Oberlin Gas and Electric Company of Oberlin has asked that a receiver take charge of the property until such time as capital may be secured on the securities offered.

The Westinghouse company is negotiating with the Cincinnati, Dayton and Toledo Traction Company with a view to installing a new system of power that is said to be capable of making a saving of about one-third. The traction company, owing to the recent invention of the system, will hesitate to adopt it, so it is reported, unless a guaranty is furnished that it will be a success. O. M. C.

Northwestern States.

Minneapolis, March 26.—The Bay City (Mich.) Traction and Electric Company will install a storage-battery plant for its street-railway system at a cost of about $5,000.

C. A. Johnson will put in electric lights at Fairfax, S. D. He has a power plant already on the Niobrara River.

A. Belanger and R. B. Freedy have opened an electrical supply house at Virginia, Minn.

The retail dealers of Minneapolis contemplate applying for a franchise to put in an electric-light plant to furnish light to members of the association.

Donald Grant may put in a street-car line at Faribault, Minn., this spring.

The machinery has been installed in the new water and light station at Two Harbors, Minn., and the plant will be put in operation soon.

The Wisconsin Light, Heat and Traction Company is securing the right-of-way for a trolley line from Milwaukee to Elkhorn.

The Twin City Rapid Transit Company has in course of construction a double-deck observation car, to be used for sightseeing parties. The new car will be of the regulation length and will have a seating capacity of 104 and will be propelled by a 250-horsepower motor. If the car proves a success several others will be built this summer. R.

Pacific Slope.

San Francisco, March 24.—The General Electric Company has closed a contract for furnishing the searchlights which are to be installed on the three cruisers now being built at the Union Iron Works. There are to be six on each vessel, each with 30-inch reflectors.

The National Electric Company has moved from its office at the corner of Powell and Post Streets to 455 Sutter Street.

The Globe Electric Company has been incorporated in San Francisco by D. A. MacDonald, F. W. Post and others with a capital stock of $200,000.

The San Francisco Gas and Electric Company has prepared plans for increasing the capacity of the independent power house at the Potrero, now known as Station A, by installing generators having a total capacity of 10,500 kilowatts.

It is understood in financial circles that the California Gas and Electric Corporation has purchased the property of the South Yuba Water Company, which has a subsidiary corporation known as the Central California Electric Company. This company has three waterpower electric generating plants within a few miles of Newcastle, which aggregate several thousand horsepower in capacity. Transmission lines connect these plants with Sacramento. The plant completed last year also transmits current to Grass Valley in competition with the California Gas and Electric Corporation. Last year the Van Norden Trust Company arranged for an issue of $2,000,000 bonds, for use whenever it became necessary to raise funds for further development work. Dr. Charles Van Norden of Sacramento, who manages these companies in California, is now in San Francisco.

Herman N. Tracy of the Tracy Engineering Company, with headquarters on Fremont Street, San Francisco, has gone to Riverside for the purpose of making a proposition to the trustees of that place to install an electric plant in the present boiler and engine house.

The Los Angeles Pacific Company is enlarging its power plant at Vineyard Station, and the main station at Ocean Park is being dismantled. Preparations are being made for handling heavy traffic during the coming summer.

C. B. Churchill, proprietor of the Escondido Mills at Escondido, Cal., is contemplating the installation of a complete lighting plant and system.

After several months of inaction, the Mutual Electric Light Company of San Francisco is making preparations to proceed with the construction of its new electric generating plant. Additional switchboard apparatus and exciters have been ordered through the Wagner-Bullock Electric Company.

A movement is well under way at Rio Vista, Cal., by local capitalists which has for its object the installation of a lighting and power plant to cost about $15,000. A company is now being organized for the work. The plant will have an initial capacity of 1,000 lights.

The power house and lighting plant located at Loyalton, Cal., was completely destroyed last week during the heavy storm which raged along the coast. The plant will be rebuilt at once, but it will be about three months before it will be in complete working order. The loss is estimated at $25,000. A.

PERSONAL.

Oscar Hagen, assistant superintendent of the Helena (Mont.) Light and Traction Company, was instantly killed recently by coming in contact with a wire carrying 11,000 volts.

Edward Weston of Newark, N. J., in recognition of his work in electrical science, both for investigations and inventions, has received the degree of LL. D. from McGill University.

On March 25th 84 associates were elected to membership in the American Institute of Electrical Engineers, and Mr. J. P. Davis of New York city was transferred to full membership.

J. C. Smith has been appointed assistant manager of the Postal Telegraph Company at Detroit. Mr. Smith was formerly manager of the Grand Rapids office and is well liked by all who know him.

Arthur C. Kretz of Reading, Pa., civil engineer for the proposed Temple-Belton interurban electric railway, is at Belton, Texas, making a preliminary investigation of the route for the proposed road.

F. A. Brooks has resigned as manager of the Charleston Gas and Electric Company, Charleston, Ill., after 15 years of service. He will engage in the electrical supply and contracting business in Charleston, Ill.

Walter Stearns, assistant superintendent of the Waltham (Mass.) Electric Light Company, has accepted a position with the Fort Wayne Electric Works. He is a native of Waltham and a graduate of the Massachusetts Institute of Technology.

Retiring Superintendent A. C. Ralph of the Boston and Worcester Street Railway Company, was given a testimonial banquet at South Framingham, Mass., on March 22d, by a deputation of the employes. He was given the additional surprise of a presentation of a purse of gold.

Many friends will regret to learn that Mr. W. B. Driver, president of the Driver-Harris Wire Company of Harrison, N. J., is still in a serious condition as a result of a siege of typhoid fever. He is well and favorably known to a large number of people in the West, upon whom it has been his custom to call from time to time in the interest of his company.

Nelson Mills of Marysville, Mich., died on March 23d. He was actively connected with electrical interests in the state of Michigan, having been president of the old Lansing street railway and president of the St. Louis and St. Johns (electric) railway, and also connected with other large interests in the state. His estate is valued at about $1,500,000.

President Edgar of the National Electric Light Association has asked Dr. S. S. Wheeler to act as chairman of the committee to examine the papers of those competing for the gold medal offered by Past-president Doherty for the best paper on underground construction, to be presented at the Boston convention of this association. Dr. Wheeler has consented to serve, and the other members of the committee will be Mr. Louis A. Ferguson and Mr. H. G. Stott.

The Society of the Genesee in New York city, composed of former [illegible] in New York state, has adopted an appropriate memorial to its departed member, Mr. John B. O'Hara. It is said of Mr. O'Hara that "his comparatively short [illegible]

poraneous with the wonderful development and practical application of electricity and was typical of that development."

Frank G. Baum, formerly assistant professor of electrical engineering at Stanford University, has been chosen general superintendent and electrical engineer of the California Gas and Electric Corporation of San Francisco, which recently absorbed several large companies and which is now in full control of the local distributing companies around the bay. Mr. Baum will have charge of all construction work on the power plants, transmission lines and sub-stations of the company. He graduated from Stanford in 1898 and later took a position there as instructor. A year ago he resigned to become the assistant electrical engineer of the corporation of which he is now the chief engineer and general superintendent.

ELECTRIC LIGHTING.

The city of Waukomis, Okla., has asked the Enid Electric Light Company to extend its plant to that city. If this is done it will be the first city in Oklahoma receiving light and power from another town.

A corporation to be known as the Heat, Light and Power Improvement Company of America has been incorporated in New York city with a capital of $600,000. The directors are J. P. Lowery, Andrew Ritchie and C. T. Eldridge.

The electric lighting and heating station owned by the Presque Isle (Me.) Electric Light Company and the mill of the Aroostook Lumber Company were burned recently. The loss is estimated at not less than $40,000, on which there is a small insurance.

On the eve of the expiration of the limit set by the City Council of Geneseo, Ill., in which the Geneseo Electric Light Company might avail itself of the city's offer to purchase the light plant for $5,000, the mayor and the City Council of that city have been served with an injunction restraining them from making such a purchase; from entering into any new lighting contract until April 5, 1904, and until after the mayor and aldermen who shall be elected on that day have duly qualified.

The following-named companies are recent additions to the membership of the National Electric Light Association: Boulder (Colo.) Electric Light and Power Company, Cheboygan (Mich.) Electric Light and Power Company, Montevideo (Minn.) Electric Light and Power Company, Indianola (Miss.) Light, Ice and Coal Company, St. Joseph (Mo.) Railway, Light, Heat and Power Company, Bellevue (Ohio) Light and Power Company, Massillon (Ohio) Light, Heat and Power Company, Darlington (S. C.) Light and Water Company, Beaumont (Tex.) Ice, Light and Refrigerating Company.

ELECTRIC RAILWAYS.

The Metropolitan Street Railway Company of Kansas City, Mo., has more than 1,200 workmen employed on its Centropolis extension. C. N. Black, engineer in charge of the work, expects to complete the extension before harvest.

Electrical Engineer Babcock of the Southern Pacific Railway Company has prepared a report on the proposed converting of the Berkeley, Oakland and Alameda (Cal.) local lines into electric roads. He has also reported on the advisability of running commuters' electric trains between Berkeley and Palo Alto.

It is announced that an electric road will be built from Trenton, N. J., to the sea coast. Engineers, contractors and bridge builders interested in the project have examined the plans of the Trenton, Lakewood and Atlantic Railway Company, which is back of the proposed road, and it is said work will be begun at once.

The Chicago City Railway Company has completed the stringing of wires on Wabash Avenue and around the downtown loop which will accommodate the Indiana Avenue cars, which are to enter the business district independent of the Wabash Avenue cable. The portion around the corner of Michigan Avenue and Madison Street was quietly constructed on Saturday night and Sunday in order to avoid interference from Montgomery Ward, who objected to a similar undertaking a few years ago.

The newly elected officers and directors of the St. Louis Transit Company have decided to sell all real estate and other property not necessary to the operation of the street-car system. The systematizing of the various lines acquired by the present organization caused the abandonment of considerable property. The sale will be at auction, beginning on April 18th under the management of the Mercantile Trust Company. The property to be sold includes car sheds and barns, warehouses, business lots and numerous residence lots in Central, North, South and West St. Louis.

POWER TRANSMISSION.

The power developments at Lockport, Ill., for the utilization of the waterpower of the Chicago Drainage Canal are proceeding slowly. The excavation of the canal which will carry the water to the power house is under way. As yet the size of the units has not been definitely decided, but in a short time this will be done and bids for the apparatus called for. Until the size of the units to be used is adopted only tentative plans for the power house can be prepared. The high stage of the water in the Des Plaines River, which is 21.5 feet at the present writing, is hindering the excavation work.

The management of the York Haven Power Company, after hearing reports showing the extent of the recent damage by flood and ice to the big power plant at York Haven, Pa., has decided upon plans for putting the plant in operation within the next 60 days. The experts who made the reports estimated the damage at a sum not exceeding $10,000.

SOCIETIES AND SCHOOLS.

The Southern Supply and Machinery Dealers' Association will hold its third annual convention at Old Point Comfort, Va., on April 12th, 13th and 14th.

The attendance at Lehigh University, South Bethlehem, Pa., at the present time is 615, of which number 90 are taking the course in electrical engineering. Besides the regular course in electrical engineering, is one in electrometallurgy.

The fourth annual meeting of the Iowa Electrical Association to be held in the Savery House, Des Moines, has been postponed to April 20th and 21st. Secretary Porter of Eldora announces that the programme, an outline of which was given in the Western Electrician last week, is about completed.

Frank W. Frueauff, auditor of the Denver Gas and Electric Company, has been asked by President Edgar to report on office methods and accounting at the twenty-seventh convention of the National Electric Light Association, to be held in Boston May 24-27. Mr. Frueauff is a progressive young man, and as he is familiar with the up-to-date methods of keeping central-station accounts, including modern devices for saving time and insuring accuracy in office work, the report, which he has promised to prepare, is sure to be a valuable addition to the programme of the meeting.

PUBLICATIONS.

In a bulletin of late date issued by the Bullock Electric Manufacturing Company of Cincinnati are described Bullock type B motors, designed to meet the demand for small machines which can stand rough usage. The details of the construction of this style of motor are fully set forth in the bulletin, which gives complete data as to sizes, rating and weights which can be furnished.

Emerson fan motors for 1904 are described in a tasteful catalogue coming from the Emerson Electric Manufacturing Company of St. Louis. The fans are of different styles, designed to operate on alternating-current circuits. Ceiling and desk fans of one and two speeds are illustrated. The Trojan fan motor is another type manufactured by the same company and possesses all the characteristics of a pure induction motor and has no commutator or brushes. The latter is described in a separate catalogue.

The Sederholm boiler, built by the Allis-Chalmers Company of Chicago, is described in a catalogue of more than passing interest. The catalogue contains several pages relative to the requirements of a good boiler, what the grate area should be, the proportion of the heating surface to grate area, etc. Following this is good practical information on the installation of boilers. In the back of the book are tables of the properties of saturated steam, factors of equivalent evaporation, contents of pipes of various diameters one foot in length, given in cubic feet and gallons, table of mean effective pressures in non-condensing Corliss engines of different cut-offs, measures of work power and duty and a table of barometric readings.

Two bulletins from the Jeffrey Manufacturing Company of Columbus, Ohio, treat respectively of electric coal-mining locomotives and storage-battery industrial locomotives. Three types of the former are illustrated, one being a four-ton locomotive for thin veins, which is built low for operation in cramped quarters. The second type weighs 12 tons and is used for drawing the heavy trains of ore. The third type is a gathering locomotive used for sidings where there is no trolley wire; it derives its current from a flexible conductor wound on a drum. The industrial locomotives described in the other bulletin are built as high as 12,000 pounds in weight with a draw-bar pull of 1,500 pounds. Usually the battery is carried on the locomotives, but in one instance illustrated it is drawn on a tender.

The Westinghouse Electric and Manufacturing Company of Pittsburg is abreast of the times, as is shown by the issue of a bulletin on single-phase railway motor and car equipment. The new motor is known as No. 91 and the bulletin contains a complete description of the motor and its parts, also the auxiliary apparatus necessary to equip a car for its use. Diagrams are also embodied showing the general arrangement of apparatus in an alternating-current railway system and the method of making connections on the car, including the controller, induction regulator, etc. Another bulletin appeared at the same time concerning type L motors for electric-crane and similar work. Besides a general description of this type of motor the bulletin contains dimension drawing and numerous curves of operation taken for various sizes of motors.

The Northern Electrical Manufacturing Company of Madison, Wis., is sending out two bulletins well worthy of note. One of these is upon motor-operated valves. The use of motors for the operation of valves to any great extent dates back only a few years. The use of motors for this purpose presents many advantages, especially in the case of large valves, which require a large amount of manual labor in turning by hand. Valves can also be controlled from a central point, which is a decided advantage. The Northern company has perfected a system of its own, which is fully described in bulletin No. 34. Another bulletin, No. 35, treats of a variety of small motors for different purposes, including a vertical motor designed especially for mounting on tools and in awkward places where the ordinary geared or belted motor would be found difficult to install.

MISCELLANEOUS.

The directors of the Cunard steamship line have officially confirmed the report that they have decided to adopt turbine engines for the new steamers to be built under agreement with the British government.

The various electric-wire-using companies of St. Louis are endeavoring to have the Board of Public Improvement defer all action on the extension of the underground-wire district until after the exposition period.

A bill has been introduced in Congress by Representative Roberts to form, under the Department of Commerce and Labor, a new bureau, to be known as the Bureau of Commercial Registration, with a chief to be known as the registrar of commercial marks, to whom it is proposed to pay a salary of $3,000 annually.

Attempts to cure cancer by means of radium are said to have been entirely abandoned in London hospitals. The authorities are, however, devoting more time and money than ever to the perfection of the high-frequency and light treatments, great efforts being made to reduce the waste of electrical power which is very marked in the present apparatus.

A Philadelphia firm has just been awarded the contract for the complete mechanical and electrical equipment of new Camden County courthouse—a building which will cost in the neighborhood of $700,000. The equipment consists of boilers, engines, generators, switchboard, steam piping, heating and ventilating systems, with Johnson temperature regulation, motors, electric elevators and electric wiring for light and power.

A question to be decided by the voters of Chicago next Tuesday will be the disposition of the Mueller bill. This enabling act of the Legislature does not become a law in any municipality until adopted by the voters at a general election. Its adoption would give the municipality authority to bring about municipal ownership of street railways if the voters at some future date, by a substantial majority, favor a traction bond issue.

A committee of consulting engineers acting for the National Board of Fire Underwriters in a report to that body upon gasoline-vapor lamps among other things makes the following statement: "The principal danger from these gasoline devices is in having the gasoline about. At ordinary temperature gasoline continually gives off inflammable vapor, and a light some distannce from the material will ignite it through the medium of this vapor. The vapor from one pint of gasoline will make 200 cubic feet of air explosive. It depends upon the proportion of air and vapor whether it becomes a burning gas or destructive explosive."

TRADE NEWS.

The annual meeting of the General Electric Company will be held on May 10th.

The Sawyer-Man Electric Company, which is under the control of the Westinghouse interests, makes the important announcement that it will not join any incandescent-lamp combination, but will remain independent.

The accounts of Receiver George R. Beach of the Storey Motor and Electric Company of Harrison, N. J., have been approved by the Court of Chancery and the final dividend declared. In all, the creditors of the company received 47 per cent. in dividends, and all the preferred creditors with claims amounting to $3,500 were paid in full.

The land and buildings owned by the James Cooper Manufacturing Company of Montreal have been purchased by the Canadian Bullock Electric Manufacturing Company. A new factory has just been erected on the site, consisting of a main shop 450 by 100 feet, a foundry, pattern shop and power house, the whole covering 13 acres.

The supervising architect of the Treasury Department, Washington, D. C., will receive sealed proposals until April 26th for the construction (including heating apparatus, electric conduits and wiring) of the postoffice at Logansport, Ind., in accordance with the drawings and specification, copies of which

may be had at the office of the postmaster at Logansport.

Louis F. Mahler, formerly western manager of the De Laval Steam Turbine Company and the St. Louis manager of the Bullock Electric Manufacturing Company, is now representing the Buckeye Engine Company of Salem, Ohio; International Steam Engineering Company of Atlanta, Ga., and New York, N. Y., and the Chase-Shawmut Company of Newburyport, Mass., at 1008 Chemical Building, St. Louis, Mo.

In a report of the British Chamber of Commerce of Egypt the opinion is expressed that among the various fields of enterprise in that country that offer opportunities in the present and are susceptible of indefinite extension in the future the trade in electrical appliances occupies a prominent position. Though manufacturing will never be of prominence in Egypt, there is a great field for electric appliances for traction, lighting and communication.

Sealed proposals are invited until April 9th for electrical work at Fort D. A. Russell, Wyo., as follows: For wiring buildings, furnishing and installing fixtures, wattmeters, etc.; for constructing primary, secondary and arc lines, furnishing and installing transformers, cut-outs, street-light hangers, street lights, etc. All proposals previously received for the above work have been rejected. Full information, plans, specifications, etc., will be furnished upon application to Capt. W. S. Scott, U. S. A., Cheyenne, Wyo.

The Perkins Electric Switch Manufacturing Company of Bridgeport, Conn., announces that the United States Circuit Court for the Eastern district of Pennsylvania has handed down an opinion sustaining the Perkins socket patent No. 626,927 against the Yost socket in the suit of the Perkins company against J. F. Buchanan & Co. The court has directed the issuance of an injunction against the defendants selling the Yost sockets, and the case is to be referred to a master to ascertain profits and damages to be awarded to the complainant.

The Standard Underground Cable Company of Pittsburg announces the recent opening of a branch office or headquarters in the Security Building, St. Louis, in charge of W. A. Caldwell, who was formerly connected with the Chicago office of the company but more recently with the home office at Pittsburg. Mr. Caldwell has had a number of years' experience in both the construction and sales departments. This enterprising company has now seven district or branch offices throughout the country, covering the whole of it from Maine to California.

The Nernst Lamp Company of Pittsburg has recently established district offices at St. Louis, Mo., and Denver, Colo. The St. Louis office, embracing the southwestern territory, is located at 908 Pine Street, with H. M. Reed as district sales manager. The Denver office, covering the middle western territory, is located at 1619 Glenarm Street, with R. D. Marthens as district sales manager. These offices will carry a complete stock of Nernst lamps and supplies and will be provided with attractive exhibition rooms, in which will be shown the different types of Nernst lamps in actual operation and in comparative tests with other illuminants.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until April 12th for furnishing the navy yards at Norfolk, Va., and Pensacola, Fla., with a quantity of arc lamps, electrical supplies, conduit and fittings, rubber-covered wire and weatherproof cable. The bureau is also inviting sealed proposals until April 26th for furnishing the navy yards at Portsmouth, N. H., Boston, Mass., and New York, with one 24-inch electrically driven engine lathe; one electrically driven deck winch; seven 20-horsepower electric motors. Blank proposals will be furnished upon application to the navy pay offices in the above-mentioned cities or to the bureau at Washington.

BUSINESS.

Owing to increased demand for their various specialties, which include the well-known Wrigley toggle-bolt, Thos. Wrigley & Co. of Chicago have recently enlarged their shop and are now enabled to give all orders prompt and careful attention.

The Electric Appliance Company, Chicago, is so elated at the hit it is making with Zenith lamps that nothing else seems of interest. War news palls. Politics are as nothing. Zenith lamps and Zenith lamps only form the topic under discussion in that quarter.

The Fibre Conduit Company of Orangeburg, N. Y., and Chicago is sending out an interesting series of mailing cards, showing on one side a picture of the company's factory and on the other illustrations and description of underground constructions as done with fiber conduit.

The switchboard illustrated in the Western Electrician of March 19th in connection with the article upon the Zanesville Railway, Light and Power Company's plant was made by the General Incandescent Arc Light Company of New York city, which also furnished the alternating-current switchboard for the same plant, not shown in the illustration.

The Central Electric Company of Chicago has issued a new price list, dated April, 1904. This price list applies to the company's last catalogue, and in it are quoted the latest discounts and prices prevailing on all electric material. It is quite an attractive little book, and the company requests that all purchasers of material who have not received a copy will write for one.

The Driver-Harris Wire Company of Harrison, N. J., makes besides its already well-known Climax high-resistance wire and Advance resistance wire, which is especially adapted for measuring instruments, a line of other resistance wires for various kinds of work. A neat catalogue is issued giving data and other valuable information, which may be had upon application.

The V. R. Lansingh Company of Chicago, western distributer for the well-known Holophane Globes and Pagoda reflectors, manufactured by the Holophane Glass Company of New York, is sending to its customers and friends a war map of Japan, Korea and Eastern China. The Lansingh Company states that the demand for Holophane products has steadily increased, and at the present time the company's capacity is being taxed to its utmost to fill orders.

The Northwesern Electric Company of Chicago is at present in a good position to furnish second-hand dynamos, motors and instruments, and is specially equipped for repair work of any kind in connection with electric power and lighting. The company has recently taken the sole agency for Atlas Coperine, a compound for commutators, for which highly satisfactory results as a lubricant and spark preventative are asserted.

For the season of 1904 the Northern Pacific announces a great reduction in rates from Chicago, St. Paul, Duluth and other northwestern points to and through Yellowstone Park. Each of the park hotels now has a capacity for 250 guests, is electric lighted, steam heated and has a good orchestra. The route by the Northern Pacific is via Livingston and Gardiner. Chas. S. Fee of St. Paul, Minn., is the general passenger agent of the Northern Pacific.

Sales Manager John W. Brooks of Pass & Seymour, Solvay, N. Y., has just returned to the home office after a two months' western trip, covering the company's various agencies. Mr. Brooks left Solvay, N. Y., about January 11th and visited Clyeveland, Toledo, Cincinnati, Indianapolis, Chicago, Milwaukee, Minneapolis, St. Paul, Duluth, Denver, San Francisco, Los Angeles, San Antonio, New Orleans, St. Louis and a number of other cities. Mr. Brooks found the demand for P. & S. porcelain and other specialties to be exceedingly good throughout the western section. In fact, it was the large increase in P. & S. output that necessitated the appointment by Secretary and General Manager B. E. Salisbury of a general sales manager to handle from Solvay the largely increased business.

The Crawfordsville Electric Company, Crawfordsville, Ind., is now building a 200-kilowatt Hornberger-Irwin revolving-field alternator for the Lexington (Mo.) Gas and Electric Company. This machine is an improved type, just placed on the market by the Crawfordsville Electric Company. It is a 60-cycle machine and is run at 180 revolutions a minute. This alternator will be direct-connected to a 250-horsepower tandem-compound condensing Alfree engine. The company is also building for Farmersburg, Ind., a complete alternating system. The plant in this case consists of a 75-kilowatt Hornberger-Irwin alternator, a full equipment of transformers and a Hornberger-Irwin alternating-current regulator. The Crawfordsville company says that it is now prepared to build these alternators in sizes from 35 to 500 kilowatts. These machines possess several features that will be appreciated by the practical man. The method of magnetically balancing the rotor so that it revolves, so to speak, in a balanced magnetic condition is a valuable characteristic. By thus balancing the rotor the difficulties arising from end thrust are overcome.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) March 22, 1904.

754,968. Telephone. Martin C. Burt, Chicago, Ill. Application filed March 17, 1903.

A diaphragm carries a series of ring armatures, a series of magnets being arranged respectively one within the other and having their cores adjacent to the armatures. Circuits connected with the magnets, and a single switch, designed to close the circuits of one or more of the magnets, complete the apparatus.

754,969. Storage Battery. Martin C. Burt, Chicago, Ill. Application filed August 13, 1903.

In combination with a battery cell are means for forcibly expelling the gases therefrom, comprising an open air conductor leading into the interior of the cell. Air is forced through the conductor, and a perforated hood or baffle is supplied, into which the gases pass previous to their discharge. (See cut.)

754,980. System of Speed Regulation for Motor-driven Machinery. Gano S. Dunn, East Orange, N. J., assignor to the Crocker-Wheeler Company, Ampere, N. J. Application filed August 20, 1903.

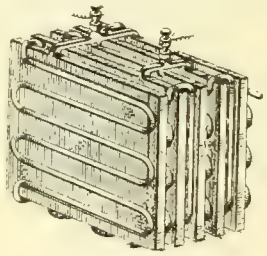
Together with a motor and means for supplying current thereto to drive it at various speeds, covering a predetermined range, is a driven shaft and a number of gears adapted to connect the motor to the driven shaft, the speeds obtainable with each successive gear train, beginning with the slowest, covering substantially from one-third to two-thirds of the range of the next succeeding faster train.

755,029. Armature Winding or Coil. Frank A. Merrick, Johnstown, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed November 9, 1899. Renewed December 16, 1901.

An armature coil or winding has straight parallel sides, lying in radially converging planes, the conductors composing the sides passing from one side to the other by end portions having arms bent obtusely to the respective sides and extended in a cylindric plane concentric with the axis of the armature and thence carried inwardly toward each other transversely across the ends of the armature. The two arms are connected by short compound bends, whereby the inner wire of one arm becomes the outer wire of the other arm, and vice versa. (See cut on next page.)

755,032. Apparatus for Wireless Transmission of Energy. Daniel M. Moore, Newark, N. J. Application filed April 18, 1903.

A vacuum break of a condenser and a spark gap are in parallel. A transformer included in the apparatus has one winding in a branch around the vacuum break, while the other winding is connected to the condenser and spark gap.



NO. 754,969.—STORAGE BATTERY.

755,048. Automatic Circuit-closer. James L. Russell, Boston, Mass. Application filed November 2, 1903.

A fluid is contained in a hollow walking beam. Two heaters in the shape of incandescent lamps are placed one under each end of the tube. When the current is turned on one lamp glows, heating up the liquid, which, by expanding, destroys the equilibrium of the tube, which is tilted over, making the circuit of the other lamp and breaking that of the first. Thus the lamps are made to glow alternately. (See cut on next page.)

755,054. Service Meter for Telephone Lines. Charles E. Scribner, Chicago, and Frank R. McBerty, Evanston, Ill., assignors to the Western Electric Company, Chicago, Ill. Application filed April 2, 1900.

A polarized magnet and switch contacts control the current through the transmitting telephone. A catch is carried by the armature of the magnet, a manually operated push and a service meter is operated by the catch. A lever also operated by the push is adapted to be brought into engagement with the catch, and means controlled by the lever destroy the control of the polarized magnet over the current through the telephone.

755,091. Telephone Transmitter. Joseph A. Williams, Cleveland, Ohio, assignor to the Williams Telephone and Supply Company, Cleveland, Ohio. Application filed April 10, 1903.

The essential parts are a mouthpiece, a casing, a diaphragm arranged in the casing, a carbon receptable, a cone-shaped stud formed on the outer surface of the receptacle, a bridge spanning the casing, and a flat spring secured at one end to the bridge and having an eye formed in its other end and arranged to receive the end of the cone-shaped stud.

755,092. Line-wire Clamp. Herman C. Willitz, Janesville, Wis., assignor of one-half to Henry Mulberger, Watertown, Wis. Application filed October 17, 1903.

Combined with the outer line wire is an inner house wire, whose end is wrapped around the line wire. A spring clamp is folded over the wrapped wire, and held tightly against it, whereby a positive electrical connection is obtained without the use of solder.

755,121. Electrical Apparatus for Therapeutic Purposes. Frederick C. Fisher, Bristol, England. Application filed September 21, 1903.

Contact plates connected to the terminals [illegible] of induction coils are arranged in a belt, so that when worn next to the body current flows through the tissues from one plate to the next.

755,125. Alarm Device. William Friedberg, New York, N. Y. Application filed November 11, 1903.

Two contact devices in an electric circuit are adapted to be pressed together by [illegible] a bell.

755,127. Electric Selective System. Julien A. Géhrung, St. Louis, Mo. Application filed February 8, 1902.

Means for sending varied or diverse electrical impulses along the main line [illegible] valved, together with [illegible] in circuit with the main line, and arranged in pairs with different [illegible] of electromagnets [illegible] an electromagnet, having a like electromagnetic [illegible] ceeding pair. [illegible] pendently controlled by [illegible]

a series of signal devices arranged in locations remote from each other, cooperate with a series of local circuits, each one of which embraces a signal device, and a selective circuit closer. (See cut.)

755,140. Electric-railway Signal. Bertram M. Kershner, Pittsburg, Pa. Application filed June 21, 1902.

A signaling wire extending over one block or division of the road is normally grounded at each end, a switch for disconnecting one end of the signal wire from the ground connects it to the source of current supply. Two magnets operate the switch, one connected to a contact for setting the signal and the other to a contact for restoring it.

755,141. Electrical Switch Mechanism. Hubert Krantz, Brooklyn, N. Y. Application filed June 29, 1903.

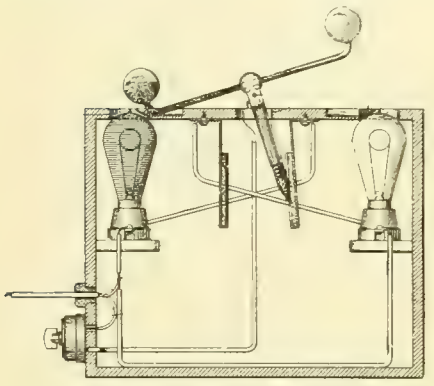
Bus bars, approximately flat cross bars and switches are the essential features. Means are also supplied for supporting the cross bars edgewise to the bus bars, and adapted to make electrical connection between the cross bars and bus bars; the ends of the cross bars forming contacts for the switches.

755,142. Storage-battery Construction. Simon Lake, Bridgeport, Conn. Application filed December 17, 1903.

A storage-battery cell comprises a series of plates of opposite polarity and sectional bus bars built up of component members permanently connected with the plates of like polarity with interposed distance pieces.

755,165. Electric Switch. Ashley P. Peck, Milwaukee, Wis., assignor to the Hart & Hegeman Manufacturing Company of Hartford, Conn. Application filed September 21, 1903.

A base of insulating material carries stationary spring contacts and rotatory contacts adapted to make and break contact with the stationary spring contacts. Barriers of insulating material extend upwardly from the base and inclosing a section of the path of the rotatory contacts between, but not inclosing the stationary contacts.



NO. 755,048.—AUTOMATIC CIRCUIT CLOSER.

755,168. Apparatus for Recording Statistical Data. Charles F. Pidgin, Boston, Mass. Application filed August 17, 1899.

Electrically operated valves open and close the outlets of a tank used in performing hydraulic experiments.

755,173. Electropneumatic System of Driving. Johann Sahulka, Vienna, Austria-Hungary. Application filed April 18, 1903.

For electrical power plants, electrical railways in particular, a driving axle with a pneumatic motor, or with a group of such motors, for starting, is used. An electric motor, or group of motors is used for the ordinary driving, both motors being in connection with each other by means of only the driving axle.

755,203. Electromagnetic Rail Brake. Karl A. Wilde, Hamburg, Germany. Application filed December 1, 1903.

Several pole pieces, provided with interfitting tubular extensions, carry brake shoes. Coil boxes are mounted on the extensions between the pole pieces with means to prevent angular movement and longitudinal displacement of the pole pieces.

755,229. Coil for Electromagnets or Other Purposes. Friedrich Klingelfuss, Basle, Switzerland. Application filed September 28, 1900.

The wire windings of the coil are wound in spirals on disks arranged perpendicular to the axis of the coil and consisting of insulating material, these spirals proceeding alternately, plainly or in echelon, thus forming layers perpendicular to the axis of the coil. The value of the insulation between every two conductor parts is proportional to their tension difference, the coil being wound in one piece of any length, running by turns alternately from outside to inside and oppositely at each change forming a layer.

755,281. Electric Time Switch. Joseph Dilhan and Ernest de Mersanne, San Francisco, Cal. Application filed August 27, 1903.

Groups of gas jets, with a number of wires, each having a number of breaks therein, are placed adjacent to corresponding gas jets, with means for introducing the wires in succession into an electric circuit, and means for starting and stopping an electric current in the circuit.

755,282. Electromagnetic Separator. Myron Dings, Milwaukee, Wis. Application filed May 23, 1903.

A pair of rigidly connected magnetizable rings are separated by non-magnetic material, and supported from the shaft. An electromagnet has one pole piece in proximity to one face of one of the rings, and the other pole piece in proximity to a face of the other ring, substantially at right angles to the face of the first-mentioned ring.

755,297. Automatic Circuit-breaker for Electric Time or Other Switches. Arthur W. Hutchins, Providence, R. I. Application filed May 15, 1903.

Contact members or brushes are connected with or cut into the conducting wires of an electric circuit. A movable disk or member is provided with independent conducting plates in engagement with the brushes to maintain a normally closed circuit. An insulated or non-conducting member, arranged with respect to and moving in unison with the disk, is capable of passing between the brushes and conducting plates to open a circuit. A switch interposed in the electric circuit is adapted to control the action of the circuit-breaker.

755,305. Peaked-wave Wireless Transmission. Daniel M. Moore, Newark, N. J. Application filed June 14, 1902.

The method described of producing waves of radiant energy in space telegraphy or power transmission consists in impressing upon the ether repeated changes of electrical potential or polarization, which, graphically described, would be a series of waves of highly peaked form.

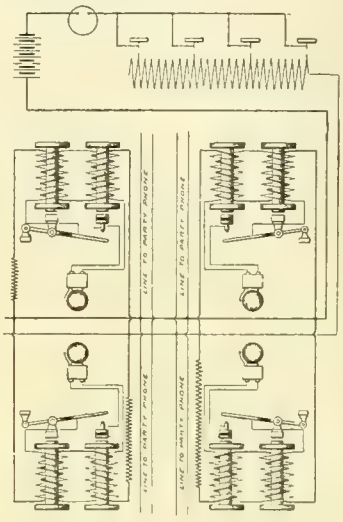
755,306. Electric Tube Lighting. Daniel M. Moore, Newark, N. J. Application filed January 19, 1903.

The lamp is composed of a sealed tube or receiver of glass having internal electrodes, a protective casing and transformer whose secondary terminals are contained in the casing and are there in immediate union with the leading-in wires or conductors for the lamp.

755,307. Electric Tube Lamp. Daniel M. Moore, Newark, N. J. Application filed February 6, 1903.

A transformer, an inclosure, a tube containing a gas adapted to be rendered luminous and means supported by the portable structure carrying the transformer for supporting the tube are the principal features.

755,308. Service Meter for Telephone Lines. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed July 16, 1900.



NO. 755,127.—SELECTIVE SYSTEM.

Combined with two telephone lines extending from sub-stations to a central-office switchboard are means at the central office for connecting the lines together. A signal indicator is located at the sub station of one of the lines, with means controlled by a switch at the central office for actuating the signal indicator. Electromagnetic mechanism controlled by the flow of current in the other line operates the switch. The flow of current in the last-mentioned line may be determined by suitable means at the sub-station.

755,367. Static Electric Machine. Ernest E. Fewkes, Newton, Mass., assignor of one-half to Frederick W. Cole, Newton, Mass. Application filed June 1, 1903.

Collecting combs carry resistance devices connected to the terminals, comprising two members, one of which is movable relative to the other, each having alternately disposed insulated spherical ends. An arm attached to the movable member, with a longitudinally movable bar loosely connected to the arm, and means for holding the bar in whatever position it may be set are the other features.

755,384. Clamping Device for Glue Presses. Albert E. Palmer, Norvell, Mich. Application filed December 19, 1903.

An appliance for use in testing for electric currents comprises a rod of insulatory material provided with a coating of a substance of low electrical conductivity, and means at one end of the rod rendering the end more highly conductive than the remainder of the rod.

755,391. Electric-railway Shoe. Henry Rosenfeld, New York, N. Y. Application filed August 19, 1903.

The shoe has a rib on its under side, the sides of the rib being divergent, and a weight-holding box on the upper side of the shoe at its forward end.

755,393. Electric Connection. Frank J. Russell, New York, N. Y. Application filed November 6, 1903.

A conduit-outlet of a terminal box is formed with a number of reversible bracket angle plates, together with means for securing the angle plates to the conduit outlet in different positions, whereby the terminal box may be secured to the conduit outlet at different distances from the center of the former.

755,460. Electric Locomotive. William Dalton and Francis J. Cole, Schenectady, N. Y., assignors to the American Locomotive Company, New York, N. Y. Application filed November 17, 1903.

In an electric locomotive are combined two main supporting trucks, driving axles journaled in bearings in the trucks, electric motors, each supported on one of the trucks and adapted to rotate one or more of the driving axles, coupling mechanism by which the trucks are connected with the capability of relative horizontal movement, but held rigidly in a longitudinal vertical plane, and a cab-supporting frame, which is carried upon the trucks with the capacity of relative horizontal movement.

755,468. Rheostat. Arthur C. Eastwood, Cleveland, Ohio. Application filed December 21, 1903.

A resistance section consists of a metallic supporting body, with a resistance material wound thereon electrically connected to the body, with a piece for making electrical contact also connected to the body.

755,515. Counting System for Telephones. Johann H. Meyer, Magdeburg, Germany. Application filed May 26, 1902.

The system comprises a counter, an electromagnetic switch having coils, polarized cells bridging the coil terminals, a set of instruments, connections from the switch terminals to the central station, a manually operated switch, an automatic relay at the central station, and means for causing a break in the otherwise completed circuit from calling to called subscriber at the relay before the operation of the counter.

755,537. Coil for Dynamo-electric Machines. Ferdinand Porsche and Ludwig Lohner, Vienna, Austria-Hungary. Application filed July 11, 1902.

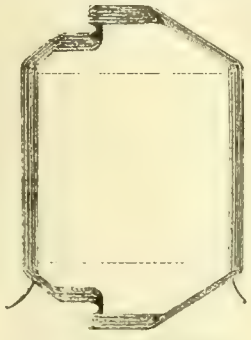
A process of manufacturing spools or coils for dynamo-electric machines out of a metallic band and a band of insuating material is described, which consists in winding the bands in laminated arrangement together into the form of a coil, and afterwards cutting away the superfluous portions, in order to give the coil the required concavo-convex form.

755,563. Automatic Controlling Device. Jacob S. Cole, Allegheny, Pa. Application filed July 15, 1903.

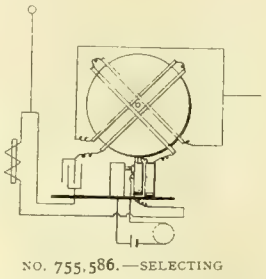
A driving motor is geared to a shaft and an electric circuit is connected with the motor. An oscillating arm controls the circuit and a circuit-shunting device is connected to the rotatable shaft. The shunting device comprises separate contacts connected respectively to the field coils and both brushes of the armature, while a resistance between the field coil contacts shunts the circuit to the motor at a predetermined time.

755,577. Electric Vibrator. William MacMillan, New York, N. Y., assignor of one-half to Egbert Winkler, New York, N. Y. Application filed July 29, 1902.

Combined with an armature are electromagnetic means located on each side of the armature, adapted to operate the armature and cause the vibrations desired.



NO. 755,029. ARMATURE COIL.



NO. 755,586.—SELECTING ELECTRICAL IMPULSES.

755,586. Method of Selecting Electrical Impulses. Daniel W. Troy, New York, N. Y. Application filed July 11, 1903.

The method of selection suggested by the inventor consists in causing a phase difference between currents produced by electromagnetic waves in receiving conductors by means at the receiving station related to and capable of causing a given phase difference at the frequency of the waves desired to be selected. By the phase-differing currents so produced responsive apparatus, operative only at substantially such given phase difference, is effected. (See cut.)

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on March 29, 1904:

[illegible] Watchman's Time Recorder. Edward J. Colby, Chicago, Ill.
360,024 Galvanic-battery Solution. William P. Kookogey, New York, N. Y.
360,025 Electric Signal System. Carvosso Lambdin, Wilmington, N. C.
360,030 Armature for Dynamo-electric Machines. William A. Leipner, Lynn, Mass.
360,040 Apparatus for Suspending Electric Lights. George P. Nichols and Moses Coombs, Jr., Youngstown, Ohio.
360,060 Electric Car Brake. Elmer A. Sperry, Chicago, Ill.
360,068 Telephone. Henry E. Waite, New York, N. Y.
360,078 Primary Electric Clock. John J. Abell and Clarence B. Gifford, Colesburg, Ky.
360,092 Secondary Electric Clock. Wirt B. Harvey, Memphis, Tenn.
360,122 System of Electric Distribution. Elihu Thomson, Lynn, Mass.
360,123 Electromagnetic Cut-off. Elihu Thomson, Lynn, Mass.
360,124 Automatic Cut-off. Elihu Thomson, Lynn, Mass.
360,125 System of Electric Distribution. Elihu Thomson, Lynn, Mass.
360,144 Electric Furnace. Eugene H. Cowles and Alfred H. Cowles, Cleveland, Ohio.
360,151 Electric Arc Lamp. Luther Hanson, Halifax, County of York, England.
360,158 Galvanic Battery. Paul Jablochkoff, Paris, France.
360,175 Electric Railway Signal. Joseph McM. Scott, Allegheny, Pa.
360,225 Electrical Apparatus for Heating and Cooling Buildings. Edward H. Johnson, New York, N. Y.
360,244 Electric Lamp and Socket. Charles G. Perkins, Hartford, Conn.
360,252 Lamp Post and Signal. William C. Smith, New Haven, Conn.
360,254 Electric Arc Lamp. John Tregoning, Hartford, Conn.
360,258 Dynamo-electric Machine. Henry E. Walter, Clifton, and Charles Batchelor, New York, N. Y.
360,259 Dynamo-electric Machine. Henry E. Walter, Clifton, and Charles Batchelor, New York, N. Y.
360,266 Annunciator and Shunt Circuit Therefor. John A. Barrett, Brooklyn, N. Y.
360,308 Electroacoustic Apparatus. Adolphus A. Knudson, Brooklyn, N. Y.
360,375 Automatic Electric-circuit Controller. Thomas P. Conant, Brooklyn, N. Y.
360,[illegible] Electric Arc Lamp. Walter A. Crowdus and Henry M. Sutton, Dallas, Tex.
360,381 Electric Indicator. Frederick K. Fitch, New York, N. Y.
360,[illegible]8 Induction Coil. Otto T. Blathy, Buda Pesth, Austria-Hungary.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, APRIL 9, 1904 No. 15

Lombard-Gérin Auto-trolley System.

Trackless-trolley or auto-trolley systems, as they are sometimes called, are designed to afford a simplification of the traction problem, especially as applied to the shorter lines. While the trolley car is well adapted for large cities and suburban lines, it is not as favorable for short lines where the traffic is less and thus does not in many cases justify the expense of first installation. A large part of the expense comes from the laying of the track, and an amount of capital is invested which does not always meet with a return. The automobile omnibus is a solution of the problem thus presented. The gasoline system, as applied to heavyweight vehicles and omnibuses, has lately obtained considerable success in the different competitive trials, but experience seems to show that the results obtained in practice are not what might be expected from the high quality of the mechanism. The steam or gasoline motor, in fact, is not well adapted to meet the demands of a continuous traction service with large omnibuses, and the maintenance in regular service becomes a large item of expense. The electric automobile would be the ideal for this kind of a system were it not for the fact that the dead weight and up-keep of the accumulators militate against this class of vehicle. The system devised by Lombard-Gérin is intended to overcome the difficulties inherent in electric vehicles, and in fact has proved quite successful upon a number of lines in France and Germany which are now in operation. It was described briefly in the Western Electrician three years ago, but the present article, showing various features developed in practice, will be of supplemental interest.

The omnibus is propelled by an electric motor, but the current is taken from an overhead line alongside of the road by a special form of trolley. An ordinary trolley device running under such conditions becomes practically impossible, as when drawn along by the vehicle in a variable direction it is almost always sure to stick or leave the wire, and this solution, which has often been tried, has never met with success. In the system under description the carriage running on the trolley wires is not drawn by the omnibus, but is provided with a small electric motor, which makes it self-propelling, running along the line at the same speed as the vehicle, due to the use of a synchronous motor. The trolley carriage precedes the omnibus and exerts a certain tension upon the cable, which is always kept at a certain height above the ground, allowing the omnibus to cross the road or turn out to pass other vehicles. When two omnibuses pass in opposite directions they exchange their cable couplings and the trolleys are not obliged to pass each other en route. Fig. 1 shows two omnibuses which have met on the road and are exchanging cable couplings.

Several lines of the Lombard-Gérin system have been installed in France and one in Germany. The first line to be put in operation was that from Fontainebleau (near Paris) to Samois in 1901, covering a distance of three miles. Fig. 4 shows the line in use upon a portion of road which would be too narrow to allow of running a railway line. Here the omnibus is in the act of turning out so as to pass the wagon which is in front of it. A second view on the same line is seen in Fig. 3, which represents the omnibus making a sharp turn among the narrow streets of the village of Samois.

The next line to be installed was that of Eberswalde, near Berlin, which has been in operation since 1902. Another line is that of Montauban, a town of 30,000 inhabitants in the south of France, which at present uses seven omnibuses for the local service.

Fig. 2 shows a sharp turn in the line. The curve is formed here by a curious iron construction which is fixed to the electric-light pole and substitutes two rails for the wires in order to make the turn. At Marseilles a suburban line was established in 1902 from the Croix Rouge to Allauch.

The overhead line is of much the same character as for ordinary trolley construction and uses a potential of 500 to 550 volts direct current. Two wires are used in order to support the rolling carriage. The current passes from the wire to each of the rollers and is sent to the vehicle by two conductors contained in a flexible cable. The cable is fixed to a short pole mounted on the roof of the omnibus, and thence the circuits pass through the controller to the motor. A simple arrangement consisting of three collecting rings fixed to the armature of the motor and connected to proper points of the winding furnishes the three-phase current. The latter passes from the collecting rings by three conductors of smaller section, which are also contained in the flexible cable, to the carriage, where it supplies a small three-phase motor, which is used to give the forward movement of the carriage. As the speed of the three-phase motor is synchronous with the frequency period the motor of the little overhead carriage always turns at a speed which is proportional to that of the main motor. The relation of the parts which transmit the movement is so calculated that the speed at which the carriage advances is always slightly superior to that of the vehicle, and the cable is thus always kept taut.

In general the overhead line is formed of two copper wires eight millimeters in diameter, placed 12 inches apart in a horizontal [illegible]

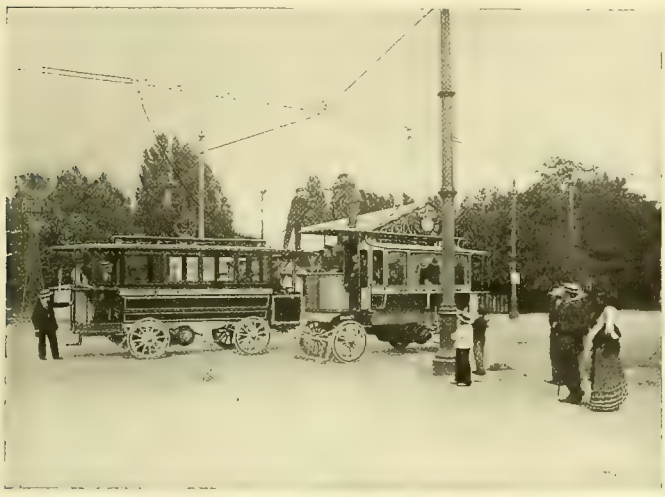


Fig. 1. Exchanging Trolleys on the Road.

Fig. 2. Peculiar Overhead Construction at Montauban, France.

Fig. 3. A Sharp Turn in the Village of Samois.

Fig. 4. The System in Use on Narrow Suburban Road.

LOMBARD-GÉRIN AUTO-TROLLEY SYSTEM.

supports are fixed in ambröine insulators, which are carried by C-shaped pieces fixed either to a cross-wire or to a pole. Fig. 6 shows the method of fastening the support to a pole. The distance between the two points of suspension varies from 30 to 35 yards in a straight line, and in the curves according to circumstances. The line is usually placed 22 feet above the ground.

The first form of rolling carriage or self-propelled trolley is that which is shown in Fig. 5. It is at present in use on the roads which were first installed. The three-phase motor of the trolley is suspended between the wires and below them by a frame which rests upon a shaft passing above and carrying metal rollers of the trolley-wheel pattern fixed on the outer ends. The motor is composed of a central field, which is fixed to the frame by a lug on each side, and around it revolves the exterior armature, which completely encloses the motor. The cylindrical field casting carries two turned-off portions, upon which rest friction rollers. The latter are mounted on the shaft which carries the trolley wheels, and thus transmit the movement from the motor. The rollers are held against the motor by an adjustable spring-arm on each side, which secures the necessary friction. The flexible cable which contains the different insulated wires is fixed to a double-jointed suspension piece below the frame so as to give it freedom of movement. This cable contains the two main wires which carry the current from the line to the motor on the vehicle as well as the three conductors of smaller section which take the three-phase current to the motor of the trolley, besides a sixth wire which operates a small electromagnetic brake, which is pressed against the outer surface of the armature and stops the trolley when necessary, as, for instance, when the vehicle stops upon a grade. The trolley thus formed is quite solid and has no delicate parts; nearly all the pieces exposed to the air are in aluminum, and this permits of reducing the weight of the apparatus to about 45 pounds, this being sufficient to assure its adhesion upon the wires as well as the necessary tension upon the cable connecting it to the vehicle.

Further simplification of the trolley has been secured by the use of a new form. In this type the friction rollers are dispensed with and the trolley

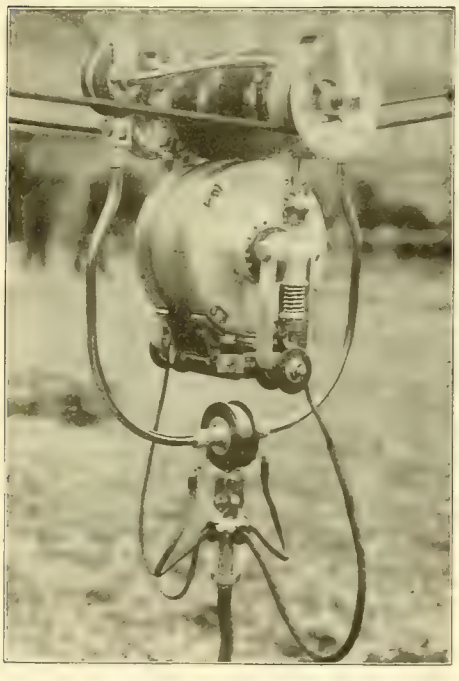


FIG 5. LOMBARD-GÉRIN AUTO-TROLLEY SYSTEM.—TROLLEY CARRIAGE.

wheels are driven directly by the shaft of the motor The exterior field is fixed and encloses the revolving armature whose shaft runs in ball-bearings and carries the trolley wheels on each side. The collecting rings which carry the current to the armature are mounted on the shaft inside the rollers and the brushes are supported by an arm fixed to the upper part of the field. An electromagnetic brake whose lever arm is applied to the armature shaft by a magnet is normally held off by a spring. The trolley carries a protecting piece above, which prevents it from falling off the wire, while below is a frame for holding the wires and the main cable.

Each omnibus has its motors connected with the rear wheels, the front pair of wheels being used for steering. The rear wheels are each driven by a separate electric motor and the two motors are mounted side by side upon the same bedframe. This arrangement dispenses with a differential mechanism and thus reduces the loss due to mechanical-transmission devices. Each of the motors has a normal capacity of eight horsepower, but this can be doubled when need be. The motors are mounted between the two axles and the movement is transmitted to the rear wheels by chain and sprocket gearing.

A controller is provided for the omnibus which, besides giving the usual changes of speed, has a point which permits of stopping the trolley by the use of the electric brake, and besides has a current changer which can be used to give the trolley a back movement. The flexible cable carrying the six conductors is brought to the pole on the roof by a coupling device which can easily be removed. The coupling is pivoted about the end of the pole. The tension of the cable is assured by the forward movement of the trolley, but to give it a greater freedom of movement the cable forms a loop hanging from the pole,

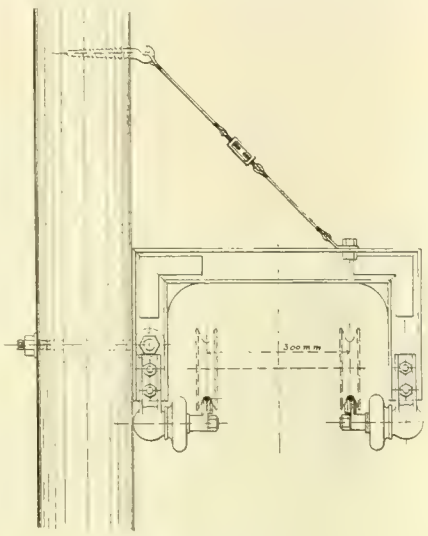


FIG. 6. LOMBARD-GÉRIN AUTO-TROLLEY SYSTEM.—TROLLEY SUSPENSION.

which is adjustable by a spring and a counterweight which slides up and down inside the hollow pole.

One of the most important applications of the system is the line which it is proposed to run from Nice to Monte Carlo along the Corniche road bordering the Mediterranean. The total length of this line will be 12 miles. The road, which was laid out by Napoleon, winds along the heights of the coast and affords a series of splendid views. It has been heretofore but little accessible to tourists, as it can only be passed over by private vehicles. The authorities did not permit of establishing a track over the route, as this would injure the roadway. The Lombard-Gérin people, however, found no difficulty in obtaining permission for an omnibus line, and a concession of 50 years was granted to a Nice engineer, G. Sacco Albanese. The Mediterranean Power Company is to furnish the current partly from a station which is already located at Nice and partly from new stations which may be afterward erected The current will be generated at 10,000 volts and will be supplied to three sub-stations along the line, where it will be transformed to 550 volts direct current. At the start 12 omnibuses will be used, carrying 16 persons each. These are somewhat smaller than the type used heretofore, which contain 22 passengers, but as the road has very heavy grades it was decided to reduce the weight of the vehicle.

Street-railway Conventions in St. Louis.

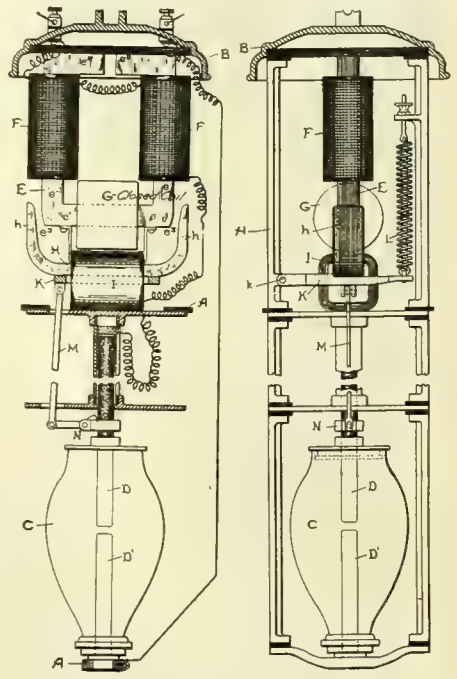
The next annual meeting of the American Street Railway Association, the Street Railway Accountants' Association and the American Railway Mechanical and Electrical Association will be held in St. Louis during the week of October 10th. Wednesday and Thursday, October 12th and 13th, will be devoted to the street-railway association proper, while the remainder of the week will be divided up between the three organizations as may be most convenient. All the sessions will be held at Festival Hall on the World's Fair grounds and will be conducted between 10 a. m. and 1 p. m. each day. The Southern Hotel has been selected as convention headquarters.

A number of special features have already been arranged, among them being the setting apart of Wednesday, October 12th, by the exposition management as Street Railway Day. The annual banquet will be held on Thursday evening. The place, however, has not yet been selected. The executive committee of the association has just concluded its session at St. Louis, where plans for the convention were formulated, the details of which will be made known soon by Secretary T. C. Penington. Every member of the association will also receive from the secretary a pamphlet regarding hotel and boarding-house rates and accommodations, together with some information about St. Louis and the fair grounds. Nothing definite concerning the programme, papers to be presented, etc., can be given at this time.

Thomson's Arc-lamp Improvement.

Stability of the arc is the prime factor in a good arc lamp. This is especially hard to obtain in enclosed arcs operated by direct current on constant-potential circuits. Elihu Thomson of Swampscott, Mass., has recently patented an arc lamp, the object of which is to produce a stable arc of considerable length without much, if any, resistance in series with each lamp, since it is well known that ordinary constant-potential arc lamps are liable to be unstable unless a resistance is interposed in the lamp branch. It has been found that this instability can be largely obviated by using a self-inductive coil in place of the resistance. Mr. Thomson makes use of such a coil, which he further utilizes to exert a regulating action upon the lamp, whereby a tendency of the arc to rupture is immediately accompanied by a shortening of the arc, while a rapid rise in the current produces a lengthening of the arc.

To this end the self-induction coils are connected in series with the arc and are located upon a core common to them and to a closed or short-circuited conductor. The movable carbon is actuated by an armature which is permanently polarized by a series solenoid. The armature is adjacent to the core, so as to be attracted by the changing strength of the core due to the fluctuating influence of the closed conductor as the current rises and falls. The operation of the lamp mechanism is thus rendered very



THOMSON'S ARC-LAMP IMPROVEMENT —ELEVATIONS SHOWING LAMP MECHANISM AND FRAME

prompt, and by so constructing the parts as to give the armature considerable range of movement without much change of the field of force which actuates it a long arc can be maintained. The accompanying illustrations show two views of the lamp and frame.

The frame, cap, globe and carbons are all of the usual construction. To the cap is secured a core (E), preferably made of laminated iron and forming a substantially rectangular frame, having upright sides; also a lower transverse member, and two upper transverse members, with a gap between their ends to increase the reluctance of the magnetic circuit and decrease the self-inductive effect of the wire coils which surround the upright sides. The coils are in series with the carbons.

On the lower transverse member of the core is placed a heavy closed band or coil of some good conductor, such as copper. This is made quite massive and is the seat of induction currents on any tendency to vary the magnetic lines of force threaded through it.

Near the coil is an armature (H), made of soft iron and preferably laminated. It has bent end portions extending along near the corners of the core. The middle portion of the armature passes through an open coil or solenoid in series with the coils (F) and the arc. There is room inside the coil for the armature to have considerable play, the armature being mounted on a frame, suitably pivoted to the frame of the lamp and movable up and down. To partly balance the weight of the armature frame, a coiled spring is attached to it and to the lamp

frame, preferably adjustable by means of a screw and nut. A link connects the armature frame with the pivoted dog clutch (N) of the lamp, which grips and lifts the carbon when raised.

The operation is as follows: The passage of the current through the coils (F) magnetizes the core (E), upon which the coils are mounted, the polarization being in one direction through the core. Any variation of this magnetic flux sets up strong opposing currents in the closed band (G) and produces free poles at (e^3) north and south, respectively, at any one time, but reversed in relation to that due to the coils (F). The effect of the coil (I) upon the armature (H) is to polarize it and cause it to attract itself toward the iron core (E). If the current in the coils (F) is stable, then this attraction is uninfluenced by the magnetism of the core itself, provided such magnetism be well below saturation. The arc is therefore struck by the attraction of the armature upward, due to its magnetization by the coil (I). If the arc becomes too long and begins the process of rupturing, the current is weakened, and the magnetizing effect of the coil on the armature is lessened, so that the armature drops and releases the clutch. This result is hastened by the interoperation of the coils (F) and the closed band (G), as follows: When the current begins to die away, the self-induction of the coils (F) sets up an electromotive force, assisting the line current and tending to maintain the arc, but at the same time the magnetic flux in the core (E) will fall. This fluctuation in the field of force in which the closed coil (G) is located sets up a current in the coil which tends to oppose the fall of magnetic flux in the core. The consequence is that free magnetism operates upon the horizontal member (e') of the core, forming poles at the points (e^3) similar in polarity to the armature (H), which will therefore be repelled. Consequently the action of the armature in shortening the arc to prevent rupture is prompt and rapid. If, on the other hand, the arc is too short, and the current rises rapidly, the armature is lifted higher, but the self-induction of the coils again opposes a counter-electromotive force tending to cut down the line current. The magnetic flux in the core will increase, however, setting up a counter current in the coil (G), which tends to polarize the member (e') of the core (E) in such manner as to attract the armature (H), thus assisting it to lengthen the arc.

The shape of the poles (h) with respect to the core (E) is such that the magnetic pull with a given current is substantially uniform in all positions of the armature or sufficiently so not to interfere with the operation of the lamp.

It appears from the foregoing description that there are three factors which operate to insure a stable arc: First, the self-induction of the coils (F), tending to oppose any change in line current, and thus delay the change in the arc until the lamp mechanism operates; second, the varying magnetic attraction between the polarized armature (H) and the iron core (E), and, third, the polarizing effect of the closed coil (G) on the horizontal member (e') of the core assisting in attracting or repelling the armature. Practical tests show that these actions occur almost constantly, so that the readjustments are frequent and rapid. The lag in the current due to the self-induction coils (F) is sufficient to give the solenoid (I) and the closed self-induction coil (G) time to shift the carbon before the arc ruptures. To this end it is desirable that the lever (K) and armature be not of too great mass, but light enough to move freely and promptly.

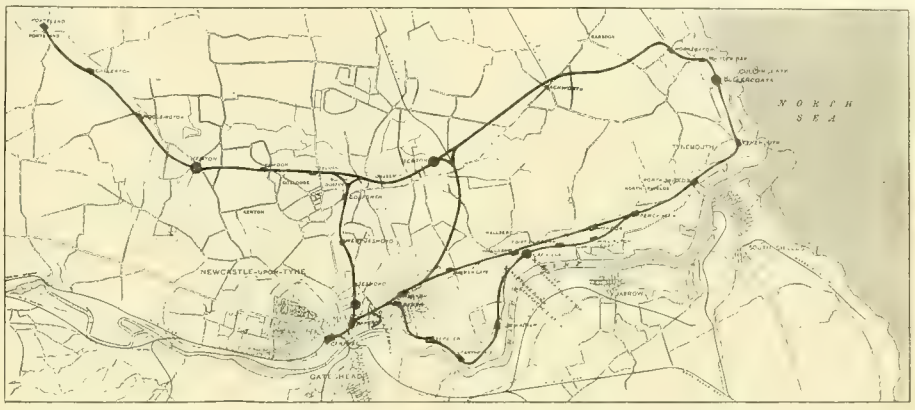
"Electrification" of the Northeastern Railway in England.

[From the London correspondent of the Western Electrician.]

Considerable interest was created when, in the middle of the year 1902, the Northeastern Railway Company, which operates some important lines in the northeast of England, called for tenders for converting to electric traction a large portion of its suburban lines around Newcastle. The original specifications included, roughly, four miles of four-line track, 35 miles of double track and a few odd miles of single line, scattered about in small pieces at various points. It will thus be seen that the track to be converted was equivalent to some 90 miles of single road. At the time the intentions of the directors of the Northeastern railway were made public, the Mersey railway had already been taken in hand by the Westinghouse company, so that, strictly speaking, the company was not the first steam concern in Great Britain to contemplate changing its mode of traction. On the other hand, however, the Mersey railway is more or less isolated, so far as physical intercommunication with other companies is concerned, so that the Northeastern company's policy is the first to have a real bearing upon the future of heavy railroad traveling in England.

The first experiment by the Northeastern Railway Company, as will be seen by the accompanying map, will affect only the suburban lines in a comparatively small area, for the company has many more miles of track running both north and south, serving large towns and cities by rails which it owns itself and having also running powers over lines traveling to the extreme south on the one hand, and to Scotland on the other. But it is quite obvious that the success or otherwise of the application of electric traction to these lines will dominate the attitude which the company will adopt toward its more important network.

First, with regard to the track construction: The gauge, of course, is four feet 8½ inches, the standard all over the country, and the old track has been reconstructed with rails 90 pounds to the yard, of the bullheaded type. But a different method of constructing and arranging the conductor or third rail to that upon the Mersey line and also the Metropolitan and Metropolitan District companies' lines in London, has been adopted. But one conductor rail has been laid. This is of high-conductivity steel, Vignoles section, weighing 80 pounds to the yard, and supported upon reconstructed granite insulators. The height of the conductor rail is three inches above the running rail and it is three feet 11½ inches away from the center of the track and outside of the track rail. At certain points, where there may be foot-passenger traffic across or near the line, such as level crossings, this conductor rail is protected by boards bolted on either side. At other places no protection will be afforded the third rail, but there will be facilities for readily applying this protection at any desired spot.



MAP SHOWING (IN HEAVY LINES) ROUTES OF NORTHEASTERN RAILWAY TO BE ELECTRICALLY OPERATED.

The company will not own a power house, but the Newcastle-upon-Tyne Electric Supply Company has arranged to erect a generating station at Carville (shown on the map) solely for the supply of these lines, and to distribute the current to five sub-stations. The equipment of this main station, which is as yet some way from actual completion, will at first consist of one 2,000-kilowatt Parsons turbo-alternator, of the revolving-field type, generating alternating current at a pressure of 6,000 volts and 40 periods per second. There are also on order two similar machines of 3,500-kilowatt capacity. They will run condensing. The current will be transmitted to the five sub-stations at Pandon Dene, Wallsend, Cullercoats, Benton and Kenton, where it will be transformed into continuous current at 600 volts, which is the pressure which will be supplied to the working conductor. Babcock & Wilcox will supply the boilers for the main generating sets. A departure has been made in connection with the boiler arrangements, each turbine having a separate range of boilers, at right angles to the engine room, and every two such ranges will constitute a boiler house, centrally fired. A considerable amount of steam piping will by this means be saved. The pressure of the steam supplied will be 200 pounds per square inch, superheated by 150° F. A condenser is placed directly underneath the turbine.

The sub-stations will be equipped with 800-kilowatt rotary converters, and in order to cope with the anticipated heavy fluctuations in load, they have been designed to work without sparking with an overload of 100 per cent. for 10 minutes, and with momentary overloads of 200 per cent. The transformers are single phase, oil insulated.

The cables carrying the current from the main power house to the sub-stations, and which will be laid solid in wooden boxes alongside the track, are of the three-core paper-insulated, lead-covered type. The low-tension distributing cables are laid in stoneware troughing.

The new cars are shown in the accompanying illustration. They have been constructed by the company's own staff at its headquarters at York. It is intended to adopt as the normal train three coaches, the two end ones being motor cars, and the center one a trailer. All the coaches will be of the corridor or American type and lighted electrically. Each coach will be carried on two four-wheeled bogie trucks, and the two motor cars will carry two 150-horsepower motors, both at one end of the coach. Consequently, drivers' cabs are only fitted at one end of the motor coaches, although arrangements have been made whereby the train could be operated from either end of the motor cars. The system of multiple-unit control adopted is the Thomson-Houston or Sprague, the details of which are well known to Americans. Each motor car is fitted with four contact shoes, and the front and rear sets of these shoes are so connected that contact is maintained by one set or the other when passing over those portions of the track where the third rail is broken, such as crossings, junctions, etc. It is estimated that 50 motor cars and 50 trailers will be required for the purpose of the lines now being converted, in addition to which there will be a couple of electric locomotives in use for freight traffic. The seating capacity of the trailer cars will be 70 passengers and of the motor cars 68 each. The average speed of the trains is reckoned at 22 miles an hour, and a few express[illegible] hour.

"ELECTRIFICATION" OF THE NORTHEASTERN RAILWAY IN ENGLAND.—THE NEW CARS.

In brief, these are the details of the scheme. A number of trial trips have been made upon the lines, current having been supplied from the Wallsend power station of the Newcastle-upon-Tyne Electric Supply Company.

ALTERNATING-CURRENT WORKING.

By W. B. Gump, Asso. Mem. A. I. E. E.

Part I.

Fundamental Properties.

The phenomena attending the flow of an alternating current are more complex than those of a continuous current for several reasons. In the first place, an alternating electromotive force is continually changing in value, first rising from zero to maximum, then diminishing to zero; reversing, again rising to maximum in the opposite direction, and again diminishing to zero. The current produced by this electromotive force must consequently be variable. The curves representing voltage and current, respectively, may or may not be sine curves, depending upon the generator. Furthermore, the current may not be in phase with the impressed electromotive force producing it, which further complicates matters.

The continuous or direct current, which evolves from a commutator, is represented practically by a straight line, being a constant quantity, and may be measured and computed readily and accurately.

From these facts it may be seen that the alternating current, by reason of its variable quantities, must be dealt with by methods less simple than those of direct current. It should not, however, be inferred from the latter statement that an alternating current cannot be analyzed. It is not only capable of analysis, but in the great majority of cases it can be computed with accuracy and by means of formulas surprisingly simple.

It will be well first to consider the ideal simple dynamo, which is represented in Fig. 1. Suppose a single loop of wire (WX) to turn in the direction indicated by the arrow, i. e., the same as a right-handed screw. The loop will cut lines for force in the field between the poles (N) and (S), and a current will be set up in the conductor. The direction the current will flow will be away from the observer in the top wire of the loop, and toward him in the bottom wire. Now suppose each end of the loop to be connected to a slip ring, insulated from the shaft, and leading to an outside circuit, as

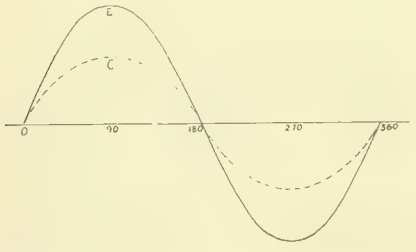


FIG. 2 CURVES OF ELECTROMOTIVE FORCE AND CURRENT

shown. As the loop continues to revolve the rate of cutting the lines of force will increase as the loop approaches a horizontal position, and hence the electromotive force will increase, the maximum positive value being reached when the loop is in a horizontal position. This is obvious, from the fact that the rate of cutting lines of force varies with the sine of the angle from the vertical position. Considering the current shown as being purely non-inductive, the current will rise and fall with the electromotive force and the current curve will be represented by a sine wave (C) in phase with the electromotive force, as shown in Fig. 2. Thus we have an alternating current in its simplest form. The curve shown in the figure shows one complete cycle, from 0° to 180° being termed an alternation In practice an alternating current is said to have a certain number of "cycles per second," or "alternations per minute."

Phase.

The term "phase" denotes the relative position of a current with respect to the electromotive force producing it, or the relative position between two or more currents or electromotive forces, respectively, to each other. In an alternating-current circuit having no inductive disturbances, such as iron in the circuit, the current will rise and fall in exact unison with the electromotive force, as was shown in the foregoing. If, however, the circuit is inductive, the current will lag behind or be "out of phase" with the electromotive force by a certain angle, called the "angle of lag." Such a condition is shown in Fig. 3, where, as before, (E) represents the voltage, while (C) is the current which lags behind the electromotive force by an angle θ

An alternator arranged to generate two electromotive forces at 90° apart is said to be two-phase or quarter-phase. Two-phase electromotive-force curves are shown in Fig. 4. They are practically separate circuits, although generated from one machine. They may be transmitted over four wires or three wires. In the latter case one wire is used as a common wire—or common return—for both currents. A three-phase system is shown in Fig. 5. On this there are three currents set up, their phase displacement being 120°. Three-phase transmission involves three currents; hence it involves three successive single-phase currents, which are practically the same as separate circuits. Only three conductors are necessary, however, since the sum of the three

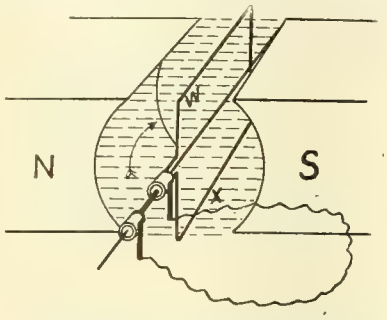


FIG. 1 DIAGRAM OF SIMPLE DYNAMO.

current values at any instant is equal to zero. Therefore the three return wires are not necessary.

Average and Effective Values of Alternating Current.

It is important to note the difference between the average and the effective values of an alternating current, since it is the latter value (a certain ratio to the average) which is recorded on commercial measuring instruments. Let it be understood that while an alternating-current curve may not necessarily be a sinusoid, as will be shown later, we shall make all calculations and analyses from the sine curve. On many generators, such as the Niagara machines, the wave form is so close to a sine curve that the inaccuracy resulting from its slight deviation from a perfect sine curve is extremely small.

Let us now consider several features concerning the sine curve which are of the greatest importance in connection with the design and calculations of alternating-current apparatus. Observing Fig. 6, which shows one lobe of a sinusoid, it will be evident that, in order to arrive at an average value of the current, the area of the lobe must be divided

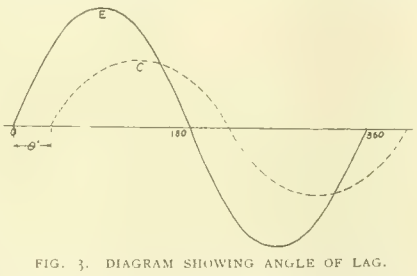


FIG. 3. DIAGRAM SHOWING ANGLE OF LAG.

by the length π which = 180°. The result will be the true average of all the ordinates composing the curve.

Therefore,

$$C = \frac{\text{Area}}{\pi}$$

Integrating to get the area: $C = \frac{1}{\pi}\int_0^{\pi} C' \sin.\ \theta\, d\theta$

$$= \frac{C'}{\pi}\Big[-\cos.\ 180°\Big]_0^{\pi}$$

$$= \frac{C'}{\pi}\Big[-\cos.\ 180° - (-\cos.\ 0°)\Big]$$

$$= \frac{C'}{\pi}\Big[1 - (-1)\Big]$$

$$= \frac{2}{\pi}\cdot C' = .636\ C'$$

in which C′ is the maximum current. The "effective value"—that is, the value producing the same heating effect as a continuous current—is not the average, but is a fraction of the maximum a little above the average, as will be shown. The heat produced, and hence the effective energy, is proportional to the square of the current, so that the average of the heating values of all of the ordinates would be the square root of the average of all the ordinates squared. In other words, this value is equal to the square root of the mean of the squares of all the ordinates, taken separately. It is generally termed the "square root of the mean square" value.

Since it is of great importance to have this value well fixed in mind, its derivation should be shown. For the sake of those not familiar with the expressions used in calculus a trigonometric demonstration will be given, which will be made as clear as possible. In Fig. 7 suppose OB to generate a sinusoid, starting from 0° on OS, and revolving in the direction indicated by the arrow. First, from geometry,

$$\overline{AB}^2 + \overline{OA}^2 = \overline{OB}^2$$

But $\overline{AB}^2 = \sin.\ \theta$

and $\overline{OA}^2 = \cos.\ \theta$

Therefore, with OB as a unit radius,

$$\overline{AB}^2 + \overline{OA}^2 = 1$$

and $\sin.^2\theta + \cos.^2\theta = 1$

Now $\sin^2\theta$ and $\cos^2\theta$ respectively, pass through the same series of values; therefore, their average values, respectively, will be equal, so that

$$\text{Av. } \sin.^2\theta = \text{Av. } \cos.^2\theta$$

$$\text{Av. } \sin.^2\theta + \text{Av. } \cos.^2\theta = 1$$

from which $2\ \text{Av. } \sin.^2\theta = 1$

$$\text{Av. } \sin.^2\theta = \frac{1}{2}$$

$$\sin.\ \theta = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$$

$$= .707 \times \text{Max. Value.}$$

This is true of both electromotive force and current, since they both follow the sine law. The value just derived (.707) is generally referred to as the "square root of mean square" value, or written V mean square.

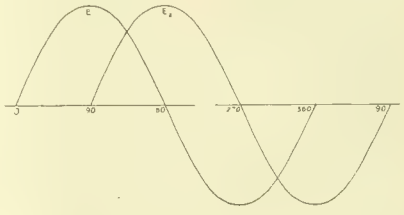


FIG. 4. TWO-PHASE ELECTROMOTIVE-FORCE CURVES

It is often necessary to refer to the maximum value. This is the case when computing dielectric strength of insulation, since it is the maximum value which is effective in breaking down insulation. A good many transmission lines are computed with regard to the maximum rather than the V mean square value. The ratio of the V mean square to average electromotive force is known as the "form factor" and with the sine curve is 1.11.

Since

$$\frac{\frac{1}{\sqrt{2}}\,E_m}{\frac{2}{\pi}\cdot E_m} = 1.11$$

when E = Max. e. m. f.

As stated in the foregoing, very few, if any, machines give a perfect sine wave, but the form factor 1.11 may be used in computations without materially affecting the results.

Inductance.

It was shown that when a conductor is moved through a magnetic field so as to cut lines of force a current is set up in the conductor, the value of this current being proportional to the rate of cutting. It is equally true that the conductor can remain stationary, and the field change. To demonstrate this, suppose that in Fig. 1 the loop remain fixed in the vertical position shown. Then let an alternating field be caused to surge between (N) and (S), alternately changing the direction of the lines of force. The poles, of course, will not remain as shown, but will alternate with the flux.

A current will be caused to flow in the conductor, the relative position of the conductor, with regard to the field being exactly the same as if the field were stationary and the conductor revolved, as formerly. It is therefore apparent that changing the number of magnetic lines in the neighborhood of the conductor causes current to flow while this change is taking place. When the ends of such a conductor are not joined together, or connected to outside apparatus, no current can flow, but an electromotive force is set up which causes current to flow whenever a complete circuit is made.

The converse of the above statement is true; that

is, when a current flows, a magnetic field is established around the conductor carrying the current. In order to analyze this phenomenon, the lines of force which are established are considered as cutting the wire which they encircle, on being created, so that if in Fig. 1 a current is sent through the loop a field will be established, and on being established will thread through the loop. If the current is stopped, or altered, the number of lines threading the coil will be altered; hence the conductor will be cut by these lines. By this action an electromotive force is set up in the conductor, tending to cause a current in the opposite direction. This is called an electromotive force of "self-induction." The magnetic field produced by starting the flow of current cuts the conductor, so that it tends to stop the current from flowing. Stopping the current causes the lines to produce an electromotive force which tends to continue the flow of current. These facts make it evident that the electromotive force of self-induction is one which tends to prevent a change in the value of the current. The greater the number of turns in the loop, or coil, the greater will be the self-induction. The electromotive force of self-induction is proportional to the square of the number of turns. The "coefficient of self-induction" is that constant by which the time rate of change of current value in a circuit must be multiplied, to give the electromotive force induced. This coefficient is usually denoted by L and is 10^9 times as large as the absolute unit of inductance, the latter being too small to be employed in commercial

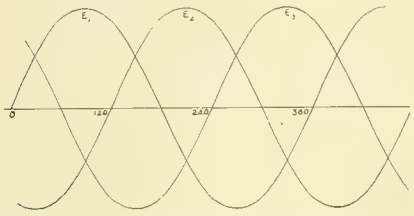


FIG. 5. THREE-PHASE ELECTROMOTIVE-FORCE CURVES.

calculations. In an alternating-current circuit the inductance is expressed by the equation

$$I = 2\pi f L$$

in which L is constant for the particular circuit considered. F is the frequency in cycles per second. The coefficient L is expressed in units, called henrys, and the inductance (or reactance) in ohms.

From a study of the foregoing it will be seen that an inductive electromotive force tends to choke the current. This effect is greatly augmented when there is iron in the path of the magnetic field, as will be shown. This reactance, together with the ohmic resistance (which acts at 90° from the former), produces a resultant resistance to the flow of current called "impedance." The reactance electromotive force, as just stated, acts at right angles to the resistance electromotive force; therefore, the impedance is equal to the geometrical sum of reactance and resistance. By reactance electromotive force and resistance electromotive force is meant the electromotive forces, respectively, which overcome reactance and resistance. In Fig. 8 let the base of the right triangle represent the resistance, and, assuming the coefficient of self-induction and the frequency to be known, let the vertical side be the reactance, $2\pi f L$ These quantities are represented in the same manner as mechanical forces, and hence in most cases may be solved graphically. With certain problems

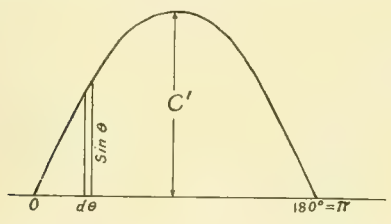


FIG. 6. ALTERNATING-CURRENT CALCULATION.

involving very small angles, it is necessary to employ an analytical method of treatment. To proceed with the explanation of Fig. 8; we see that the hypotenuse of the right triangle is the resultant of the other two forces and represents impedance which has the equation

$$J = \sqrt{R^2 + (2\pi f L)^2}$$

In the above expression and in the expressions to follow

J = impedance.
R = ohmic resistance.
R′ = reactance.

It was stated that the presence of inductance caused an angle of lag Θ between the electromotive force and current. We may then write the equation

$$\tan \Theta = \frac{2\pi f L}{R} = \frac{R'}{R}$$

Hence when the reactance and resistance are known, the angle of lag may be computed.

Capacity.

Capacity expresses the ratio of the quantity of electricity charged upon a dielectric, to the difference

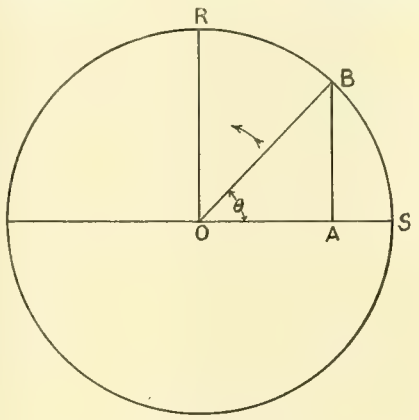


FIG. 7. ALTERNATING-CURRENT CALCULATION.

of potential caused by the charge. Algebraically

$$C = \frac{Q}{V},$$

therefore the capacity of a condenser is equal to the quantity of current which will produce a difference of potential between the terminals of one volt.

The practical unit of capacity is the farad. A condenser which has its difference of potential raised one volt by one coulomb has a capacity of one farad. It must be remembered that one coulomb per second is one ampere. The farad is 10^{-9} times the absolute unit, and is too large a unit for general work. On this account the microfarad

$$\left(\frac{1}{1{,}000{,}000}\text{ farad}\right)$$

has come into general use The effect of capacity

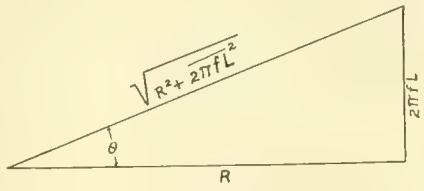


FIG. 8. ALTERNATING-CURRENT CALCULATION.

in a circuit is opposite to the effect of inductance, and creates a negative angle of lag, causing the current to precede the electromotive force producing it. The effects of inductance and capacity will both be taken up more in detail in the discussion which follows.

[To be continued.]

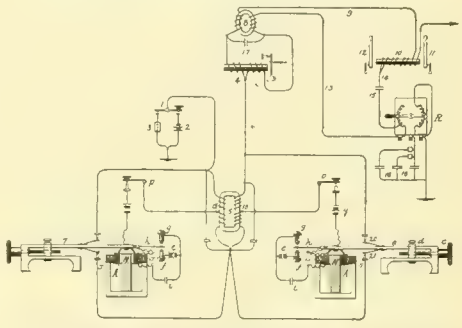
Multiplex Telegraphy.

Stephen Dudley Field of Stockbridge, Mass., on March 5, 1903, filed an application for a patent for a system of multiplex telegraphy, the essential feature of which was a tuned reed used in the transmission of the signals. Another patent has been granted Mr. Field, dated March 29, 1904, relating to certain improvements on the previous invention. By consulting the accompanying diagram the following description of the completed apparatus will be made clear.

A key (1) is used to actuate a line battery (2) and battery resistance (3), first one and then the other being cut into line. The currents from this key pass the coils of an ordinary differentially wound Morse relay (4) in the ordinary duplex manner. Between the relay and the key is interposed an inductive device (5), in which two independent windings are associated on the same core and are connected reversely to each other. Each of these windings is in connection with a vibratory reed (6) and (7), respectively, and its contacts, while each reed is tuned to a different rate of vibration. After passing the Morse relay the line and equating circuits pass the windings of a differentially wound retardation coil (8), after which they divide, the line circuit (9) passing the coils of a tone receiver (10) equipped with two reeds (11) and (12). The coils of the tone receiver are in parallel and reversed to each other. The equating-circuit branch (13) goes to the rheostat (R) and earth in the usual manner. Midway on the windings of the tone receiver is a leak or tap (14), which leads through a condenser (15) to a point distant from the line terminal of the rheostat sufficient to compensate for the resistance of one of the coils (10) of the receiver. This makes the tapped point of the coil neutral to outgoing currents, since the disturbance introduced by the first half of the coil is compensated for by that portion of the resistance of the rheostat cut off by the tap circuit. The rheostat employed is of peculiar arrangement. It consists of a series of coils of equal value bridged by a blade-spring switch in such a manner that a balance can be obtained by a single movement. The condenser (16) is of the divided type and is adjusted to the line at its maximum of static capacity, after which it requires little further attention. In order to arrive at a correct understanding of this arrangement, it must be borne in mind that the static of a line never varies. Changes in the rate of leakage by carrying off more or less of the static charge renders an adjustment for static capacity necessary. Hence the rheostat is constructed so that conditions due to leakage on the line can be reproduced with respect to the equating condenser by permitting more or less leakage around the condenser. Consequently the apparent capacity of the condenser is altered in a manner very similar to that experienced on the line when leakage occurs. Lowering the resistance to compensate for line leakage at the same time increases the leakage to which the condensers are subjected.

It will be seen that outgoing straight currents are balanced in practically the usual manner. Incoming Morse currents pass the coils as usual. The quick harmonic vibrations, however, are choked by the impedance coil (8) and mostly pass through but one coil of the vibratory receiver magnet and thence to earth via the condenser tap circuit and rheostat. A condenser (17) is placed between both branches of the circuit at a point between the retardation coil and relay. This condenser serves to equalize whatever vibratory impulses pass the retardation coil (8) and equilibrate them through both branches of the relay.

Coming now to the tone transmitters, (N) (S) is



MULTIPLEX TELEGRAPH—DIAGRAM OF CONNECTIONS

a strong magnet, between the laminated poles of which a coreless coil (A) vibrates freely. The coil is attached to a tuned reed (6), the rate of which is governed by varying its point of suspension by means of the screw (c) acting on the clamp (d). The coil gives motion to the reed (6) by virtue of the energy derived from the battery (e). The reed may be set in motion by hand or mechanically. When the insulated blade spring (h) collides with contact (f), the condenser (i) receives a charge which, passing around the convolutions of coil (A), impels the same, with the attached reed, in the direction of contact (f). In other words, the coil is sucked in. This condenser charge, however, is but of an instant's duration. It results, in a blow or snap to the reed, leaving the same free to start on its return excursion on the completion of its stroke. Upon the return stroke of the reed contact (g) collides with blade spring (h), thus giving a path for the discharge of the condenser. The discharge passing coil (A) results in an outward impetus to the reed (6). Thus the reed is continuously operated by a series of minute impulses of fixed and determined value imparted at the instant when the fork is occupying its "zero displacement."

It is a law of automatically vibrated pendulums or reeds that to secure absolute uniformity of movement the actuating force must be applied at the precise moment when the fork, pendulum, or string is passing through the point of zero displacement. To obtain this effect through the agency of electromagnets is extremely difficult. A coil of the character described, cutting the lines of force of a powerful magnet, the poles of which are carefully laminated, possesses all the necessary qualifications for exact work, and such a coil can, through the agency of the condenser circuit, be made to deliver its torque to a vibrating agent at practically any desired point in the arc of its vibration.

Referring again to the core (5) and its association with both reeds, it will be seen that the closure of either finger key (o) (p) will send induced currents to line. For instance, (o) being closed, will alternately energize the two halves of the divided coil (18) through battery (q) and contacts (20) and (21), the currents induced in the opposite half each time being relied upon to produce the signal at the distant station. Likewise coil (19) will operate under the control of key (p).

The Hartlepool (England) Electric Tramways Company has built for its own use a double-deck electric car having seats for 84 passengers—half inside and half outside. The body of the car was made from two obsolete car bodies, and the total cost, exclusive of the trucks, was $700.

Single versus Multiphase Generators in Alternating-current Railway Work.

By W. A. Blanck.

The present great interest in the development of alternating-current railways makes most timely some considerations as to the selection of the generators delivering the energy to the system, particularly the choice between single and multiphase machines.

If the road to be equipped with the alternating-current system takes its current from a power house in which polyphase apparatus is already installed, it would be natural to supply the various sections of the line from the different phases of the generators. However, in the case of an entirely new installation the use of single-phase generators may be more advantageous, notwithstanding the greater cost of the single-phase as compared to the multiphase generator of equal capacity. Some of the relative merits of the two systems will now be considered.

For the purpose of discussion, three typical cases have been chosen, represented by Figs. 1, 2 and 3 of the accompanying diagrams. In each case, 20,000-volt generators are assumed to feed directly into the high-tension bus bars, thus simplifying the diagrams by the omission of the step-up transformers. High-tension switches connect the bus bars to the transmission lines leading to the stated sub-stations. In the sub-stations are installed the step-down transformers, with primaries connected to the transmission line by high-tension switches. Single-pole switches are inserted between one side of the 3,000-volt secondaries and the trolley wire, while the other side and the transformer case are tied to the rail. The power house is located at the center of the line, which is divided into sections as the case may determine. These sections are separated by suitable insulators, and arrangements are provided for readily connecting them by jumpers, in case of emergency. A simplification of these cases is also shown in corresponding diagrams designated Fig. 1A, Fig. 2A and Fig. 3A. This is accomplished by using the rail as a common return for both primary and secondary circuits. It will be noted that in case this is done with the three-phase generators 34,000 volts must be delivered to the bus bars in order to maintain 20,000 volts between the transmission line and the grounded neutral.

In the case of Fig. 1, using a single-phase system, it is necessary to install double-pole switches on the transmission line, both in the power house and sub-station. Normally, the static strain between the transmission line and ground will be half of the impressed voltage. In the case of Fig. 1A, with a single transmission line, it is only necessary to use single-pole switches in all primary circuits, thus effecting a very material saving in the expense of high-tension switches, as well as the saving of 50 per cent. in transmission-line copper and insulators. It will be noted, however, that this arrangement subjects the transmission system and transformers to the full static strain of the impressed voltage. This will call for somewhat greater care in insulation of the transformers and will continuously subject the insulators of the transmission line to a higher strain.

The decreased number of insulators, with the corresponding decrease in points at which failure can occur, tends to counterbalance the somewhat more rigorous requirements.

Should it transpire that one line is grounded in the case of Fig. 1, the system can still be operated during such time as repairs can be made, while in the case of Fig. 1A such a failure would necessitate the shutting down of that particular transmission line. This condition, however, is exactly analogous to that of a three-phase system, now so generally operated with a grounded neutral.

When the system depicted in Fig. 1 is in normal operation, the adjacent sections are at the same potential and the section insulators are subjected to no strain whatsoever, while if one section is shut down the insulator will have to withstand the full trolley potential of 3,000 volts.

Should any one section of the transmission line or any one sub-station be put out of commission, it is possible, by use of the jumpers mentioned above, to feed the disabled trolley section from each of the adjacent sections, thus maintaining service without excessive drop.

A very important feature in the operation of this system is the fact that the full generator capacity is available at any point on the system, thus making it possible to take care of any unbalance in the distribution of the load, due to the congestion of traffic at any point of the system.

In the case shown in Fig. 2 the use of two-phase generators is considered. This will be most advantageous when applied to a system consisting of a single line with the power house located at the center. Current will be supplied to one end of the system from one phase of the generators while the second phase feeds the other end.

In comparing Fig. 2 and Fig. 2A, the conditions are exactly similar to those of Fig. 1 and Fig. 1A, so far as the saving in switches, copper and insulators and the static strains are concerned. However, a noticeable difference exists so far as operation is concerned. Since the adjacent sections are fed by different phases, the section insulator must stand 4,200 volts when in normal operation. In case one section of the transmitting system is disabled, current can be supplied by means of jumpers only from the adjacent sections supplied by the same phase, which will result in double the drop due to similar occurrence in Fig. 1.

Since the section of the system fed by the different phases must be entirely separated, this arrangement does not provide for an unbalance in load so well as that of Fig. 1. In fact, only 50 per cent. of the generator capacity is available on either section—a point of considerable importance in practical operation.

Considering now the case in Fig. 3, the application of three-phase generators to the single-phase system is shown. This arrangement is best adapted to a railroad system consisting of main line and branch, with the power house located at the junction, since it will then be possible to feed the sections without necessary overlapping of the transmission lines. Again, similar relations hold between Fig. 3 and Fig. 3A as between Fig. 1 and Fig. 1A, so far as the saving in switches, copper and insulators and the static strains are concerned.

The insulators separating sections fed by different phases have to withstand 5,200 volts, as compared with the 4,200 volts in the case of Fig. 2. The same limitation in feeding any section of the trolley from its adjacent section in case of a disabled transmission line holds as in Fig. 2. So far as available generator capacity for any section is concerned, the two cases are materially different. In the case of Fig. 3, due to the delta connection, it is possible to utilize 66 per cent. of the generator capacity on any section, whereas in Fig. 3A, with the star connection, only 33 per cent. of the generator capacity is available on any one section.

It is evident that on account of the high potentials, section insulators must be of considerably greater length than those now used on the low-voltage trolleys of approximately from four to six feet in length. This will have a very appreciable effect on the lights when the car passes the section insulator, as well as presenting the difficulty in starting which would arise should the car come to rest under the insulator. Moreover, the arcing due to the interruption of the current with the high-voltage trolley is apt to prove serious.

All of these difficulties can be overcome in the case shown in Fig. 1 by the use of two trolley bows, one mounted over each truck of the car. Since these will more than span the section insulator, the current will not be interrupted, thus materially improving the operation of the system.

This arrangement with the two bows can only be applied in the arrangement shown in Fig. 1, as in the cases of Fig. 2 and Fig. 3 it would not be permissible to short-circuit two sections fed by different phases, which leaves the latter cases subject to the difficulties above mentioned.

A metallic-circuit telephone system installed on the same poles as the grounded high-tension line will be subjected to higher static strain and greater inductive action than in the case of the ordinary transmission line. The effect of induction can be overcome by frequent transposition of the telephone wires. To guard against shocks due to static strains, care must be taken to provide perfect insulation for the telephone instruments, as well as for the person using the telephone.

From the foregoing discussion, it appears that it will be entirely possible to use two and three-phase generators now installed to furnish power for single-phase systems, but that the difference in potential between sections and the small generator capacity available on any section are serious ob-

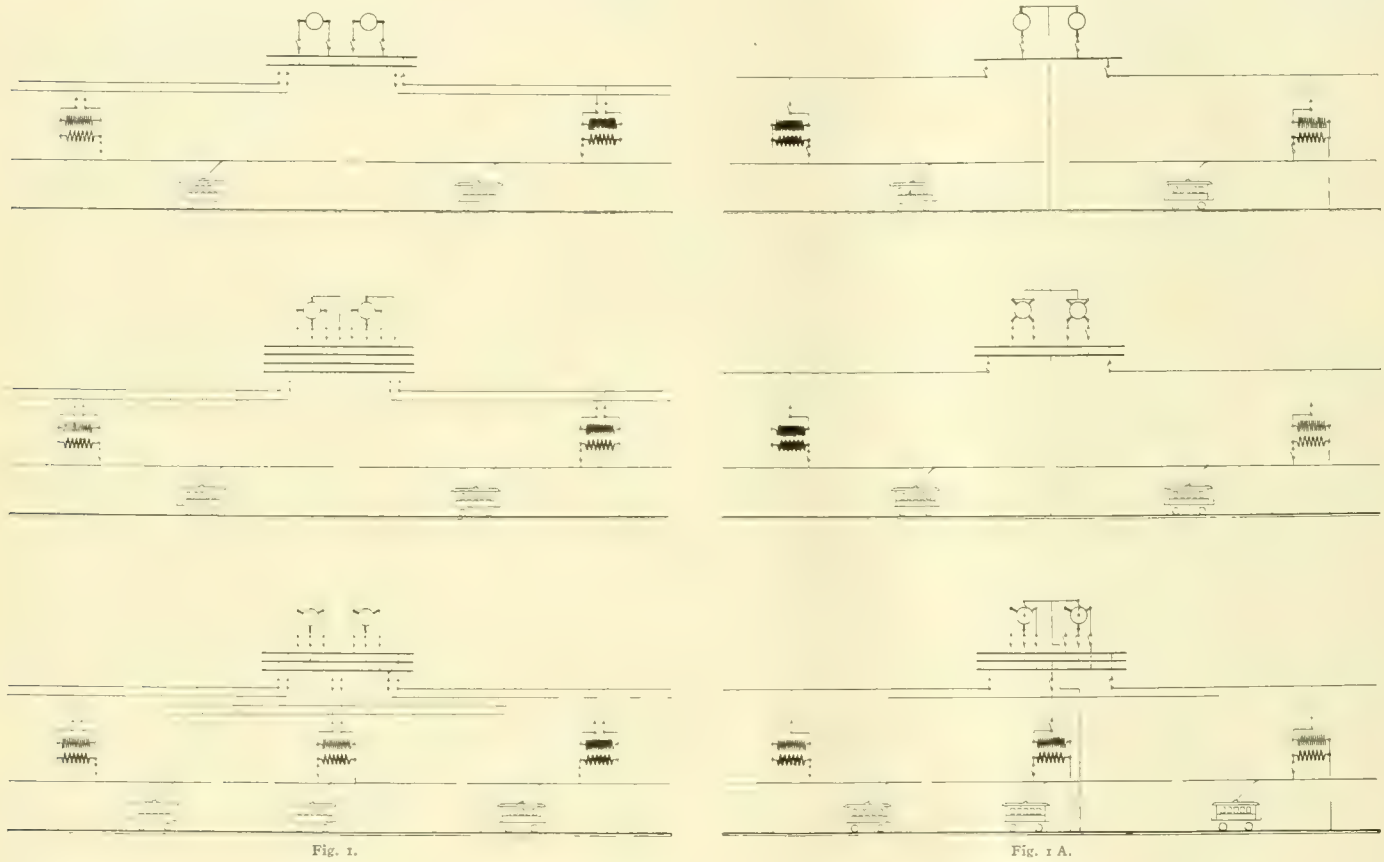


Fig. 1.
Fig. 2.
Fig. 3.

Fig. 1 A.
Fig. 2 A.
Fig. 3 A.

SINGLE VERSUS MULTIPHASE GENERATORS IN ALTERNATING-CURRENT RAILWAY WORK.

stacles to the satisfactory operation with this arrangement.

Where entirely new apparatus is to be installed, it is undoubtedly better to use single-phase generators. Their first cost is somewhat greater, but the system is far more flexible in its ability to handle unbalanced-load conditions, and with the double-bow trolley, gives perfectly continuous service over section insulators.

While the suggestion to use rail as common return for both high-tension and trolley circuits is a radical departure from current practice, it does not involve greater risks for personal injury or the continuity of the service than in the ordinary three-phase system with grounded neutral. The great advantages of simplification and decrease in the expense of the transmission system bespeak for this feature most careful consideration.

Electric Mine Locomotives.

Electric locomotives for use in mines are of comparatively recent origin, but so important have they become in the economy of operation that in many of the large mines animal haulage has been entirely displaced. In 1887 the first electric lomomotive ever used in a coal mine was put into operation in the Short Mountain colliery of the Lykins Valley Coal Company. It was a rude piece of mechanism as compared with present-day standards, but even with its faults it was kept in operation for 16 years.

William L. Affelder, superintendent of the Mosgrove Coal Works, Mosgrove, Pa., in an article recently published in Mines and Minerals, gives an account of the development of the mining locomotive, from which the following extracts are taken:

"It is true that electric mine locomotives made their first appearance in rather crude attire, but this fact did not disguise their merits nor did it obscure the important position which they were to assume in the development of coal mines. It took some time to convince operators of their practicability and to prove that such real objections as there were to their adoption would soon be more than overcome by their merits."

"One of the early objections was to the dangers that would be encountered by men and live stock coming in contact with the overhead-trolley wire. At one large mine, where trolley haulage had been introduced, the drivers refused for a time to work because an occasional touch of an ear against the wire made the gathering mules too wild to handle."

"Experience has, however, proved that the trolley wire is not as objectionable as was first supposed, and fatalities from this source are comparatively rare. In many mines the voltage does not exceed 250 volts, which is seldom sufficient to cause serious injury. Where the roof is sufficiently high, the trolley wire is carried high enough to allow free passage below it. Both men and live stock soon learn that distance lends enchantment, and it seldom takes a mule or horse of average intelligence more than a day to learn where the disturbing element is located."

"The traction locomotive consists essentially of a heavy cast-iron frame, within which are contained the motors and driving mechanism. The current, which is always direct and generally either 220 or 500 volts, is taken from an overhead copper trolley wire by a grooved brass trolley wheel and transmitted through the controller to the motors, and finally back to the generator through the copper-bonded steel rails upon which the locomotive runs. The motors are geared to the truck axles by means of cut-steel gear wheels. The locomotive wheels are shrunk and keyed upon the truck axles, and are either inside or outside the locomotive frame. In narrow entries it is sometimes necessary to place the wheels outside the frame, in order to reduce the width of the locomotive, but when a heavy locomotive is used on a narrow-gauge track, it is necessary to place the wheels inside the frame, in order to allow sufficient room for the motors and gears. Aside from the essential requirements due to width of entries or gauge, it is advantageous to have the wheels inside the frame, in order to have easy access to the journal bearings of the trucks. The minor details of construction depend upon the local conditions and the use to which the locomotive is to be put. The locomotives generally have a speed of from six to 10 miles an hour."

"A 10-ton Jeffrey gondola-type locomotive of 30-inch gauge was installed at the mine of the Mosgrove Coal Works, a year and a half ago, and has never been idle a day on account of defect or accident. During that period of time it has hauled almost 150,000 tons of coal at a cost of less than one-tenth of a cent per ton for repairs. From Fig. 1, which shows a profile of the haulage road, it will be readily seen that the locomotive has had decidedly adverse conditions with which to contend. In fact, the grades are such that the output of the mine would hardly be one-third of what it is if animal haulage were still employed. It will be noted at (A) that for a distance of 250 feet there is a grade against the loads of a trifle less than three per cent. Twenty to 30, and occasionally as high as 35 cars per trip are being hauled up this grade by the locomotive, each loaded car weighing 3,700 pounds. At least 25 cars of the trip are on the steep grade at one time, and any in excess of that number are on the lesser grades above or below the hill. A stout mule has frequently been known to fail to haul two loaded cars up this same hill. At another point in the mine at (B), the grade is 4¼ per cent. in favor of the loads for 125 feet, and then three per cent. for 125 feet. With mule haulage this grade was always a dangerous one, even with two wheels of each car spragged, but the locomotive holds back as many as 35 loaded cars with every car wheel in the entire trip running free."

"No discussion of electric haulage would be complete without a brief mention of electric gathering locomotives, which are beginning to take the place of live stock with far greater rapidity than main-haulage electric locomotives originally did. Fig. 2 shows a view of a Jeffrey gatherer. The gathering locomotives are constructed along the same general lines as the ordinary traction locomotives of larger size, except that they are shorter and lower. A trip of empty cars is taken from the gathering parting and distributed by the motorman into the several rooms in his particular section, and on the return trip he gathers up the loaded cars. In traveling along the entries, the locomotive obtains its power by means of a regular trolley attachment, but when leaving an entry to go into a room, the pole is fastened down and a No. 4 flexible insulated cable is hooked upon the trolley wire. The current returns through the bonded room rails to the entry rails."

"In 1899 the Morgan Electric Machine Company placed its first third-and-traction-rail locomotive, or so-called 'sprocket' locomotive, in the Star City (Ind.) mine of the Harder & Hafer Company of Chicago. Whether or not it profited by the failures of its predecessors, it has certainly gone far toward proving that haulage on steep grades can be successfully accomplished by means of electric locomotives."

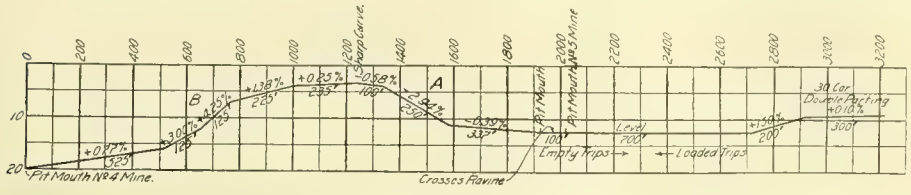


FIG. 1. ELECTRIC MINE LOCOMOTIVES. PROFILE LINE IN COAL MINE.

"The third rail is laid between the two regular track rails and is generally placed five inches to the right of the center of the track. There are three sizes of third rail—standard, heavy, and special, and the component parts of each are made in 16-foot lengths. The standard size will be described. A 6½-inch by 1½-foot white-pine bottom stringer (F), Fig. 3, is securely spiked to the ties, which are first trimmed if necessary to receive it. Upon this stringer are spiked at intervals of about 18 inches pine blocks (E) of sufficient thickness to bring the height of the completed third rail four inches above the height of the steel rails. Two longitudinal pine strips (D), each 2½ by 1½ inches, are spiked to the blocks, leaving a 1½-inch slot between them. They are trimmed on top in such a way as to allow the iron track (C), which is four inches wide and five-eighths-inch thick, to be partially countersunk. This track consists of a flat bar of iron with 1⅝-inch square holes punched through it at intervals of the same distance. It is made continuous by means of perforated fish-plates (J), which are securely bolted to the ends of the two bars at a joint. Two pine strips (D D), which are similar to strips (D) except that they are trimmed on the lower side to cover the iron rail, are laid upon the strips (D) and fastened to them with four-inch spikes. By means of an insulated copper cable, which is connected with the iron bar, the positive electric current is introduced into the third rail. The wooden portion of the rail acts both as a carrier of the iron bar or rack and as a medium for insulating it. The negative current is carried by the bonded steel rails."

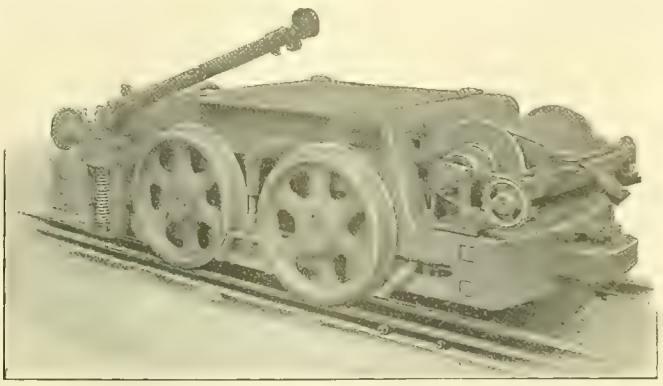


FIG. 2. ELECTRIC MINE GATHERING LOCOMOTIVE.

"The teeth of the two locomotive sprocket wheels,

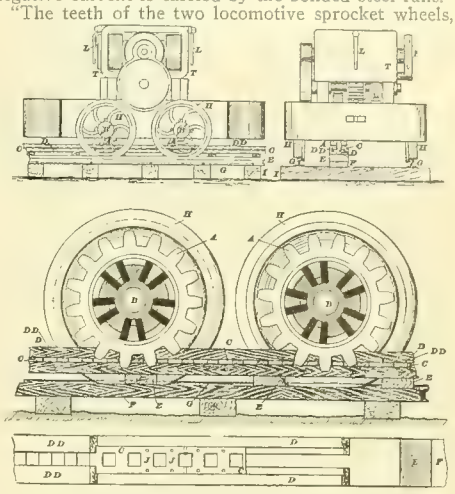


FIG. 3. ELECTRIC MINE LOCOMOTIVES.—RACK AND CONTACT-RAIL SYSTEM.

which are geared to run in unison, run in the slot between the two wooden strips (D D) and (D) of the third rail and engage the iron rail (C). In coming in contact with the charged iron rail, they take up the current, and, through the agency of copper contact springs which rub against them, impart the current to the motor or motors. In revolving, the motor drives the sprockets, and as the construction of the third rail is such as to make it absolutely rigid, the movement of the sprockets in the perforated iron track produces motion of the locomotive. As all transmission of power is through cut-steel gear wheels, loss of power is entirely eliminated. The entire locomotive frame is made of riveted steel. Its speed is easily controlled by means of a powerful brake, working upon a band wheel on or geared to the armature shaft."

Cleveland Three-cent Fare Decision.

Judge Lawrence has refused to make perpetual the injunction against the construction of a three-cent-fare street railway on Denison Avenue, Cleveland, by the Forest City Railway Company. The court held that the withdrawal of consents by certain persons had no effect on the matter, nor did the consents given the Cleveland City Railway Company. The power to grant the franchise is with the City Council, after all, he said. A second injunction suit is pending against the road on the same avenue, but no restraining order has been issued. M. A. Fanning, president of the Forest City company, says that work will be begun on the line at once.

A franchise ordinance has been introduced in the City Council which makes many concessions to the Cleveland Electric Railway Company. The company is asked to state the fare that it is willing to grant in return for the renewal of its franchises under the concessions. President Andrews has promised to meet the City Council with a proposition within a few days. Then the matter will be discussed both by the council and probably in public meetings.

Electric Coal Cutters.

At a recent ordinary meeting of the Glasgow section of the Institution of Electrical Engineers Mr. Samuel Mavor delivered an address on electrical coal-cutting machinery. He said that the number of coal-cutting machines in use in America was between 3,000 and 4,000, whereas the number in use in the United Kingdom was only between 300 and 400. The output of coal per man in the United States was nearly double that in the United Kingdom. This difference was due, in part, to the fact that American seams of coal were thicker than those in the United Kingdom, and the coal was therefore more easily won. The exhaustion of the thicker seams of coal in the United Kingdom and the thin seams now being worked, he said, precluded undercutting in the coal.

Electrical Equipment of Illinois Central Suburban Service.

While it is believed that ultimately the Illinois Central Railroad Company will equip its suburban service in and near Chicago for electrical operation, the report of last week that the company is about to make the change is denied. The subject has been under discussion for the last 10 years or more. That the improvement will be made eventually is taken as certain, but just when no one is bold enough to predict. There seems to be no foundation, at present, for the newspaper story that the Arnold electropneumatic system is to be adopted, while the talk of negotiations with eastern manufacturing companies is probably equally baseless.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

Iowa Electrical Association (annual meeting), Savery House, Des Moines, April 20th and 21st.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

ELECTRIC fountains form one of the oldest types of electrical decoration, but in almost every case the arc light has been used to supply the illumination. But in an attraction of this sort recently erected in the Pompeiian Court of the Crystal Palace in London incandescent lamps within a cylindrical water curtain produce the effect, which is said to be striking. The water, delivered to the fountain through a central hollow stem, is distributed over the surface of a dome-shaped crown, and, leaving the edge of this, descends in the form of a hollow cylinder into the ornamental cistern below. Inside the "water tube" a large number of incandescent lamps of various hues are artistically arranged, and beautiful effects are obtained by the light playing on and through the water. The fountain is about 14 feet high, and deals with 300 gallons of water, circulated at the rate of 1,000 gallons a minute by an electrically driven pump. It diffuses a great deal of light, in addition to being an attractive spectacle, and the falling water, by a fan arrangement, cleanses and cools the air.

JAPAN'S success thus far in the war with Russia was attributed to superior technical training and skill by Mr. William F. Slocum, president of a Colorado college, in a recent address in Chicago before the North Central Association of Colleges and Secondary Schools. President Slocum spoke on "European Problems as Affected by Technical Education." "Japan has trained many of its men in the technical schools of America, Germany and England," he said, "and they have applied their knowledge to good advantage in the handling of their torpedo boats and other equipment for warfare. Technical education has been developed rapidly in Japan during the last 20 years, and its influence has been a large element in the success of the people of that country." This statement is undoubtedly true, and it shows, in a rather unexpected manner, how technical training adds to national assets. In proportion to its size and importance as a nation, Russia has paid little attention to technical education, and, at least in the opening stages of its war with Japan, it is paying the penalty. Technical training is principally valuable in industrial affairs—in the conquests of manufacture and trade rather than of arms—but machinery enters so largely into the operations of modern warfare, especially in the navy, that widespread technical ability is of great value.

ALTERNATING CURRENT is now such a very important factor in the electrical field that it behooves every student to be familiar with its rather complex phenomena and with its applications and possibilities. When one stops to consider its use in power transmission, both for long distances and in city central-station systems: in lighting, both arc and incandescent; in railway work (not only for transmission to sub-stations but recently in direct application to the car motors); in the operation of factory plants, and in other branches of the industry, it is apparent that the alternating current is exercising a profound influence on the whole development of the art of applied electricity. This being the case, it is of prime importance that every man interested in the practical use of electricity should be familiar with alternating-current working.

In view of the importance of the subject, we take much pleasure in announcing a series of articles on "Alternating-current Working," the first of which is published in this issue. These articles are intended for all who wish to extend their knowledge of the theory and practice of alternating-current apparatus. They are carefully written by Mr. Walter B. Gump, an associate of the American Institute of Electrical Engineers and an engineer of practical experience, thoroughly competent to handle the subject which he treats. The general topic is considered in seven articles arranged as follows:

I. Fundamental Properties.
II. Inductance and Capacity.
III. Alternators.
IV. Transformers.
V. Alternating-current Motors and the Rotary Converter.
VI. Power Transmission.
VII. Measurements and Tests.

The articles are illustrated by 72 diagrams and accompanied by tables and mathematical demonstrations where necessary. They will be published in the Western Electrician at frequent intervals, possibly every week until the number is complete, although on occasion it may be found necessary to intermit a week. We regard this series as of much educational value and lay it before our readers with the confident expectation that they will indorse our estimate.

THAT such of the citizens of Chicago as care to vote on the subject continue, by a decisive majority, to favor municipal ownership was shown by the election of Tuesday. Several matters of public policy were submitted to the voters. Of these, three are of general interest. The first question put to vote was as follows:

"Shall the act of the General Assembly of the state of Illinois, entitled 'An Act to Authorize Cities to Acquire, Construct, Own, Operate and Lease Street Railways and to Provide the Means Therefor,' approved May 18, 1903, in force July 1, 1903, commonly known as the 'Mueller law,' be adopted and in force in the city of Chicago?"

To this the answer was: Yes, 152,434; no, 30,104.

Other questions and answers were as follows:

"Shall the City Council, upon the adoption of the Mueller law, proceed without delay to acquire ownership of the street railways under the powers conferred by the Mueller law?"

Yes, 120,744; no, 50,893.

"Shall the City Council, instead of granting any franchises, proceed at once, under the city's police powers and other existing laws, to license the street-railway companies until municipal ownership can be secured, and compel them to give satisfactory service?"

Yes, 120,181; no, 48,056.

It will be observed that the majorities were large in each instance. However, there was a total registration of 359,937 and a total vote of 230,711 for aldermanic candidates. Less than half of the legal electors voted for the Mueller law, showing how large a proportion of the voters are indifferent on this very important subject. Moreover, the recorded opinion of the voters is not mandatory.

MUCH discussion has been caused by the proposed law in Ohio which will turn all franchise matters over to a state commission to be appointed by the governor. Some of the daily papers have characterized the movement as an attempted "grab," while others see some of the good points and speak favorably of it. Of course it will all depend upon the provisions of the bill, but it would seem that such a measure would be, on the whole, more satisfactory than the present means of granting rights to corporations that serve the public, whether in the city or country. At present it is understood that a board consisting of three members appointed by the governor, would have complete control of the matter of franchises of electric-railway, light, gas, water, and other public-service corporations, even to fixing the rate of fare and the price of light and water. These figures they are to determine by hearings, to which the board may summon witnesses. The findings are to be final, and the corporation must abide by them. The salaries of the members are to be $6,000 a year each, with expenses, all to be borne by the companies through an assessment.

While it would seem that a state commission is probably advisable, there are things in the bill that could be amended to the advantage of both the state and the corporations. In the first place, the authority should not be absolute. There should be some means of appeal. Too much power is sometimes worse than none at all. Again, if the state desires such control it hardly seems fair to assess the cost of maintaining the board upon the companies. Very few of them have asked for the change. However, if the commission could be operated along lines used by a similar board in New York, it might be advantageous.

The trouble with the present method of granting franchises is, in one word, politics. City councils and county commissioners too often overlook the real merits of an enterprise in their eagerness to forward their own interests. Other forms of personal benefit and profit sometimes enter into the decisions, and occasionally spiteful prejudice goes a long way in the determination of important questions. Public-service corporations assert that if their applications were taken up purely upon their merits and they were not forced to petty dickering with city and village councils their officers could give their time and energies to building and putting into operation better properties, serve the people better and for less money.

The Incandescent-lamp Situation.

The situation in the incandescent-lamp trade is of great interest just now to all makers and users of incandescent lamps. For the last year or two a large proportion of the incandescent-lamp manufacturers have been closely associated, and the movement appears to have resulted in a number of meetings held recently in Cleveland and New York. As the result of these meetings it is announced that most of the companies manufacturing incandescent lamps in the United States have become licensees under the several patents relating to incandescent lamps and certain processes for their manufacture controlled by the Edison Electric Light Company, or, in other words, by the General Electric Company. The licenses to the manufacturing companies are issued for five years, with the privilege of further renewal for five years.

Mr. J. H. Wormley, the secretary of the New York meetings, announces that the followed-named companies are the licensees under this general movement:

Downward Light Electric Company, New York.
Sterling Electrical Manufacturing Company, Warren, Ohio.
Brilliant Electric Company, Cleveland, Ohio.
Banner Electric Company, Youngstown, Ohio.
Franklin Electric Manufacturing Company, Hartford, Conn.
United States Incandescent Lamp Company, St. Louis, Mo.
Standard Electrical Manufacturing Company, Niles, Ohio.
Capital Electric Company, Denver, Colo.
Gilmore Electric Company, Boston, Mass.
Liberty Electric Company, Pittsburg, Pa.
Warren Electric and Specialty Company, Warren, Ohio.
Colonial Electric Company, Ravenna, Ohio.
Shelby Electric Company, Shelby, Ohio.
Bryan-Marsh Company, Marlboro, Mass.
Buckeye Electric Company, Cleveland, Ohio.
Munder Electric Company, Springfield, Mass.
Sunbeam Incandescent Lamp Company, Chicago.
Independent Incandescent Lamp Company, Cleveland, Ohio.
New York and Ohio Company, Warren, Ohio.
Fostoria Incandescent Lamp Company, Fostoria, Ohio.
General Incandescent Lamp Company, Cleveland, Ohio.
National Electric Lamp Company, Cleveland, Ohio.

This leaves seven or eight companies which have not entered the license agreement, but it is said that some of these companies are likely to do so. In fact, it is asserted that there is a stipulation that all companies which were exclusively manufacturers of incandescent lamps on April 1, 1904, are entitled to the license privileges.

However, the licensee scheme is not without vigorous opposition. The Sawyer-Man Electric Company of New York, controlled by the Westinghouse interests, issued on March 30th this official statement to users of incandescent lamps: "We are advised that circulars are being sent out by competing companies to certain dealers alleging that lamps not of their manufacture infringe certain patents. We desire to assure you that we will at our own expense defend any or all suits or proceedings that may be instituted against you for the infringement, or alleged infringement, of any patent or patents by reason of the sale or use of any of the Sawyer-Man incandescent lamps, provided you will kindly notify us in writing of the institution of suit or proceedings, in order to permit our counsel to act effectively. The Sawyer-Man Electric Company is one of the oldest electric companies in this country engaged in the manufacture of incandescent lamps and the owner of a number of basic patents under which other companies are manufacturing lamps. In this connection we wish to advise you that recent important developments in the art of incandescent-lamp making enable this company to place upon the market at this time lamps possessing mechanical and electrical features which are superior to the product of any other company."

At the time of issuing this announcement it was stated that the Sawyer-Man Electric Company would not enter any incandescent-lamp combination, but would remain independent. The General Electric and Westinghouse companies have an agreement to exchange certain patent rights, but this does not extend, apparently, to incandescent-lamp patents.

The incandescent-lamp patents controlled by the General Electric Company and to which particular reference is made in the licensee arrangement are the following:

United States patent No. 537,693 of April 16, 1895.
United States patent No. 726,293 of April 28, 1903.
United States patent No. 444,530 of January 13, 1891.
United States patent No. 532,760 of January 22, 1895.
United States patent No. 754,251 of March 8, 1904.

Patent No. 537,693 was granted to Arture Malignani of Udine, Italy, on "Process of Evacuating Incandescent Lamps," and is popularly known as the chemical exhaust. It is asserted to be practically a necessity in the making of high-grade lamps, as the highest grade of vacuum is possible by the use of this process.

Patent No. 726,293 was issued to John W. Howell and is regarded as an improvement on the Malignani process.

Patent No. 444,530, issued to Thomas A. Edison, is a detail patent, yet said to be very valuable. The process described is, essentially, that of "tying a knot" between the platinum and the copper wires. These wires are welded together, and the (seal) glass is then squezed around them from a piece of glass tubing. The "knot" being sealed in the glass, any danger of the platinum wire working up and down, and thus becoming loosened in the glass, is prevented.

Patent No. 532,760 was issued to Mark H. Branin of Lynn, Mass. It describes a sealing-in process by which the seal is brought between the filament support and the neck of the bulb upon the outside of the neck, forming an anchorage for the bulb in the lamp collar.

Patent No. 754,251 is the most recently issued of the lot. It was granted to Charles P. Steinmetz and appears to relate more particularly to the Meridian lamp.

It is announced that about 30 suits have been entered by attorneys for the General Electric Company against jobbers, dealers and consumers in connection with these patents, and it is now stated that all these suits will be withdrawn.

On behalf of the General Electric Company and its licensees it is said that the warfare in incandescent-lamp prices will be largely eliminated now and that a more stable market will obtain hereafter. This means, undoubtedly, that there will be some advance in prices.

Itinerary of International Electrical Congress Guests.

The first meeting of the International Electrical Congress reception committee of the American Institute of Electrical Engineers was held in New York on March 24th, at which Chairman J. W. Lieb, Jr., proposed an itinerary for the tour of the European visitors, which was accepted. The details of the tour, as suggested, were thoroughly discussed, and while there was a feeling that it would be a severe tax upon the visitors, it was difficult to see how the trip could be curtailed without omitting some desirable and important features. Ladies are expected and special arrangements will be made to insure their comfort. The foreign guests of the Institute are expected to arrive in New York previous to September 3d. After this date the itinerary will be as follows:

Sunday, September 4, 1904—New York city.—This day will be spent in a steamer ride up the Hudson River.

Monday, September 5th.—The visitors will inspect points of engineering interest in New York city. In the evening there will be a reception to the visitors, under the auspices of the American Institute of Electrical Engineers.

Tuesday, September 6th—Schenectady, N. Y.—The party will be received and entertained by the General Electric Company at Schenectady.

Wednesday, September 7th and Thursday, September 8th—Montreal, Canada.—Reception at McGill University, Montreal, and visits to the important power transmission plants in the vicinity.

Friday, September 9th—Niagara Falls, N. Y.—Visit to the falls and the important power houses and electrical industries of the locality.

Saturday, September 10th—Chicago, Ill.—Visits to important power houses and local points of interest.

Sunday, September 11th—St. Louis, Mo.—To be spent in St. Louis, resting, etc.

Monday, September 12th.—Opening of the International Electrical Congress at 10 o'clock a. m., with joint sessions of all of the sections.

Wednesday, September 14th.—Special joint session between the American Institute of Electrical Engineers and the British Institution of Electrical Engineers, to which all foreign guests are invited.

September 13th, 14th, 15th and 16th.—Sessions of the various sections of the Congress each day from 9 to 12 a. m. and from 1:30 to 4:30 p. m.

Saturday, September 17th.—Closing general sessions of all sections of the International Electrical Congress.

Monday, September 19th—Pittsburg, Pa.—Reception and entertainment by the Westinghouse company, and visits to important and interesting local industries.

Tuesday, September 20th—Washington, D. C.—Inauguration of the National Bureau of Standards at Washington and visits to places of local interest.

Wednesday, September 21st—Philadelphia, Pa.—Visits to important power houses and points of interest.

Thursday, September 22d—Boston, Mass.—Visits to power houses, Harvard University, Massachusetts Institute of Technology and places of local interest.

Friday, September 23d.—Unassigned.

As an executive committee of the general reception committee the following-named gentlemen have been selected: F. J. Sprague, J. J. Carty, J. C. Barclay, Calvert Townley, H. W. Leonard, I. B. Stillwell, George G. Ward, E. H. Mullin, H. G. Stott. J. G. White, F. W. Jones, J. W. Lieb, Jr.

The following-named gentlemen were elected chairmen of the local reception committees: New York, Mr. T. C. Martin; Schenectady, Mr. E. W. Rice, Jr.; Montreal, Professor R. B. Owens; Niagara Falls, Mr. George W. Davenport; Chicago, Mr. Samuel Insull; St. Louis, Lieutenant W. V. N. Powelson; Pittsburg, Mr. Charles F. Scott; Washington, Mr. O. T. Crosby; Philadelphia, Mr. J. B. McCall; Boston, Mr. C. L. Edgar.

Arthur Warren.

The Allis-Chalmers Company with the recent important extensions to its field of operations has thought it desirable to create a department of publicity, and for this purpose, as previously stated in the Western Electrician, has been fortunate enough to secure the services of one of the most experienced men in the business, Mr. Arthur Warren, whose achievements in technical and popular journalism and in the promotion of great industries are so well known in America and in Europe that they do not need description here.

ARTHUR WARREN.

Mr. Warren is a journalist and an author. In the New York Times he recently told what a publicity department is and ought to be. He is a native of Boston and was educated in that city and in Europe. His qualifications for his work are unique. Before he became a journalist he had some machine-shop practice so that he might become familiar with the mechanical end of a business at whose commercial end he was seeking a position. He got his position and it sent him traveling. Then his services were sought by the press, and after a sojourn in Europe he joined in January, 1883, the staff of the Boston Herald and became its chief special writer. People and places and economics were his subjects, and he was also engaged with conspicuous success in literary and dramatic criticism. On industrial themes he wrote much and his articles were widely quoted.

In December, 1888, Mr. Warren went abroad as London correspondent of the Boston Herald. He remained nine years, making a high reputation and a world-wide acquaintance. His London home he still retains, spending in it a few weeks of every year. The studies he made of industrial conditions in Europe and America have furnished many a text for public workers.

In November, 1897, George Westinghouse invited Mr. Warren to return to the United States, offering him an important place on his executive staff. Mr. Warren accepted the offer and organized the Westinghouse companies' publishing department, with headquarters in New York, Pittsburg and London, and, as a contemporary writer has said, "his record of solid achievement in the way of publicity of the best kind; in articles and advertising, in pamphlets and displomacy, has never been surpassed."

In February, 1904, Mr. Warren resigned his Westinghouse connections after a period of rather more than six years of successful work, which had kept him busily oscillating between the continents (he has made over 40 voyages). He had made all his plans for returning to the scene of his former literary and editorial activities and had engaged his passage for London for the 12th of March. But early in March Mr. Edward D. Adams, chairman of the executive committee of the Allis-Chalmers Company, sent for him and offered him the post of chief of publicity for the Allis-Chalmers organization under its new regime. So he is now installed in his new position, and while he may himself entertain regrets at not following up the purely literary work offered to him, it is a matter for congratulation that he will devote his time and energies to the publicity side of one of the great mechanical and electrical enterprises in the United States.

Mr. Warren has remarkable ability for work, but he works easily and never appears busy. In Boston he kept up the Boston Herald work, edited a local weekly and wrote for the New York papers. He has also written several books. For several years he has owned the Kirkwood Inn at Scarborough Beach, Maine, one of the best-known family resorts on the New England coast. Here Mr. Warren and his family make their summer home. Mr. Warren is a member of the Engineers and Lawyers Clubs in New York, and of the Automobile and Whitefriars Clubs of London.

Mueller Law Is Approved.

Chicago voters, by a large majority, have declared in favor of the Mueller law, under which the city can in the future, if it so desires, assume ownership of its street-car lines. The vote was 152,434 for and 30,104 against. The advocates of immediate municipal ownership mustered 120,744 votes, securing a majority of 69,851, or 52,479 less than for the Mueller law. The proposition to license street-car companies instead of granting them franchises, as at present, received a majority of 72,125. The voting on these propositions was at the aldermanic election of April 5th.

The hydraulic turbine of today is by no means a late invention. The Chaldees are said to have made use of a simple turbine called the "shell wheel" in the city of Van 2,000 years B. C. There still remain canals, one of which is 60 miles long, which this ancient people used to convey water to the turbines for driving flour mills. Ruins of these structures are still to be seen. The country of the Chaldees adjoined what is now Armenia, and should not be confused with ancient Chaldea.

Warner Magnetic "Cut-meter."

Instruments for correctly indicating the circumferential velocity of flywheels, of stock in lathes, planers and other machine tools, or for indicating the velocity of elevators, etc., have always presented difficulties in the matter of design, especially where the attempt has been made to make use of centrifugal devices. Centrifugal force increases as the square of the speed, necessitating the spacing of the scale divisions farther and farther apart and limiting the scope of the instrument.

An ingenious device has been placed on the market by the Warner Instrument Company of Beloit, Wis., which is illustrated herewith. Fig. 1 is a view of the "cut-meter," as it is termed, and Fig. 2 a cross-section of the instrument.

The meter contains a magnet (c) carried by the ball bearing (b). The outside is threaded and screws into the outer case (a). The ball bearing is secured by a spring washer, and can be turned only with a specially shaped wrench, as it is not intended to be moved except in the factory. In front of the magnet is a soft steel ring (d), which deflects the lines of force through the aluminum disk (g). This disk is mounted on a hardened-steel shaft and is supported by the jewels (j). On the outside edge of the aluminum disk are engraved the figures indicating the speed. Also attached to this shaft is a hairspring (h), so adjusted that it resists the turning of the aluminum dial, and brings it back to the zero point when the magnet is at rest. The jewel bearings and the steel ring are carried by the inner case (e), which telescopes into the outer case and can be removed at will. The inner case also serves the purpose of protecting the dial (g) from the air currents set up by the magnet when revolving. Through both outer and inner case is an opening, covered by a glass (k), through which the figures on the aluminum dial can be read. Attached to the main shaft is the driving wheel or disk, of proper diameter, having a grooved periphery, into which is snapped a miniature rubber tire (m).

The lines of force of the magnet flow from the north pole through the aluminum dial to the steel plate, and back again through the dial to the south pole of the magnet. When the magnet is revolved it sets up a dragging, or accessory action, in the dial, this action or rotation being in proportion to the speed of the magnet, and as the hairspring is subject to the same law, it is evident that increasing the speed of the magnet will increase the displacement of the dial in exact proportion. The dial or scale can therefore be marked by equal divisions from the lowest to the highest reading. Since adjusting the magnet closer to the steel ring increases the torque, or dragging effect, it is only necessary to select a hairspring of proper stiffness, to revolve the magnet at a known speed, at the same time adjusting the ball bearing until the scale indicates the correct speed. The instrument will then be accurate on the entire range of the scale, and will remain so permanently, there being no necessity for subsequent adjustment or recalibration.

As there are no mechanical connections between the magnet and the indicating dial, and as the magnet runs very easily (there being always an abundance of power to drive it), there can be no possible inaccuracy up to this point.

Mounted on a steel shaft is the indicating dial, the points of which are hardened and supported in sapphire jewels. How perfectly this is accomplished can be judged from the fact that a change in speed of one-fifth of one per cent. is shown on the dial. It should not be thought that because this disk is mounted on jewels that the instrument is a delicate one, requiring careful handling. Since the dial and shaft are very light, the strength of the jewels and pivot is much greater in comparison to the weight and experience has shown that they will stand the regular service likely to be given in any ordinary machine shop.

Obviously the vital part of the cut-meter is the magnet. Especial care has been exercised in the design at this point, with the very necessary result that the magnet is practically permanent under all conditions. The manufacturers contend that the design is an ideal one for maintaining permanency. The air gap is only about one thirty-second of an inch, or about one-half of one per cent. of the entire length of the magnet. This narrow air gap effectually prevents the instrument from being influenced by outside magnetic forces. The steel used is of a special quality. The pieces are first hardened, then magnetized, and then aged by a process which prevents further change in strength. They are carefully tested and laid aside for a considerable interval before being retested. If they show the slightest loss of strength between these tests the magnet is discarded.

The instrument is sufficiently small and light so that it can be carried in the pocket without inconvenience. It presents a handsome appearance, being substantially constructed of brass, nickel plated. The handle is turned from a hard tropical wood and is highly polished.

The machine-shop manager, who with one of these instruments tests every machine in his factory, will be surprised at the results and will be astonished at the great difference between what he supposed his cutting speed to be and what the instrument shows it actually to be.

Fig. 1 Device Ready for Use

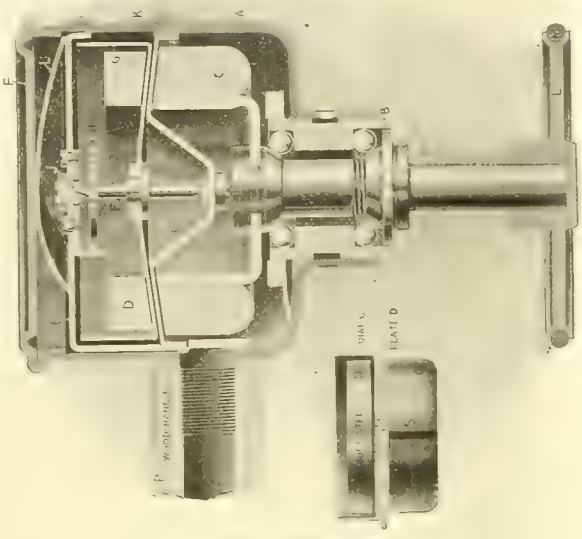


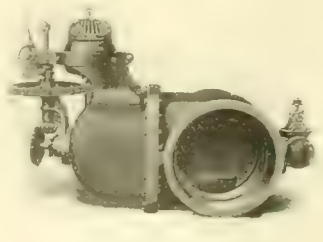
Fig. 2 Sectional View.

WARNER MAGNETIC "CUT-METER."

Motor-operated Valves.

One of the useful applications for the small electric motor is the operation of heavy valves, which, when turned by hand, often require the efforts of several men. The opening and closing of such valves by electric motors is especially desirable in electric power plants, since the motors can be controlled from the main switchboard.

The Northern Electrical Manufacturing Company of Madison, Wis., has developed a system of valve operation by electric power. Under this system the motor is geared direct to the valve mechanism and is always ready for operation. The motor can be started at a central point, and any distance from the valve without necessitating the presence of anyone at the valve. A few small wires constitute all the connections between it and the station. There are no packings to dry up during inaction and to leak when the valve is being opened or closed, as when hydraulic power is used. There is no water to freeze in the winter time, or oil to drop into the water mains and pollute the water supply, as is the case when oil is used as a substitute for water to avoid freezing.



MOTOR-OPERATED VALVE.

The motor is always ready and can be started by any ordinary laborer at a moment's notice, and stopped just as readily. It is clean, practically noiseless and unaffected by wind or weather. It is highly economical and consumes no power except when the valve is being operated. The complete system of valve operation, which comprises safety and indicating devices, is such that the motor automatically will be stopped when the valve is full open or full closed, so that the valve cannot be injured in any way, by neglect of the operator in shutting off the power.

The accompanying picture illustrates a standard gate valve equipped with a Northern universal motor. The gate proper is of the ordinary type, with one-piece valve not easily injured by jamming the plug to its seat. The motor is supported in a split bracket, which is solidly bolted to the gate cap. The gearing is simple and provides proper reduction of speed for operating the bronze screw. An indicator wheel placed in close proximity to the handle shows at a glance just how far the gate is open or closed, and by reversing the position of the lever the operation of the gate is stopped. Provision is made for the operation of the gate by hand when this is essential.

If the valves are not accessible for lever-throw devices, the gates can be arranged to be controlled from a common switchboard from any distance. The motor is first brought up to speed and the valve operated by throwing in the clutch.

Besides the operation of gate valves, the motors are also made to open and close rising-screw gate or sluice valves by a simple system of bevel gearing.

Tesla Split-phase Patents.

In the action brought by the Westinghouse Electric and Manufacturing Company against the Electric Appliance Company of Chicago to restrain that company from selling or manufacturing the Gutmann wattmeter, Judge Kohlsaat of the United States Circuit Court in Chicago handed down the following decision on March 26th, sustaining the Tesla patents Nos. 511,559 and 511,560, on the rotating-field split-phase system, and granting the injunction asked for:

"This case comes now on to be heard upon complainant's motion for an injunction pendente lite restraining defendant from infringing letters patent Nos. 511,559 and 511,560. The inventions relate to the operation of rotating-field motors upon a single alternating-current circuit, under what is known as the Tesla split-phase system, applied in the present case to the operation of electric motors. The former patent covers the method of operating the motors, while the latter covers the means for so doing. The inventions may be said to consist in splitting the current, at the motor, into two or more branches, constituting the independent circuits of the motor, and producing by artificial means the difference of phase necessary to operate the motor. The drawings of the patents seem to call for an armature in the form of a cylinder.

"The defendant's armature consists of a disk. The specification and claims, however, of the patents in suit are not limited to details of form, but call broadly for 'an armature within the influence' of the energizing circuits. I am of the opinion that defendant's device is fairly embraced within the terms of the patents in suit. Both are operated under the principles of Tesla's patent of May 1, 1888, the invention of which was the production, by means of a series of stationary magnet poles, energized by alternating currents of different phase, of an effect upon an armature, mounted within the influence of such poles, similar to that which would be produced upon the same armature by rotating around it bodily the pole or poles of a physical magnet. The equivalency of the two is shown in Gutmann patent No. 614,225, under which defendant's device is manufactured. The difference in the location and application of the magnetic influence is equalized and compensated by a corresponding difference in the angles of the slots in the cylinder or disk. The principle of the rotary impulse and progression is the same. The question is satisfactorily settled for the purpose of this motion by the respective decisions in the suits brought by complainant herein v. Roberts, decided by Judge Archbald of the Eastern District of Pennsylvania, September 10, 1903, and same v. Mutual Life Insurance Company et al., decided by Judge Hazel of the Western District of New York, February 4, 1904.

"I deem the question of infringement duly established. From the record it appears that the validity of the patents in suit is assailed principally upon the Bailey and Ferraris publication set out. The former was practically eliminated from this case by the decision of Judge Townsend of the Second Circuit in the original suit upon Tesla's fundamental patents Nos. 381,968, 382,270 and 382,280, entitled Westinghouse Electric and Manufacturing Company v. New England Granite Company, 103 Fed. Rep., 95, which ruling was affirmed on appeal 110 Fed. Rep., 753, and again by Judge Archbald in the Roberts case (supra.). In the case of this complainant v. the Catskill Illuminating and Power Company, 121 Fed. Rep., 631, the Court of Appeals for the Second Circuit reversed the decision of Judge Lacombe, 110 Fed. Rep., 377, largely upon the ground that it did not appear from the record that Tesla's said inventions were not anticipated or described in the paper read by Professor Ferraris before the Royal Academy of Sciences, of Turin, Italy, on March 18, 1888, and published, in part, in an electrical journal issued at

Milan on April 22, 1888. This ruling was followed by Judge Colt of the First Circuit in the case of complainants herein v. Stanley Instrument Company, not yet published. In the cases of Roberts and Mutual Life Insurance Company of New York (supra.), as herein, this difficulty was overcome. The records in those cases, together with certain original proofs herein, corroborative thereof, are now before the court, from which I am satisfied that Tesla's inventions in suit antedated the Ferraris article, and were original with him, and that the said patents are valid.

"It therefore becomes unnecessary to pass upon the other questions raised by complainant.

"The patents being found valid for the purposes of this motion, and also infringed, it follows that the preliminary injunction should be granted. Complainant's counsel may prepare an order in compliance herewith."

Hornberger-Irwin Transformers.

Varied types of the Hornberger-Irwin transformer are shown by the accompanying illustrations. For sizes from 20 kilowatt to 100 kilowatt inclusive a case design is used as shown in Fig. 1, which consists of a cast-iron base and cover. The body is of sheet steel of substantial thickness, securely riveted to the base in such a manner as to make leakage of oil impossible. It is known that the radiating surface of a transformer does not increase in the same proportion as its capacity. Hence, with transformers after reaching a certain size, the question of radiation has been a serious problem. With the temperature inside of the case, greatly in excess of the external temperature, moisture will accumulate, especially when the case is of cast iron, as the necessary thickness of the walls prevents the free and rapid radiation of the normal heat, even when the case is

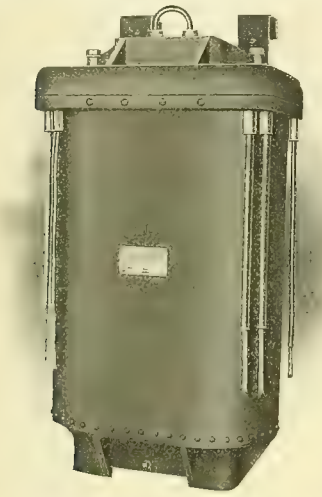


FIG. 1. HORNBERGER-IRWIN TRANSFORMER OF 30-KILOWATT CAPACITY.

filled with oil. A cast-iron case should therefore, according to some authorities, be used only for transformers of small size, wherein low-operating temperatures are inherent, and thin iron case walls possible. While a sheet-steel case is more expensive to build, it is superior to a cast case, for the reasons stated, and the weight is greatly reduced. As a comparison the 50-kilowatt case complete weighs only 350 pounds, whereas in the same size the weight of a cast-iron case is over 800 pounds.

For sizes larger than 100 kilowatts the design of Fig. 2 is used, as shown, which is made for foundation support only on account of the weight, and can be arranged for either oil, air-blast or water circulation. The construction is massive and in keeping with the size and heavy duty for which designed. This type is common to street-railway work or for long-distance, high-voltage transmissions. It is designed for any frequency from 25 periods a second up, and for either single or multi-phase circuits, and for any voltage. In most sizes of this type the multi-coil construction is employed, in which are embodied special features of safety not possible in the shell-type construction. The complete transformer is made up of many coils, each having the required number of ratio turns within itself, all coils then being joined in multiple to the terminals. A possible disablement of one coil does not mean that the transformer must be entirely replaced, but only that coil which is injured, as the correct terminal voltage is obtained, even were a number of coils removed from the transformer; therefore its operation is affected only to the extent that its capacity would be reduced by the number of coils not in operation.

The manufacturers of the Hornberger-Irwin transformer call attention to the fact that many buyers of transformers lose sight of the point that true efficiency in a transformer does not alone consist of low-iron loss and good regulation. It is easily possible, the manufacturers say, to fulfill both of the above conditions in two different transformers of the same rated capacity but different in weight, and while one transformer will operate at a low temperature the lightweight transformer will run at a high temperature. It is obvious that the temperature has everything to do with true efficiency, as the life of the insulation as well as the permanent magnetic quality of the iron core is directly dependent. Owing to liberal design and to the special feature of multi-coil construction, as shown in Fig. 3, the rise of temperature in the Hornberger-Irwin transformer is said to be small.

The iron loss of a transformer of a given size depends directly upon the quality of the iron, upon the volume of the core, and the extent to which it is magnetized. The iron losses are also increased as the frequency is lowered. This is due to a higher density of the iron being reached when subjected to a magnetizing force for a greater length of time.

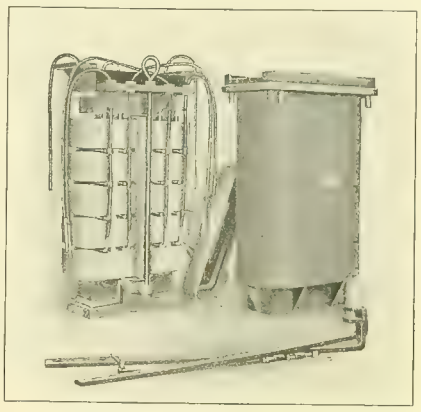


FIG. 3. HORNBERGER-IRWIN TRANSFORMER READY TO ASSEMBLE.

Thus, in order to produce the best transformer it is necessary to keep in mind the above conditions.

Hysteresis losses in the iron are ever present, but do not increase perceptibly when the core temperatures do not exceed a certain figure. However, with an inferior grade of iron, or with good iron operated at too high a density a constant increase in hysteresis loss occurs. This results in the aging of the iron. With the multi-coil core-type construction and the low densities employed, together with the use of steel made under rigid specifications, low temperatures are attained and the aging of the cores decreased when operated in accordance with specifications for which the transformers are designed.

Oil used in the larger sizes maintains the transformers at a more equal temperature and contributes to the rapid radiation of the natural heat of the core. As inferior oil is very detrimental, the oil used in the transformers should be furnished by the makers of the transformer.

All transformers before being crated for shipment are carefully and critically tested in order that any possible deficiency may be discovered in the factory instead of by the customer. A breakdown test of

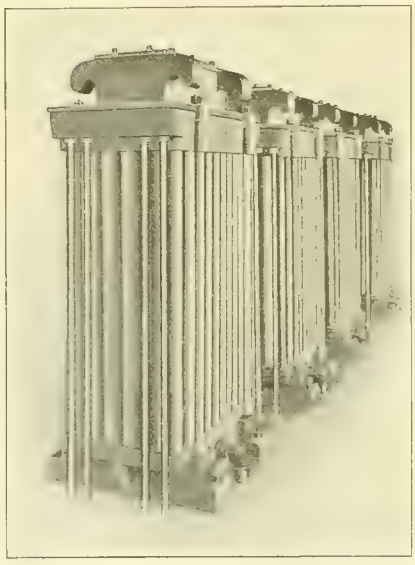


FIG. 2. HORNBERGER-IRWIN AIR-BLAST TRANSFORMERS OF 300-KILOWATT CAPACITY.

10,000 volts is applied between the primary and secondary windings as well as between the windings and the core.

In the selection of insulating material special attention has been paid to its behavior after long periods of use in transformer work. It is perhaps unnecessary to say that of all forms of insulation preparations of mica are the best and should be selected in all cases for transformer work. Mica insulation is used throughout in the construction of these coils and is prepared under the most rigid supervision.

Ample allowance of copper has been provided for the increased amount of current which is required in the operation of inductive apparatus of low-power factor.

Hornberger-Irwin transformers are built for all classes of multi-phase distribution in single-transformer units for the combined phases, although it has been customary to use single-phase transformers connected together, one transformer to each phase. Single-unit polyphase transformers are recommended on account of the better results obtained in the direction of regulation and efficiency, compactness of design and lower cost. The cross-section of copper allowed is liberal, and in addition to this the copper used is that refined by the electrolytic process.

The Hornberger-Irwin transformers are built by the Crawfordsville Electric Company of Crawfordsville, Ind., recently organized by H. H. Hornberger and O. C. Irwin, together with G. B. Luckett as secretary. It is the purpose of the company to devote itself generally to the manufacturing of alternating-current machinery of standard character, the factory being well equipped with the necessary tools, while the officers and employes of the company are familiar with the manufacture of alternating-current apparatus.

New Members of the Institute.

Among those elected to associate membership in the American Institute of Electrical Engineers at the directors' meeting in New York city on March 25th were the following-named:

Anderson, William, Cascade Water Power and Light Company, Cascade, British Columbia.
Babcock, A. H., Southern Pacific Company, Oakland, Cal.
Boldenweck, F. W., Western Electric Company, Chicago, Ill.
Canada, W. J., Dayton, Springfield and Urban Electric Railway Company, Springfield, Ohio.
Childs, J. S., Buffalo, N. Y.
De Forest, Lee, De Forest Wireless Telegraph Company, New York city.
Feather, R. J., Columbus Railway and Light Company, Columbus, Ohio.
Gaines, C. A., Board of Fire Underwriters of the Pacific, Salt Lake City, Utah.
Giles, A. F., General Electric Company, Atlanta, Ga.
Harvey, Dean, Underwriters Laboratories, Chicago, Ill.
Hazen, W. P., Central Market Street Railway Company, and Columbus, London and Springfield Railway, Columbus, Ohio.
Horne, S. H., Indiana Electric Construction Company, San Francisco, Cal.
Hull, R. E., Okani Hull Company, Columbus, Ohio.
Keller, Arthur, Northern Electrical Manufacturing Company, Madison, Wis.
Lanier, A. C., University of Tennessee, Knoxville, Tenn.
Lindberg, F. A., with George M. Brill, Chicago, Ill.
Miller, F. H., Louisville Railway Company, Louisville, Ky.
Ogle, J. H., New Orleans Lighting Company, New Orleans, La.
Paige, Nathaniel, Jr., Westinghouse Electric and Manufacturing Company, St. Louis, Mo.
Price, W. M., Seattle Electric Company, Seattle, Wash.
Reed, L. C., Interstate Electric Company, New Orleans, La.
Lukes, J. B., Seattle Electric Company, Seattle, Wash.
Manley, R. E., Central Union Telephone Company, Columbus, Ohio.
Simpson, F. G., Ballard Electric Company, Seattle, Wash.
Smith, A. B., Woodbine Telephone Company, Woodbine, Iowa.
Stone, Frank J., Electric Storage Battery Company, Somerville, Mass.
Titus, J. Van E., Garton Daniels Company, Keokuk, Iowa.
Wellman, H. P., Camden Interstate Railway Company, Ashland, Ky.
Willard, Ben, General Electric Company, New Orleans, La.

COMMUNICATION.

Prof. H. B. Smith's High-potential Work.

To the Editor of the Western Electrician:

In your issue of March 26th, on page 248, you allude to the high-potential transformer designed and built under the direction of Professor Harold B. Smith, Worcester, Mass. In that note, however, you speak of this work as having been done by four students of "the Massachusetts Institute of Technology." Permit me to call your attention to the fact that you have inadvertently credited this work to the wrong institution. Professor Smith is professor of electrical engineering in the Worcester Polytechnic Institute; and the high-potential work which has been done during the past few years and which has attracted considerable attention not only in this country but in Europe, has all been done under his direction, and either by him personally or by his students in connection with their thesis work.

Will you kindly make the necessary correction in your next issue, giving it such prominence as would seem to be necessitated by the widespread publicity which has been given to the matter through your error? In connection with this it may be stated that Professor Smith's work has obtained among scientific men such wide recognition that he has been invited by the committee in charge to present a paper on this subject before the International Electrical Congress to be held at St. Louis in connection with the World's Fair in September. Professor Smith has accepted the invitation and some important results which have never yet been published will be presented by him at that time.

Lewis L. Conant,
Professor of Mathematics.
Worcester Polytechnic Institute.
Worcester, Mass., March 31, 1904.

[The error was a clerical one, occurring in the report of a discussion of Professor Ryan's paper before the American Institute of Electrical Engineers. We are glad to give the Worcester Polytechnic Institute the credit which is its due.—Ed. W. E.]

Evansville Municipal-telephone Scheme Receives Severe Blow.

The Evansville (Ind.) Municipal Telephone Company was worsted on March 28th, when Judge Robinson, special judge, sitting in the Vanderburg Superior Court, overruled the demurrer of the city in the suit of ex-Judge R. D. Richardson to enjoin the city from embarking in the municipal telephone business. Of course the suit for an injunction is still pending, but the ruling on the demurrer practically disposes of the question. Judge Robinson holds that the city has a right to "subscribe" for stock in the telephone company and give in payment therefor a franchise and vote it through the mayor. If the city has placed itself in a situation where it will become indebted, such an obligation is not a present one, and the most that can be said is "that it all depends upon contingencies which may or may not happen."

The court reaches the legal obstacles of the scheme in the delegation of three of the directors by the preferred stockholders. The Indiana statute declares that such preferred stock shall not be voted at any meeting of such company, nor shall the holders thereof, as such, have any voice in the management of the affairs of such company. In the organization of the municipal telephone company there are seven directors, to each of whom the mayor assigns one share of common stock to be held in trust and reassigned at the expiration of his term, each of whom shall be an owner of preferred stock. Until the preferred stock is redeemed three of the directors are designated by the holders of a majority of the preferred. Of the remaining four directors, two are taken from each of the political parties casting the highest number of votes at the last city election. The faith of the city is pledged to the subscribers of the preferred stock to carry out this provision as to the directors, and it is made the duty of the mayor in all elections for directors to cast the vote of the city's stock in accordance with the provision.

Judge Robinson held that it is a fundamental rule of law that a corporation such as the proposed telephone company is created and exists by virtue of statutory authority, and by that only. The statutes must be regarded as entering into and forming a part of the articles of association. Any regulations and provisions inserted in the articles of association in addition to those required by the creative statute would be void. The company can place no restrictions upon the manner of exercising its corporate duties other than the statute provides. The Legislature of Indiana has determined that a sufficient reason exists for denying to a holder of preferred stock, as such, a voice in the management of the corporation. The court upheld the right of Richardson as a taxpayer to sue to prevent a misuse of the corporate powers relating to municipal rights and property and declares the contract void if it is shown that employes of the city are interested, because the statute expressly forbids, either directly or indirectly, their being a party to any such contract or scheme.

It was shown that at the time the subscription contract was made and when approved by the council the members of the council and Board of Public Works were holders of preferred stock in the telephone company. Therefore the court finds that the scheme is illegal—first, because the preferred stockholders are allowed to name certain of the directors, which is contrary to the statute, and, second, the contract between the city and the telephone company is void if employes of the city are interested in the company as private stockholders.

The directors of the Municipal Telephone Company held a meeting during the last week and discussed the status of the company, but took no definite action as to the future. In legal circles the decision is regarded as a deathblow to the municipal telephone idea in Evansville. An appeal to the higher courts, it is asserted, would only afford time more completely to destroy the patience and confidence of the people. There are people who have clung to the dream that the "municipal" telephone plan would be an ideal consummation, and of course they are disappointed at the court's decision, but it is generally understood that Mayor Covert and others prominent in the scheme are heartily glad of the decision as the best way out of a futile attempt to form a partnership not recognized by law.

Independent Long-distance Plans Discussed.

An important meeting of the traffic committee of the new telephone association, which is composed of nearly all of the long-distance Independent telephone companies in the country, was held at the Claypool, Indianapolis, on April 2d, and plans for the betterment of the long-distance Independent service were thoroughly discussed. The principal question considered was the building of connecting links for the long-distance lines and the employment of competent and expert telephone men to map out proper plans for perfecting the general system contemplated. The committee is composed of F. S. Dickson, J. B. Hoge and B. W. Overley of Cleveland, Ohio; C. H. Ledlie and C. M. Foster of St. Louis; M. R. Patton of Kansas City; J. C. Splain of Pittsburg, and S. P. Sheerin of Indianapolis.

Ohio Telephone Notes.

The Baltimore and Ohio Railroad Company is equipping its line between Newark and Chicago Junction with telephones. They will be used for convenience where they can be substituted for telegraph reports, but will not replace the telegraph. It is believed that much time can be saved by their use.

Nearly 50 miles of new line is being constructed by the Weston Home Telephone Company of Weston. A toll line will be built to connect with the Bowling Green system, and at that point with the United States Telephone Company. Franchises have been secured in Custer and Milton also.

Telephone men in Cleveland believe that the measured service will come into general use within a short time. They say that there is too much useless conversation over telephone lines, and it all costs someone something. When the measured service is brought into use, the cost of all conversations will be placed where it belongs. It is believed that a more satisfactory service can be maintained where telephones are used only when necessary.

The Trotwood Home Telephone Company of Trotwood has been incorporated with a capital stock of $10,000 by G. W. Minnich, William Swinger, Joseph Laudes, S. A. Blessing and W. L. Besler.

An increase of capital stock from $10,000 to $20,000 has been made by the Camden Telephone Company of Camden.

Several telephone men met at Dayton a few days ago and discussed the advisability of constructing a line from Dayton to Richmond, Ind., to connect the long-distance lines. This line will be built at an early date, but whether by the United States or a separate company has not been stated.

The Seneca Telephone Company of Gibsonburg has been incorporated with a capital stock of $20,000 by N. B. Erwin, F. C. Harning, F. W. Zorn, C. H. Miller and C. B. Snyder

Bids are being considered for the new Bell telephone building at East Liverpool, and it will likely be under construction before early summer. The building is to be 30 by 70 feet, three stories high, and modern in every particular. C.

Telephone News from the Northwest.

The United States Telegraph and Telephone Company, recently formed at Springfield, Minn., has opened negotiations with the Tri-state Telephone and Telegraph Company of Minneapolis for long-distance connections, and it is expected to be able ultimately to secure connection with Chicago over Independent wires.

Hans Berg and R. G. Welsh have bought the interest of C. R. C. Johnson in the Stevens County Telephone Company at Morris, Minn.

The Wausaukee (Wis.) Telephone Company has sold its toll lines, 51 miles in length, to the Wisconsin Telephone Company.

The city-hall and court-house commission in St. Paul thinks there are too many telephones in use in the building. An inquiry showed that there are 53 Northwestern and 51 Twin City instruments.

A number of rural lines and a local exchange for Finley, N. D., is planned by the Union Telephone Company.

The Renville (Minn.) Rural Telephone Company has been incorporated with a capital of $20,000. A. E. Carver heads the list of incorporators. A line will be built from Renville to Bird Island and Fairfax.

The Pelican Telephone Company has been incorporated at Pelican Rapids, Minn. The capital is $25,000. J. P. Wallace is president and N. P. Moen secretary.

The Duncombe (Iowa) Telephone Company has been incorporated. D. Maricle is president and Dr. J. Thompson secretary.

The City Telephone Company has sold its Farragut (Iowa) exchange to R. Whistler & Sons.

The contract for rebuilding the Mutual Telephone Company's exchange at Des Moines, Iowa, has been let to the Stromberg-Carlson company of Rochester, N. Y. The cost will be close to $250,000.

A convention of North Dakota electrical and telephone men will be held at Grand Forks on May 11th and 12th. R.

Michigan Telephone Matters.

The Michigan State Telephone Company has filed a trust mortgage to secure the issue of $10,000,000 bonds. All the property of the old Michigan Telephone Company has now been conveyed to the new company. This virtually winds up the proceedings. It is understood that the new company will eventually make a settlement with the minority stockholders of the Michigan Telephone Company.

The Michigan State Telephone Company is running a cafe for the benefit of its employes, at which meals are served at a reduced rate from other restaurants. The place has, however, been so much crowded of late that the men have been excluded. It is contended that they are better able to pay a high price than the girls.

It is rumored that the People's telephone plant of Detroit, including the mains in the street and its uncompleted building, has been sold to the Michigan State Telephone Company. It has been denied, however, that the uncompleted exchange building has been sold, the mains only having been turned over to the Michigan company.

A new telephone company may be organized in Detroit in opposition to the newly formed Michigan State Telephone Company, which took over the Michigan (Bell) Telephone Company. T. F. Ahern of Detroit, who built the Detroit Telephone Company's system, says that such a project is in view and that it was proposed to give first-class service at reasonable rates, probably $30 or $45. The organization of this company perhaps accounts for the purchasing of the conduits of the People's Telephone Company (upon which work has been abandoned) by the Michigan State Telephone Company. The new company, it is asserted, will not ask for a franchise. W.

Indiana Telephone Items.

The Waupecong Home Telephone Company of Waupecong has filed articles of incorporation. The capital stock is $1,000. The company will establish an exchange in Waupecong and Miami County. The directors are M. D. Hensler, Taylor Hamilton, Silas Gerber, Andrew Zook and Mast Max.

A telephone company has been organized at Daleville and a portion of the material purchased for a new plant. Daleville has over 1,000 inhabitants and is a thriving town, but has never had a telephone system

The Delaware and Madison County Telephone Company has begun the work of changing instruments and installing its switchboard at Summitville to replace the one formerly operated by the Central Union company, and which was owned by R. M. Inglis. The Central Union hereafter will operate a toll station there only.

After wrangling for 14 months the City Council of Wabash has granted a franchise to the Central Union Telephone Company. The City Council and the Central Union have been at swords points all this time, and for more than a year the company has been doing business in Wabash by sufferance, the franchise having expired more than a year ago.

The City Council has not yet approved of the change in the corporate powers and methods contemplated by the Indianapolis Telephone Company, which, by the terms of the New Telephone Company's franchise, requires the approval of the Board of Public Works and the council. It is generally believed the approval will be obtained, since the change will enable the company to enlarge its facilities and extend its business. However, there are two distinct organizations and the franchise was granted to and authorizes the one only to do business. F

TELEPHONE MEN.

At the annual meeting of the American Telephone and Telegraph Company in New York, on March 29th, Thomas B. Bailey was elected a director to succeed the late J. Malcolm Forbes. Over 1,000,000 shares of stock were represented, mostly by proxy.

Frank H. Bethell was recently elected general manager of the Chesapeake and Potomac Telephone Company, with headquarters in Washington, D. C., his duties beginning on April 1st. Previously to his election to the office which he now holds Mr. Bethell was contract agent for the New York Telephone Company.

Retiring General Superintendent J. W. Lattig of the United Telephone and Telegraph Company was recently presented a handsome dinner set of 150 pieces and a cut-glass water set at the company's offices in Philadelphia by the employes of the United company, as well as the officers of the York State Telephone Company, the officers of the Eastern Electrical Construction Company and the officers of the Eastern Telephone Manufacturing Company, with whom he has held business relations. Mr. Lattig has been with the United Telephone and Telegraph Company for 2½ years, and during that time, as shown by the handsome gift, he has earned the good will and earnest co-operation of everybody from the officers of the company down. Mr. Houck, the traffic manager, made the presentation. Mr. Lattig has begun new duties with the Delaware and Atlantic Telephone and Telegraph Company.

NEW COMPANIES.

The Newark Telephone Exchange of Newark, N. Y., has been incorporated. The capital is $25,000 and the incorporators are E. A. Smith, J. E. Pulver and E. P. Thatcher of Newark.

The Hotel Telephone Company, with headquarters at Albion, N. Y., has been incorporated by C. M. Beattie and Garrison Babcock of Rochester and G. L. Merrill of Albion. The capital stock is $50,000.

A. J. Davis and associates have organized the Tremont Independent Telephone exchange at Tremont, Ill., where they propose to operate a telephone system. The company has been incorporated with a capital of $20,000.

A local telephone company will probably be organized at Vacaville, Cal., in opposition to the Sunset Telephone Company. The Vacaville Water and Light Company has offered the use of its poles throughout the city to the new company.

Philip King, W. J. Reid and T. B. Mitchell have incorporated the Edwards County Mutual Telephone Company of Albion, Ill. The company is capitalized at $8,000, and it is proposed to operate a telephone system throughout Edwards County.

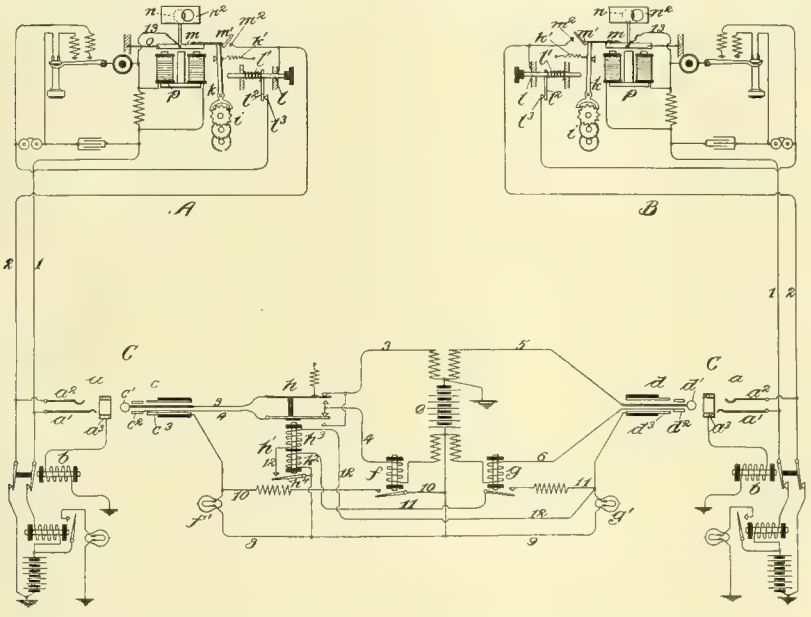
Service Meter for Telephone Lines.

Frank R. McBerty of Chicago has recently invented a service meter for toll lines, assigned to the Western Electric Company. Reference to the accompanying diagram will make clear the following description:

The subscriber's apparatus at each of the sub-stations (A) (B) is of the usual type, with the exception of the toll-counting device and its associated mechanism for "blocking" or rendering inoperative the telephone apparatus. Each telephone line consists of two limbs terminating at the central office in line-springs of a spring-jack. The usual line signal is associated with each telephone line at the central office for indicating calls. A cut-off relay is also associated with each line, being connected in a grounded branch from the third contact or test ring of the spring-jack, the relay being adapted when energized to disconnect the line-signal apparatus from the line. An answering plug and a connecting plug are furnished at the central-office switchboard.

The conductors (4) and (6) include the magnet windings of supervisory relays, which control supervisory signal lamps. One pole of the battery is grounded and the supervisory signal lamps are included in conductors (8) (9) respectively, leading from the other pole of the battery to sleeve contacts of the plugs. These sleeve contacts of the plugs register with the grounded test rings of the spring-jacks.

Shunt circuits (10) (11) are provided about the signal lamps, the shunt circuits being controlled by switch contacts operated by the supervisory relays. When either of the shunt circuits is closed its corresponding signal lamp is thereby deprived of current.



SERVICE METER FOR TELEPHONE LINES—DIAGRAM OF EXCHANGE AND SUBSCRIBERS' CONNECTIONS.

The conductors (5) (6) of the plug circuit terminate respectively in the tip and ring contacts of the plug (d). Similarly the conductors (3) (4) of the plug circuit are normally connected with the tip and ring contacts of the plug (c). A double-pole switch is provided, however, whereby the connections of the conductors (3) (4) with the contacts of the plug (c) may be reversed, the switch being adapted to be operated by an electromagnet (h'). The magnet is provided with two windings. One of the windings (h^2), of low resistance, is included in series in the conductor (11), which shunts the signal lamp (g') and is controlled by the supervisory relay (g). The other winding (h^3), of high resistance, is serially included in a conductor (12), which forms a second shunt around the signal lamp and is controlled by the relay armature (h^4) of the magnet itself. When the supervisory relay is energized the effect is first to close the shunt (11) around the supervisory signal lamp, thereby causing the lamp to be deprived of current and the light extinguished. Since the shunt thus closed includes the winding (h^2) of the magnet, the magnet will be energized, attracting its armature and also operating the double-pole switch (h) to reverse the connections between the battery and contacts of the answering plug (c). The armature being drawn up closes the circuit (12), which includes the retaining winding (h^2) of the magnet, whereby the magnet is supplied with current and maintained energized independently of the circuit (11).

Turning now to the apparatus at the sub-stations of the system. The toll device shown in the drawing is a connection register or service meter and consists of a train of counting wheels (i), including a star-wheel, the teeth adapted to be engaged by the pallets of an oscillating escapement lever. The counting train may thus be moved step by step, a full beat or complete oscillation of the lever (k) being necessary to advance the counting train the full distance from one figure of the dial to the next. A spring is fastened to the actuating lever, tending to rock the lever in a clockwise direction to cause the initial movement of the escapement pallets carried by the actuating lever. A subsequent movement of the lever in a reverse direction will complete the registration. A manually operated plunger or push-key (l) is associated with the actuating lever, whereby the lever may be moved in a contra-clockwise direction. The plunger (l) preferably is not mounted upon the actuating lever, but is capable of movement independently and is normally maintained in its outer position by means of a spring (l'). The plunger preferably carries a movable switch contact which normally rests against a stationary contact, engagement between the contact parts being broken when the plunger is pushed in to move the actuating lever (k) of the toll counter. The contacts are serially included in the telephone circuit, whereby the circuit is broken momentarily when the subscriber pushes in on the plunger (l) to operate his toll-counter, the plunger moving back again under the influence of the spring to re-establish the circuit as soon as pressure is removed. The object of this arrangement is to prevent the subscriber from keeping the plunger permanently pushed in with the design of preventing the operation of his toll-counter.

A polarized electromagnet (p) is associated with the toll-counting mechanism, the windings of the magnet being connected in the branch of the line which leads through the subscriber's telephone talking apparatus. The winding of the magnet is preferably shunted by a comparaitvely high non-inductive resistance to diminish its impedance to telephone currents. This polarized magnet has a centrally pivoted tilting armature which carries a latch or detent adapted to engage and hold the end of the actuating lever when it has been pushed in by the plunger. The armature also carries a movable target adapted to be displayed in an opening in a shield when the armature is tilted to one side in a clockwise direction. A contact point is associated with the latch, the latch being normally separated from the contact, but being adapted to make engagement therewith when the polarized armature of the magnet is moved in a clockwise direction.

The operation of the system is as follows: Assuming that the subscriber at sub-station (A) desires to communicate with the subscriber at sub-station (B), he takes his receiving telephone from its switch-hook and permits the telephone switch to close the circuit of the line in the usual manner, providing a path for current in the line from the central source, which excites the line relay and causes the illumination of the line-signal lamp. On seeing the call-signal thus displayed the operator inserts the answering plug of a pair of plugs into the answering jack of the calling line. This act of the operator closes a local circuit through the cut-off relay to remove the line-signal apparatus from the circuit. At the same time the battery of the plug circuit is connected in a bridge between the limbs (1) (2) of the telephone line by way of the cord strands of the plug circuit. Since the circuit of the telephone line is closed at the sub-station by the telephone switch the circuit from battery over the line is completed. This circuit includes the winding of the supervisory relay, which is included in the cord strand of the plug circuit, whereby the relay is energized and closes the shunt circuit (10) about the supervisory signal lamp (f'), the signal lamp remaining dark. The polarized magnet being included in the line circuit at the sub-station (A) receives current from battery, the circulation of current in the circuit being in the proper direction to tip the armature (m) of the magnet in a contra-clockwise direction, whereby the actuating lever (k) of the toll-counting mechanism is released, as before explained, and is drawn over by spring (k'), effecting a half registration.

The central-office operator now communicates with subscriber (A) by telephone in the usual manner and inquires the number of the station with which connection is desired. Upon receiving this information she inserts the other or connecting plug of the pair into the spring-jack of the line wanted and signals the called station in the usual way. Upon connection of the plug with the spring-jack of the called line circuit is completed from the grounded battery through the conductor (9) and supervisory signal lamp (g') to the sleeve contact of the plug (d), and thence to ground by way of the called subscriber's cut-off relay.

When the subscriber at the called station takes his telephone from its switch-hook to answer the call the telephone switch closes the circuit of the called line, whereby the supervisory relay (g) in the conductor of the plug circuit receives current and draws up its armature. The shunt conductor (11), including the winding of the magnet, is thus closed, energizing the magnet. The resistance of this shunt conductor (11) is so low that the lamp (g') is deprived of current and is extinguished. The magnet being excited draws up its armature, closing the circuit (12), which includes the retaining winding whereby the magnet is continuously supplied with current as long as the plug remains in the spring-jack of the called line. The excitation of the magnet, which is thus consequent upon the removal of the telephone at the called station from its hook in response to the call operates the double-pole switch (h), reversing the connection of battery with the calling line, and the reversal of the current through the polarized magnet (p) at the sub-station (A) of the calling line causes the armature (m) of the relay to tip in a clockwise direction. This movement of the armature accomplishes two results: First, it closes the short-circuit (13) about the telephone apparatus, rendering the apparatus inoperative and blocking communication between the stations (A) and (B), and, second, it moves the target (m) before the opening in the shield. The display of the target indicates to the calling subscriber that the called party has answered and that he must push in on the plunger (l) to operate his toll-counter in order that he may use his telephone. When the plunger (l) is pushed in it completes the registration previously initiated when the central-office operator plugged into the line in answering the call and also releases the catch (m') from its contact, thus breaking the short-circuit and permitting the use of the telephone.

Independents Gain a Point in Cincinnati.

The telephone companies that have been trying to get into Cincinnati and have been unable to get a grant from the city for the use of the streets have won a point in the Probate Court. The companies concerned are the Cincinnati Telephone Company, the Queen City Company, the Fitzsimmons, and the Interstate. They filed an application in the Probate Court asking for a franchise after the City Council had failed to grant what was asked of it. The city filed a motion in that tribunal asking that the defendants state specifically what streets they desired to use, and at what points on those streets they intended to set their poles.

Judge Nippert decided that the right to the use of the streets was one that was granted by the Legislature, and it was only the mode of use that becomes the subject of agreement between the municipality or the judicial determination of a court. The effect of the decision, should it be sustained in the upper courts, would seem to limit the power of the city in the matter of granting franchises to corporations seeking the use of the streets.

MANUFACTURERS AND DEALERS.

The Bowling Green Telephone Company, Bowling Green, Mo., has recently completely re-equipped its central-office apparatus and enlarged the exchange to meet the rapidly increasing demand for Independent telephone service. It installed a 400-line self-restoring drop switchboard, which, together with the telephones, was furnished by the International Telephone Manufacturing Company of Chicago. The latter company asserts that it is receiving a large call for its new "never-failing" self-restoring drop, not only for complete switchboards for the new exchanges but for re-equipping plants.

Selective telephones for central-energy systems, as manufactured by the American Electric Telephone Company of Chicago, form the subject matter of a small booklet, which gives the theory of operation and practical hints on the installation of the American system, made clear by the aid of plenty of good diagrams. Among the advantages held up by the company in favor of its system are the absence of any relays in the equipment; the fact that in signaling the high-frequency bells on two-party line selective circuits no ground is used, only one master key being necessary; the absence of compensating springs in bell equipment, and the fact that the condensers are connected in series with the equipment, preventing loss of current.

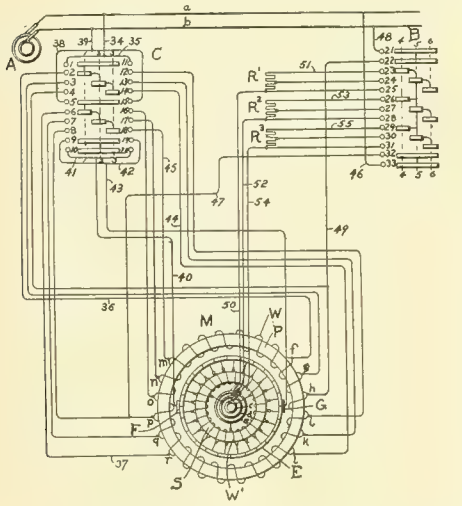
A Topeka, Kan., [illegible] become so widespread in Wetmore, Kan., that Dr Willis, unable to attend to all his calls, has mothers bring the babies to the telephone transmitter and let them cough. By the cough heard over the wire he diagnoses the case.

Repulsion Motor as a Braking Generator.

Systems of braking in which propelling motors are converted into braking generators are well understood in connection with continuous-current apparatus and some types of alternating-current apparatus and have proved of particular value in the operation of railway cars. However, it has not heretofore been proposed to convert a repulsion motor into a braking generator by transforming it into an induction generator. The speed at which a repulsion motor operates most efficiently is greater than the synchronous speed, and therefore such a motor may be transformed into a braking generator at ordinary speeds by locally short-circuiting sections of the secondary winding, the primary winding being connected to the alternating-current source.

According to a method recently patented by Charles P. Steinmetz of Schenectady, N. Y., a railway car arranged to be propelled by repulsion motors may be braked by converting the motors into induction machines when the machines are operating at a speed above synchronism. This is the case at ordinary speeds of the car, so that in going downgrade or at other times when it is desired to limit or to reduce the speed of the car without bringing it to a full stop the braking generator may be called into operation to maintain the speed within proper limits and to slow down the car until the speed of the machine has fallen to near synchronism.

The conversion from repulsion motor to braking generator may be accomplished by connecting the secondary winding of the motor so that a number of sections having locally closed circuits may be formed, thereby changing the repulsion-motor sec-



REPULSION MOTOR AS A BRAKING GENERATOR.

ondary into the secondary of an induction generator. The local closing of the secondary circuits may be brought about by means of taps taken from the winding in a manner similar to that employed in connection with rotary converters, which taps are then connected together, or by joining the commutator segments by conducting rings.

Connecting the commutator segments would ordinarily produce a greater subdivision of the secondary circuits, and therefore the operation of the machine would be improved over one in which a comparatively small number of taps from the windings were connected together, as it would usually be impracticable to bring out enough taps to produce so great a subdivision of the winding as is produced when the segments are connected. On the other hand, where the point of control must be at some distance from the motor, as in railway work, the apparatus for actuating a means for connecting the commutator segments would be rather cumbersome, while taps taken from the winding may be readily extended any distance to a controller for connecting them together.

The latter scheme of connection gives good braking effects, and the action may be made to approach as nearly as desired to that where the commutator segments are connected by making the number of taps approach the number of commutator leads. The latter plan of connection will therefore be found more generally desirable.

Referring to the accompany drawing, which is a diagram illustrating a motor, controllers and suitable connections, (A) is an alternating-current source of supply from which extends a set of mains. A repulsion motor (M) comprises a primary member (P), on which is placed a primary winding, a secondary member (S), upon which is placed a secondary winding, a commutator (E) connected to the secondary winding, and collector rings (c), (d) and (e), connected to taps from the secondary winding, which in this case are in three-phase relation. Taps (f) to (r) inclusive are taken from the primary winding at points suitable for controlling the operation of the repulsion motor.

In practice a toothed primary member and a distributed drum winding, such as is usually employed in induction motors, would be made use of, while the secondary winding would be of the distributed-drum type commonly employed in the armatures of continuous-current machines. The controller (C) operates to connect the motor to the source in such relation that it will operate as a motor of the repulsion type, while controller (B) operates to connect the motor windings so that it will operate as a braking generator. The resistances (R'), (R^2) and (R^3) are employed to regulate the braking effect. The controllers (C) and (B) are shown in the diagram with their contacts developed upon a plane surface, the stationary contacts being represented by small circles and the movable contacts by rectangles, as is customary in illustrating such apparatus.

The controllers being in the "off" position, as shown, the motor may be connected for either direction of rotation as a repulsion motor by moving the movable contacts of controller (C) either to the right or to the left, as the case may be. Let it be assumed that the desired direction of rotation will be secured by moving these contacts to the left into engagement with the stationary contacts (1) to (10), inclusive. In the first position of the controller the stationary contacts will lie along the dotted line (1 1), when circuits may be traced as follows: From main (a) through conductor (34), conductor (35), stationary contact (1), stationary contact (2), conductor (36) to tap (f) of the primary winding, thence through the two sides of winding in parallel to tap (r), through conductor (37), stationary contact (6), stationary contact (5), conductor (38), and conductor (39) to main (b). The armature is now short-circuited through the brushes, as will be seen by tracing the following circuit: From brush (F) through conductor (40), conductor (41), stationary contact (10), stationary contact (9), conductor (42), and conductor (43) to brush (G). The machine is now connected to operate as a repulsion motor and is in the starting position. Movement of the controller (C) into its successive positions (designated by the dotted lines (22) and (33), respectively), operates to shift the connections of the mains to the pairs of taps (g) and (q), (h) and (p), respectively, and when connected in the last position of the controller to taps (h) and (p) the motor is in the "running" condition.

The motor may be connected for the opposite direction of rotation by moving the movable contacts of controller (C) to the right until the movable contacts come into engagement with the stationary contacts (11) to (20), inclusive, the circuits being easily traceable on the diagram as before. In all of the operative positions of the controller for this direction of rotation, as well as for the other, the brushes bearing upon the commutator are short-circuited.

If now it be desired to convert the motor into a braking generator the movable contacts of controller (B) are moved to the left until they come into engagement with stationary contacts (21) to (33), inclusive. In the first operative position of this controller, in which the stationary contacts lie along the dotted line (4 4), circuits may be traced as follows: From main (a) through conductor (46), stationary contact (33), stationary contact (32), and conductor (47) to tap (p) of primary winding, and from main (b) through conductor (48), stationary contact (21), stationary contact (22), and conductor (49) to tap (h) of the primary winding, which is therefore connected to the alternating source (A). The connections of the secondary winding may be traced as follows: From collector ring (e) through conductor (50), resistance (R'), conductor (51) to stationary contact (23), from collector ring (d) through conductor (52), resistance (R^2), and conductor (53) to stationary contact (26), from collector ring (c) through conductor (54), resistance (R^3), and conductor (55) to stationary contact (29). Stationary contacts (23), (26) and (29) are connected together by the movable contacts of controller (B), and therefore the three-phase taps from the secondary winding are connected in Y with a section of resistance in each leg.

The primary being connected to the source of supply, its frequency is fixed, and the secondary having its winding short-circuited in sections serves as the secondary of an induction generator, and therefore if the machine is running above synchronism current will be returned to the line. This is the most economical arrangement; but it is obvious that the primary could be connected to any other source that would fix the frequency. In the position of the controller (B), as already described, the machine will exert the least braking effect, as the maximum amount of resistance is included in the secondary circuit. Should a greater braking effect be desired the controller would be moved into the next position, when a section of each of the resistances would be cut out, thereby increasing the braking effect, and a still further movement of the controller into the last position would cause the resistance to be entirely cut out and therefore the sections of the secondary winding to be short-circuited and the maximum braking effect obtained.

Lighting the St. Louis City Hall.

A plan to illuminate the new city hall in St. Louis is being worked out by Thomas B. Carter, supervisor of city lighting. The Twelfth Street entrance, which, when the hall is finished, will be the main entrance, is to be lighted and ornamented by 14 lamp clusters of artistic design. Six of these will embrace groups of 25 incandescent lights, and are to be placed along the walk leading to the entrance. Four smaller posts, with 12 lamps each, will light the circular driveway, and four of the same size will illuminate the portico. Arc lights on specially designed brackets will be placed at the Clark Avenue and Market Street entrances. The rotunda, now being completed, will be lighted by 2,000 incandescent lamps. Of these 250 will be placed in an electrolier depending from the skylight and the others will be fixed to the pillars surrounding the rotunda. Many additional lights will be placed in the halls. The total number will be about 5,000. An electric elevator is also to be placed at the Twelfth Street entrance.

General Electric Gossip.

At the annual meeting of the General Electric Company on May 10th, according to Wall Street report, it is probable that the capital stock will be increased $3,325,000. On this subject the New York Commercial, which is apparently well informed, has the following: "This new stock, together with $1,062,600 of stock now held in the treasury, will be offered to stockholders at par to the extent of 10 per cent. of their holdings. The authorized capitalization of General Electric is $45,000,000, of which $43,937,400 is understood to be outstanding. This leaves $1,062,600 of stock in the treasury. This stock in the treasury, together with the $3,325,000 of new stock to be authorized, will make $4,387,600. This is practically 10 per cent. of the amount of capital stock now outstanding. As General Electric is selling around $170 a share, the rights to subscribe to the new stock issue will be valuable. In 1898 the capital stock of the General Electric was reduced 40 per cent. During the next few years the earnings increased so largely that the directors in July, 1902, voted to declare a stock dividend of 66⅔ per cent. In this way the 40 per cent. reduction made in 1898 was restored. The new stock issue will be equivalent to a dividend of something over five per cent. General Electric is now said to be earning at the rate of about 25 per cent. on its capital stock. It has not been announced for what purpose the funds to be derived from this new stock issue will be used. It is understood that a part will be used to extend the foreign business of the company. The advance orders so far received indicate that the business of the General Electric this year will be much the largest in its history. The orders received are said to be largely in excess of the orders received during the corresponding period of last year. It is understood that E. W. Rice, Jr., will be elected a director to succeed the late William C. Whitney. The other retiring directors will be re-elected."

Free Luncheons at National Electric Company's Plant.

Free luncheons for the officers of the National Electric Company of Milwaukee and for the employes in the executive offices and the engineering department and the heads of the departments will be served daily at the expense of the company. Two pleasant dining rooms, a butler's pantry and a kitchen have been fitted up in the new office building recently erected at the company's plant near Riverside Park. One dining room is for the officers of the company and their guests and business men from other cities who come to Milwaukee to inspect the plant. It is expected that the officers will get into closer personal touch with one another by dining together each noon and that many informal executive sessions for the discussion of the company's interests will be held over the coffee cups and cigars. The second dining room will be for the employes of the offices and engineering department. There will be no charge whatever to the employes for the dinners, but the company's object is not purely philanthropic, as it is believed that the plan will be mutually beneficial to employer and employed. The employes now have an hour and a half for the noonday luncheon, but with dinners served at the plant it is expected that the men will be ready to return to their desks at 12:45 instead of 1:30 o'clock.

Chicago Elevated-railway Traffic.

The March traffic on the elevated railways of Chicago showed a good increase over the corresponding month last year. The Northwestern Elevated Railroad Company shows an increase of 6.1 per cent., the South Side elevated 5.1 per cent., and the Metropolitan 4.9 per cent. The daily average on the Chicago and Oak Park Elevated Railway (formerly the Lake Street company) was 45,524 against 45,332 in March, 1903. Comparative figures of passengers carried are as follows:

	1904.	1903.	Increase
Northwestern.			
January	70,204	68,266	1,938
February	73,193	69,889	3,304
March	74,344	70,070	4,278
South Side.			
January	87,601	86,637	961
February	90,370	88,516	1,854
March	92,547	87,980	4,568
Metropolitan.			
January	112,473	112,771	35
February	119,073	116,000	2,908
March	122,507	116,717	5,790

The Interstate Street Electric Company will build a 20-mile electric railway from Port Allegheny, Pa., to Coudersport, Pa. The company has been chartered, with a capital of $200,000.

Installation of Electric Cables.

Mr. H. W. Buck, electrical engineer of the Niagara Falls Power Company, delivered a lecture before the Electric Club of Pittsburg on February 29th on "The Installation of Electric Cables." This is, of course, a practical and important subject. What follows is an abstract of Mr. Buck's lecture, taken from the Electric Club Journal.

In laying out the design of a power plant every wire and cable should, if possible, have a definite place provided for it in advance, just as much as for any other piece of machinery. Cables of different classes, that is, cables carrying currents of different voltages and kinds, should, as far as possible, be kept apart from each other. This is a matter of great importance, in order to prevent an interlinking of different systems in case of trouble.

In laying out a power-station cable system the questions are often raised whether to use lead-covered or braided cables, and whether to run in ducts or expose upon racks in cable subways. In my opinion, lead-covered cables should not be used in a power house except in places where protection against water is required. The lead sheath being necessarily grounded, makes the cable vulnerable to puncture from ground throughout its entire length, which danger does not exist in a braided cable. On account of the softness of lead, it serves as a very poor guard against mechanical injury. If a lead-covered cable is struck, the grounded lead is very likely to be driven through the insulation to copper, and the cable is put out of business. Braid-covered rubber cables are not exposed to this risk. As a protection against fire, a lead covering is useless, for the lead melts at a very low temperature, and exposes the inflammable insulating compound to ignition. When once started, a lead-covered cable will support its own combustion until completely destroyed.

In high-voltage work a single-conductor lead-covered cable is especially objectionable. Static discharges seem to take place through the insulation to the lead, which rapidly injures the insulation—especially rubber—and a breakdown soon follows. I have known a number of instances where such single-conductor cables have withstood a test of three times normal voltage and have broken down at normal voltage a few hours after being put in service. These breakdowns occur usually near the ends of the cable. In multiple-conductor cables this action does not seem to occur, the static activity probably being neutralized.

The present tendency in power-station construction is to put all cables in groups of ducts as a protection against fire. The arrangement serves this particular purpose, but it is not, in my opinion, a satisfactory solution of the general problem, and it is open to several objections. In the first place, where cables are drawn into ducts a lead sheath is usually needed to protect the insulation from abrasion. If the cable is single conductor, operating at high voltage, we have the objection stated above against this combination. If the cable is not lead-covered and operates at high voltage, a static discharge also takes place to the tile duct, which breaks down the insulation in time. Furthermore, if the cables in the ducts are of low voltage carrying large currents, and if a number of them are grouped together, serious difficulties will be encountered from lack of ventilation and consequent overheating of the cables.

In my opinion, as a general proposition, especially in high-voltage work, the best way to wire a power house is to use braided-rubber insulated wire, supported in free air upon porcelain or other insulators which in themselves have sufficient insulation to withstand the operating voltage of the cable. The rubber insulation then serves only as a safeguard to life in case of momentary contact, and to prevent a short-circuit in case of temporarily lying tools or such things upon the cables. Cables should be spread out as far as possible from each other, in order to obtain the best possible ventilation and to minimize trouble in case of short-circuit.

Where a large number of cables have to be led through a subway on account of the conformation of the power-house structure, they should preferably be racked on insulators in such a way as to give good ventilation and to render each cable accessible. It is well to locate the cables on the walls of the subway and as low down as possible, so as not to be influenced by the hot air which will float at the top of the subway. When cables are installed in this way they should be rendered fireproof by some means. A method which has been adopted by the Niagara Falls Power Company consists of the following:

Asbestos strip, about three inches wide and three-sixteenths inch thick, is soaked in a silicate-of-soda solution until it is thoroughly impregnated. It is then, while soft, wrapped spirally around each cable which has been put in place on its rack in the subway. This covering very quickly hardens and forms a coating like stone over the braid of the cable, which is fireproof. Asbestos applied in this way has many advantages. It needs no binding wire or steel bands to hold it in place around the cable, which are apt to uncoil when most needed, for the silicate serves as a firm bond. Furthermore, the asbestos, having its pores entirely filled, becomes a good conductor of heat, and the heat from the copper losses can get out by conduction. Dry asbestos, on the other hand, in a porous, cloth-like condition, is a good insulator of heat, which is likely to subject the insulation of the cable wrapped with it to a high temperature. The method of fireproofing here described has been given severe fire tests, and it has served its purpose in every case.

The conditions governing underground cable work are quite different from interior wiring. Here lead covering is absolutely necessary for cable protection on account of water, and also because paper cables must be used for reasons of economy, and all cables must be drawn into ducts underground, for any form of subway with bracket supports for the cable would be prohibitive in cost. My objection to the single-conductor lead-covered cables still holds for underground use for voltages over 5,000. Such high-voltage conductors should, if possible, be placed in the form of multiple-conductor cables, where breakdown in insulation from static effects is seldom experienced if liberal-sized bells are used at the terminals of the cable.

In connection with underground-cable work, I should like particularly to call your attention to the grouping of ducts and construction of manholes. Ordinarily, ducts are bunched together and brought out at the center of the manhole. Here the cables divide, half passing on one side and half on the other side of the manhole, being racked on the manhole walls. This design is objectionable, for a number of reasons. First, it exposes every cable in the conduit to damage from short-circuit at the points where they are in close proximity to each other. Secondly, it necessitates bending every cable sharply in every manhole, which tends to crack the insulation and cause trouble. Most breakdowns in underground work do occur at these points. Another objection to this form of conduit construction is from the standpoint of heating. The cables in the inner ducts, if heavily loaded, will rise to a high temperature, for there is no way for the heat to get away by conduction. The inner ducts are surrounded by chambers containing still air, which constitute the best possible insulator of heat.

The heating of underground conduits is a matter which is overlooked to a great extent, and it is probable that many underground cables for this reason are operating at a much higher temperature than they should. The heating constants vary considerably with the nature of the soil surrounding the conduit, but a fairly safe rule is not to exceed three watts per duct-foot for copper loss in cable, and not to concentrate too many ducts in one group.

The forced ventilation of underground conduits has been tried, but without success. Forcing air under pressure through the ducts has the effect only of lowering the temperature at the end where the air enters, but of raising the temperature toward the end where the air escapes. There is a method, however, of cooling cables in ducts which is very effective, but almost prohibitive in cost, except in a few special cases. It consists of drawing into each duct with the cable a small lead pipe, through which water is kept circulating. This arrangement is used at Niagara in a conduit 250 feet long, between power house No. 2 and the transformer house, and the results have been very good.

Where single-conductor lead-covered cables are used in underground installations for carrying large alternating currents at low voltage trouble from induced current in the lead sheath should be guarded against. I do not refer to local eddies, but to the current which flows in the lead sheath of two parallel cables as secondary induced by the current in the copper of the same cables as primary. When the lead circuit is closed at two manholes by contact with supporting iron brackets the current which flows in the lead is very considerable, and the resulting loss is nearly equal to the I^2R loss in the copper, even at 25 cycles. At higher frequencies this loss will probably be greater. As a specific example I will cite some readings which were taken on two parallel 300-foot lengths of 1,250,000-circular-mil cable, carrying 800 amperes in the copper at 25 cycles. The open-circuit voltage induced in the lead was 15 volts, and with the lead sheaths short-circuited at one end through an ammeter, the current was found to be approximately 200 amperes. You can see from these figures that the matter is one of the greatest importance, and special precautions should be taken in all underground work to meet it. The lead sheaths of all cables should be either bonded together carefully in every manhole or else carefully insulated. If neither one thing nor the other is done, sparking will occur from this lead current at the cable supports at the manholes, which will burn through the lead sheaths and cause a breakdown.

In conduits built of insulating material, such as vitrified clay, little trouble need be feared from electrolysis if the conduit is well drained and dry. If the ducts, however, contain water and the cables are partially submerged, the lead covering will rapidly disintegrate, unless the sheath is bonded at frequent intervals to the nearest railway return circuit.

In conclusion, I may say that the points brought out in this paper are not based upon theory, but upon actual experience, with a large variety of electric cables operating under various conditions.

It is announced that an electric railroad connecting Lead, S. D., with the coal mines of Northeastern Wyoming is to be built. The promoters declare that the preliminary survey will be made as soon as the snow gets off to enable the engineers to take the field. This road will be between 40 and 50 miles in length and it is proposed to build it by way of Welcome City, Wyo., and Cyanide, S. D.

CORRESPONDENCE.

Great Britain.

London, March 26.—Although the present parliamentary session, from the electrical point of view, promises to be as dull an affair as we have had for many years, the gas companies have already made themselves prominent, and, in addition, there appears to be the same strong feeling in certain quarters against municipal trading in electrical matters as was manifest last year. The unfortunate Marylebone Borough Council, whose purchase of the undertaking of the Metropolitan Electric Supply Company in its area has been so much commented upon, has not been spared in the discussion of the subject. The council's bill enabling it to borrow the necessary money to complete the purchase, which is now before Parliament, was assailed on coming up for second reading, an attempt being made to have inserted in it a clause to the effect that if after the first year's working, the revenue from the undertaking did not exceed the expenses, the price of current should be raised, so that the one balanced the other. To advocates of municipal trading the effect of such a condition upon any electrical undertaking is obvious, especially during the early period. Last year the clause in question was inserted in one or two municipal bills, with the proviso, however, that it should not come into operation until after two and in some cases, three years.

Means of communication in London, and especially across the Thames, have never been superfluous, and consequently it was generally deemed a sensible scheme when a private company promoted a bill in Parliament for the construction of a tube railway between North and South Woolwich, two districts having both a dense residential and working population. The idea was to have a single tube, running trains every three minutes from either end at a penny fare. Hitherto the only means of crossing the river near Woolwich from bank to bank has been by means of a steam ferry, and naturally in winter the inconvenience was a maximum. But the promoters of the tube railway in question were opposed by the London County Council, which argued that it was quite possible that it would at some time or other construct a free tunnel at that spot. Eventually, after a rather long hearing, the bill was passed, with the provision, however, that when the County Council did promote its scheme, the promoters of the present one should not oppose with the object of securing compensation. Naturally, no one can be found to put money into a concern burdened with such conditions, and it is understood that the promoters intend to abandon the project.

Mention has been made on one or two occasions of the proposal to adopt a surface-contact system of electric traction upon the tramways in Musselburgh (Scotland). Several experts were engaged to report upon the system proposed, and eventually the Town Council sanctioned it. Now, however, it is stated that the idea has been abandoned and that the promoters will equip the lines upon the overhead-trolley system.

Some new regulations have just been issued with respect to heavy motor lorries and the like. Hitherto such vehicles have been under special regulations, the speed limit being exceedingly low, but under the new rules they will come under the terms of the motor-car act of 1904. In addition, the maximum width has been increased to over seven feet as against six feet six inches.

The Admiralty is seriously taking in hand the electrical equipment of its dockyards and workshops, and last year a large sum of money was voted for this purpose. Quite recently a contract was let to a British firm for 10,000 horsepower of plant for the Chatham dockyards, and a scheme is, I believe, in hand with respect to Devonport.

The contract for the cars which will be run upon the tube railways controlled by Mr. Yerkes in London, provides for some 500 cars, and the price of the tender is $7,000,000.

An unusual thing in this country is for a municipality to secure parliamentary powers to construct tramways, and then to put them up for sale publicly. Such a method of procedure has been adopted by the authorities of South Shields, but little success has attended the action. Only two bidders came forward, one of whom was the very company which the local authority desired to take the control of the existing horse tramways away from, in asking for parliamentary powers to construct lines itself.

The Association of Chambers of Commerce has held its annual meeting, when many matters of electrical interest were dealt with. Among them were resolutions urging the railway companies of Great Britain to grant facilities for placing telephone call boxes on all stations; another, that steps should be taken to connect all lightships and lighthouses with the shore by means of telegraphy, telephones or space telegraphy, and still another, complaining of the inadequacy of means of telephonic communication with the Continent. G.

New York.

New York, April 2.—Mr. Andrew Carnegie's $1,500,000 gift to the engineering [illegible] of New York was the subject of a bill introduced at Albany on Thursday, designed to [illegible]

Engineering Society and to authorize that society to accept Mr. Carnegie's donation.

Notwithstanding the rapid progress that has been effected of late upon the work of the New York subways, the contractor, Mr. J. B. McDonald, will not be able to carry out the promise to have trains running in June. Some delays are now found to be unavoidable with regard to the completion of the enormous power house, and the best that a sanguine prophet can now foretell is that the system will be opened on the approach of next winter. There are to be seven huge generators in the Fifty-ninth Street power house, five of which are necessary for running the system, but so far only two of these have been installed, and the earliest date at which the remaining can be set up is the end of August. The contract time for completion is September 24th.

The four Bedell bills before the Assembly at Albany, full of technical details as to the rights and wrongs of transit companies in their relationship with the municipal powers of Greater New York, have been sent back to committee without advancement in spite of a long and eloquent defense of the measure by Mr. Bedell. A fifth Bedell bill has been withdrawn at the request of the Metropolitan Street Railway Company, its effective sponsor. On the other hand the Elsberg-Newcomb bill, which is the result of a consolidation by the committee of the state Senate and which affects future franchise conditions in New York city, has been advanced to a third reading, and now generally embodies all the proposals of the Rapid Transit Commission.

Mayor McClellan was called upon this week to start the new refuse destructor on Forty-seventh Street and North River, intended for the final disposition of light rubbish and paper waste. The cost of the new plant was $28,900. Commissioner Woodbury gives some figures about the prospective utilization of the heat energy of the burning refuse in electric lighting which are quite absurd. If foreign experience is any guide, the destructor will be successful purely as a destructor and not as a power generator.

The objectionable "near-side" ordinance, by which since the middle of January all surface cars have been obliged to stop when signaled by passengers on the near side of street crossings, has aroused so much popular indignation that its repeal is almost certain.

There has been a second "third-rail" shoe accident this week. On Monday a contact shoe from a Fulton Street elevated car fell squarely upon the helmet of a Brooklyn policeman who was passing below, and the officer is now in the hospital suffering from concussion of the brain.

Seven employes of the Public Service Corporation of New Jersey were arrested last night on charges of conspiracy to defraud. This company operates perhaps the largest street-railway undertaking in the vicinity of New York and has, moreover, increasingly extensive electric-lighting interests. The alleged frauds total up to an estimated loss of $75,000, and were carried on by means of dishonest dealings in transfer exchanges. The system was simplicity itself: Conductors on cars which transferred passengers at certain points have been, it is alleged, in the habit of interchanging transfer tickets and handing them over at the end of the day in lieu of the cash fares they represented.

During the coming week the Automobile Club will conduct tests of commercial motor vehicles. Among the entries in the competition for the second class (1,000-2,000 pounds carrying capacity) there are no less than five electric vehicles out of a total of nine. D. W. W.

New England.

Boston, April 2.—As a sequel to the rejection of the Springfield Suburban Street Railway Company's petition for a line to operate in Springfield and vicinity there is in preparation a petition for a franchise to be presented to the Springfield authorities for the Springfield and Eastern Street Railway Company. The Suburban was a new company formed to compete with the existing company in Springfield on account of the dissatisfaction locally with the older company. The railroad commissioners vetoed the project. The Springfield and Eastern is on a different footing, however, being an established company operating from Palmer, and it now seeks entrance into Springfield.

Opposition to the proposed new through line from Haverhill to Malden, there to connect with the system of the Boston Elevated Street Railway Company, was concentrated at the railroad commissioners' hearing this week, the Boston and Northern Street Railway Company objecting decidedly to the paralleling of its lines, which would take place if the newcomer were given the rights for which it asks. The hearing was adjourned to April 4th, when remonstrants will be given further opportunity to be heard.

Thomas I. Reed of Burlington, Mass., has resigned the presidency of the Lowell and Boston Street Railway Company, which is one of the roads tied up for two or three weeks subsequent to the recent severe weather. It operates between Woburn and Billerica and is about nine miles long.

Fire destroyed the car barn of the Citizens' Electric Street Railway Company of Newburyport during the night of March 28th. The loss was about $65,000. The building was insured.

The Boston police on March 30th placed under arrest two youths who are charged with the numerous robberies of the New England Telephone and Telegraph Company's slot telephone booths. They were caught in one of the booths at the Hotel Wellesley, a connection with the nearest police station having been made with a view to entrapping anyone tampering with the machine there. B.

Dominion of Canada.

Ottawa, Ont., April 2.—The North American Telegraph Company is applying to the Parliament of Canada for an amendment to the charter of the company to enable it to increase its capital from $1,000,000 to $10,000,000, and to extend its line to Manitoba and the Northwest and change its head office from Kingston, Ont., to Winnipeg, Man.

The electric tramway of Nova Scotia, embracing the towns of Westville, New Glasgow, Stellarton and Trenton, will soon, it is announced, be an accomplished fact. Contracts for the machinery and material have been let and work has commenced on the power house situated in the town of Stellarton.

J. A. Dawson, a manufacturer of railway and electrical supplies, of Montreal, Que., and his brother, S. A. Dawson of Toronto, Ont., are in the City of Mexico, where they will remain several weeks. They spent a month looking over the electrical situation in Cuba and Jamaica before going to Mexico, and they propose visiting many points throughout the republic before returning to Canada. They are reported as being thoroughly impressed with the resources and opportunities of Mexico and are hopeful that reciprocity will be arranged between Canada and Mexico.

The report that the Mexican Light and Power Company, the big Canadian concern which is installing one of the greatest hydro-electrical plants in the world at Necaxa, state of Puebla, will take over the street-railway lines of the Mexican capital, has been revived. It is now said that a definite proposition to sell the system to the Canadian company for $18,000,000 has been made, but an outright sale is said not to be likely.

The rights of E. S. Jenison of Chicago to the waterpower of the Kekabeka Falls and Ecarte Rapids, Ont., have been fully restored by the private bills committee of the Ontario Legislature. By this action the town of Fort William, Ont., and Mr. Clergue receive a black eye, as they put forth every effort to defeat the proposition of Mr. Jenison.

The application of the Current River Power Company for permission to construct storage dams on the Current River and to erect poles and string wires on the streets of the towns of Port Arthur and Fort William, Ont., has been thrown out of the Legislature of Ontario by the private bills committee. This is considered a victory for the principle of municipal ownership. Port Arthur already develops power at the mouth of the river, and the company would enter into direct competition with the municipality if this application for incorporation had been granted.

The Shawinigan Water and Power Company of Shawinigan Falls, Que., has just completed arrangements for the erection of another transmission line from the Falls into Montreal, with a capacity of 10,000 additional horsepower. This entire additional voltage will be taken by the Montreal Light, Heat and Power Company, and it is intended that it shall be a duplicate of the existing line. In order to meet the increasing demands for power the Shawinigan company is just completing at its works the installation of a third unit, consisting of a water wheel with a capacity of 6,000 horsepower and a generator of 3,750 kilowatts capacity, thus giving the company an increased output of 5,000 horsepower. A similar additional unit will be installed this summer. W.

Michigan.

Detroit, April 2.—The Cheboygan Electric Light and Power Company has increased its capital stock from $100,000 to $200,000.

The people of Mt. Clemens have succeeded in getting freight rates from the Rapid Railway which will allow light packages to be carried between Detroit and that city for 15 cents. There will be two cars each way a day.

The receiver of the Michigan Electric Company has been ordered to hold a number of lamps for sale or to set aside $2,500 of the proceeds, pending the decision of the claim of the Bryan-Marsh Company, which maintains that it has a clear title to a large number of lamps which were in stock at the time the Michigan Electric Company went into bankruptcy.

The electric interests throughout the state have suffered on account of the extraordinary high water, and large cities, such as Grand Rapids, Lansing, Saginaw and Bay City, have suffered temporarily on account of the suspension of the electric-lighting plants. At the present writing, however, the floods seem to have reached the maximum, and improvement in the situation is expected.

The McCleary Electric Company of Detroit, which has been incorporated with $10,000 capital stock, takes over the business of the McCleary & Colquitt Company, with stock and fixtures.

At next Monday's election the people of Bay City will vote upon the question of bonding that city for a new electric plant, to furnish commercial lighting. It is understood that if the voters were sure that $50,000 would cover the cost of the plant the project might go through.

The mayor of Ann Arbor has vetoed an electric-light and power franchise recently granted the Michigan Milling Company by the Common Council. This company expected to erect a plant on the Huron River.

The voters of West Bloomfield Township will decide by ballot whether or not the township shall institute proceedings against the Detroit United Railway, to force that company to grant them a 25-cent rate of fare to Detroit. The present charge is 35 cent, but since the Detroit United Railway gained control over the old Northwestern line, the people of that township have had this grievance. At a mass meeting, held a short time ago, it was decided to submit the question. C. G. W.

Ohio.

Cleveland, April 2.—A franchise has been granted the Ohio Northern Traction Company by the Village Council of Wauseon. The villages of Weston and Lion have agreed to take $18,000 and $10,000, respectively, of the stock of the company. The line is to extend from Wauseon to Adrian, Mich.

Railroad men are making a fight against the Austin bill, which seeks to require railroads to keep mileage books on sale at all offices at $20 per 1,000 miles. While the electric-road officials have not taken any hand in the matter, the passage of such a bill would probably affect their business to some extent.

Barney Mahler will retire as president of the Electric Package Company at once, it is stated, in accordance with an arrangement by which each of the roads that are interested will take turns in the management. The matter is in the hands of a committee that will name the next official.

It is reported that the Lake Shore and Michigan Southern contemplates purchasing the electric line from Angora to Lake James in Indiana and converting it into a steam road. Several miles of track will be necessary to connect it with the Lake Shore.

Plans are being laid to have a through electric-railway service from Columbus to Zanesville by May 15th. The through schedule, when the cars are put in operation, so the trip can be made without change, will be two hours and 30 minutes.

A contract for street lighting in Zanesville will be awarded within a short time. Several members of the council are now visiting other cities for the purpose of studying the lighting question. The local light company will make a bid, and it is stated that the Welsbach gas-light people will also put up a hard fight for the contract.

The Atlas Engineering Company of Cleveland has been incorporated with a capital stock of $50,000 for the purpose of doing a general engineering business. F. E. Wright, F. W. Treadway and others are interested.

Representative Steward has introduced a measure in the Legislature to the effect that, where a third rail is employed, it must be either 18 inches underground or 20 feet overhead. The Scioto Valley Traction Company is one of the very few roads that will employ the third-rail system, and this looks like a blow at it.

Representative Charles Williams' bills, allowing electric-light and gas companies to manufacture each other's product have been reported from the house committee. The bill also carries with it a provision that water companies may be merged with street-railway and light companies. Another bill provides for fixing the minimum price of gas and electric light, but says nothing in regard to the maximum figures. Some opposition has developed to all these bills on this account.

Mayor Snyder of Dayton has vetoed the ordinance granting a franchise to the Dayton Electric Light Company, on the ground that it did not keep its agreement in regard to prices for commercial light and power and did not furnish the residence portion of the city with service for private homes.

The Shaker Lakes and Boulevard Street Railway Company has been granted a franchise by the village of Euclid Heights. Work on the line will be begun in a short time, it is stated.

The Cleveland Electric Railway Company is having a large open car made into a convertible car, as an experiment, before placing additional orders. It is believed that a car of this kind can be used both winter and summer, and thus save the expense of having so many, half of them being idle a portion of the year.

The Ohio Union Traction Company has filed a mortgage for $700,000 in favor of the Security Trust Company of New Jersey, to secure an issue of five per cent. bonds. The proceeds from the sale of these securities will be used to construct an electric line from Findlay to Kenton. As A. E. Appleyard is the president of the Union Traction Company, it is supposed this line will form the connecting link in his system from Cincinnati to Toledo. If this is true, the Kerper line from Toledo to Bowling Green will probably be the means of reaching Toledo from that point.

William E. Hutton has resigned from the directorate of the Interurban Railway and Terminal Company of Cincinnati, to devote his attention to the Board of Public Service, of which he was recently appointed a member.

J. A. Nestor has been appointed general superintendent of the Cleveland and Southwestern traction

lines, succeeding E. W. Coe, who recently resigned. Mr. Nestor has been in charge of the office at Norwalk for some time. He will make headquarters at Elyria.

Engineer W. H. Pelton of Cleveland, Ohio, has been in Chattanooga, Tenn., for some time, locating a proposed road between Louisville, Ky., and the former city. The line will be built on a high standard and will pass through an undeveloped territory.

Floods in the northern and western portion of Ohio last week caused a great deal of damage to electric and steam-railway property. Ohio has had a number of floods this spring, and all have caused more or less damage to the electric-railway lines. O. M. C.

Indiana.

Indianapolis, April 4.—The Geneva Traction Company has filed articles of incorporation. The preliminary capital is $20,000. The company proposes to build and operate a line of street railways in the town of Geneva and interurban lines through Adams, Wells, Blackford, Jay and Grant Counties. Charles D. Porter, A. G. Briggs, S. W. Hall and J. H. Hardison are the incorporators.

The Indiana interurban-railway lines operating in the White River and Wabash River Valleys were heavy losers as the result of the recent floods. Washouts occurred, and bridges and culverts were carried away. At Peru the Union Traction Company lost a fine new steel bridge and at Columbus the Indianapolis and Columbus line lost a good bridge over Blue River. Officers of the interurban lines estimate the loss to these companies, including loss of business, etc., at $300,000. At Indianapolis the waters flooded the power house, as it did also in Anderson, and put the fires out and crippled the service. It will require several weeks to repair the breaks and losses.

The Henderson Traction Company has brought suit at Evansville to appropriate a right-of-way over the Henderson bridge that spans the Ohio River. The action assumes that the bridge is a public highway, owing to the charters under which it does business. It is nearly four miles long, most of it in Indiana.

The largest mortgage ever filed in Tippecanoe County was filed in Lafayette on Saturday. It represents a value of $7,500,000 and was given by the Ft. Wayne and Wabash Valley Traction Company to the North American Trust Company of Philadelphia to secure the issue of bonds on property now owned by the traction company and on property it expects to acquire. This action insures the building of the interurban line along the old Wabash and Erie Canal towpath from Logansport to Lafayette and possibly from Lafayette to Danville, Ill.

The Richmond Street and Interurban Railway Company has purchased new and high-speed motors for the interurban service. The new motors are credited with a speed of 65 and 70 miles an hour.

Elwood McGuire of Richmond has invented an automatic electrical signal device for use on railroads. The invention is designed for use in the cabs of locomotives and in motor cars, and is intended to prevent collisions of all kinds. The engineer or motorman is warned of approaching trains, and it is impossible for one to get within one mile of any danger without warning.

By an arrangement perfected on April 1st the South Bend Electric Company has contracted for all the surplus power of the St. Joseph and Elkhart Power Company, supposed to be an opposition concern, and controlling the Hen Island dam. This deal occasioned considerable surprise to prospective power users, but it insures reliable service, as the powers of the different plants are to be interchangeable at South Bend, Mishawaka and Elkhart.

J. W. McCoyl has been appointed superintendent of the Evansville and Princeton Traction Company's lines. Mr. McCoyl is a railroad man of experience and ability and will at once improve the new line.

The Randall Motor Car Company of Ft. Wayne has incorporated. The company will manufacture motor cars, automobiles and automobile supplies. F. P. Randall and Louis Churchins are among the incorporators. F.

Pacific Slope.

San Francisco, April 1.—The General Electric Company has been awarded the contract for two 250-kilowatt, three-phase generators, to be installed by the Edison Electric Company of Los Angeles in its new Lytle Creek station.

Superintendent Samuel Naphtaly of the San Francisco Gas and Electric Company states that the company has placed an order with the Westinghouse Electric and Manufacturing Company for 1,300 series alternating arc lamps and regulators for the same. The company has done away with direct-current series arcs almost altogether in commercial lighting, and the new lamps will enable the public street lighting to be supplied from the alternating-current lines.

Among the callers in San Francisco last week were G. W. McRoss, superintendent of the electric pumping station at Comstock mines, and Samuel Hill, president of the Seattle Gas and Electric Company.

An additional 150-kilowatt generator has been ordered for the extension of the power plant in the Rialto Building, San Francisco. The contract also includes additional switchboards and instruments sufficient for the ultimate capacity of the plant. The new equipment for the power plant will also supply the new hotel which the owner of the Rialto Building will erect on Market Street.

W. H. Hammond, president of the Mt. Whitney Power Company, has returned to Visalia from an extended trip throughout the East.

The loss of the dam at Colgate deprives the California Gas and Electric Power Company of the use of 12,000 inches of water for generating electricity. The demand for electricity is so great that the Bay Counites company must have the major portion of this waterpower, so a plan of pumping water into the flumes will be tried until the dam is completed.

The Oregon Water Power and Railway Company of Portland, Ore., has signed an agreement with the Portland General Electric Company by which the latter agrees to purchase all the power to be generated at the projected plant of the Oregon Power and Railroad Company on the Clackamas River at Cazadero. The agreement is for 22 years, with a 20-year renewal privilege. The power plant will be constructed on the south side of the Clackamas River across from Cazadero, 43 miles from Portland. About a year and a half ago the Oregon Water Power and Railway Company contemplated the installation of an electric-lighting plant in Portland, to run in opposition to the General Electric Company. After considerable consideration, however, the two companies managed to get together, with the result that the latter company will do the wholesale electrical business, while the former will retail the electric power of the city.

The Siskiyou Power and Electric Light Company, with headquarters at Yreka, Cal., has purchased the Ashland Electric Light and Power Company. The new owner will at once install new machinery and make a number of modern improvements in the plant.

The Portland General Electric Company of Portland, Ore., has been granted a permit to erect a superstructure for its power plant to cost $35,000. The plant complete, including equipment, will cost $250,000. A.

Northwestern States.

Minneapolis, April 2.—E. C. Hurd, promoter of the electric line from Omaha to Beatrice, Neb., is in the East in an effort to finance the proposition.

A franchise and right-of-way was voted to the Sioux City, Homer and Southern railway at Dakota City, Neb.

Farmers in the vicinity of Tipton, Iowa, are talking of building an electric road from that place to Muscatine.

The street-car line at West Duluth, Minn., will be extended 10 blocks by the Duluth-Superior Traction Company.

It is thought that the present trouble between the city of St. Paul and the Twin City Rapid Transit Company over the extensions of street-car lines will shortly be aired in court. The city insists on a five-per cent. gross earnings tax before it will grant permits for extension of the company's lines.

One of the generators at the new power house of the Twin City Rapid Transit Company has been started and is furnishing about 6,000 horsepower. The second is being installed and the third will be in place by July. When finished each generator will furnish 9,000 horsepower. R.

PERSONAL.

Walter C. Fish, general manager of the Lynn works of the General Electric Company at Lynn, Mass., has sailed for Europe.

Charles F. Foster of Chicago has been appointed chief operating engineer of the World's Fair power plant. He will assume charge at once.

W. H. P. Hill of Watsonville, Cal., has been chosen manager of the Salinas (Cal.) Light and Power Company, and assumed his duties on April 1st.

City Engineer Harry R. Gard of Monroe, Mich., has resigned his position to accept a position as chief engineer of the electric road which is to be constructed between Kansas City and St. Joseph, Mo.

Matthew C. Brush, formerly of Minnesota, who accepted the position of assistant to Adams D. Claflin, president of the Boston Suburban Electric Companies, last July, has been appointed general manager of the system.

A. B. du Pont, who has lately resigned as second vice-president and general manager of the St. Louis Transit Company, it is reported, will go to Detroit, Mich., and continue in the service of the Detroit United Railway as consulting engineer.

C. C. Starr, formerly connected with the firm of John Starr, Son & Co., has been engaged by the Canadian Westinghouse Company to act as its representative in the Maritime Provinces. Mr. Starr will have his headquarters at Halifax, Nova Scotia.

Capt. Robert McCulloch, who has left Chicago to return to St. Louis to take charge of the St. Louis Transit Company, has been honored by his Confederate comrades, having been elected grand commander of the United Confederate Veterans, to succeed Frank Gaiennie.

Capt. Alexander R. Piper, formerly second deputy police commissioner of New York, and who recently concluded a thorough investigation of the Chicago police force, has been appointed general superintendent of the American Railway Traffic Company, which was organized to conduct a freight-traffic business over the lines of the Brooklyn Rapid Transit Company. Mr. Piper was appointed captain in the volunteer service in 1898 and was retired when he lost an arm.

Benjamin H. Glover, formerly with the Underwriters' Laboratories in Chicago and for the last year engineer of the Chicago Fuse Wire and Manufacturing Company, at Buffalo, N. Y., is now associated with the Westinghouse Electric and Manufacturing Company at East Pittsburg, Pa.

J. J. O'Brien, who for more than 14 years has been in the auditing, accounting and financial departments of the Chicago office of the General Electric Company, for the last few years having occupied the position of cashier and chief clerk, has resigned to take the position of general auditor with the engineering firm of H. M. Byllesby & Co.

Henry A. Bogardus of Chicago, who was perhaps the most widely known telegraph operator in America, died on March 29th in Chicago. He was born in Rochester, N. Y., 60 years ago. "Old Bogey," as he had been familiarly known for a quarter of a century, had worked in nearly every telegraph office of importance in the United States, Canada and Mexico.

Colonel Hiram M. Carpenter, an inventor of electrical devices, died in New York on March 29th. He invented and improved storage batteries, and lately had been engaged upon a wireless telephone. Mr. Carpenter was born in Williamstown, Mass., 64 years ago and was related to the late United States Senator Matthew Carpenter. He gained his military title in the Civil War.

Mr. J. N. C. Shumway, manager of the Taylorville (Ill.) Electric Company and a member of the executive committee of the Illinois State Electric Association, dearly loves a joke, but he probably had little appreciation of the sardonic humor of the man from Taylorville sentenced in St. Louis to two years in the penitentiary on a burglary charge, who gave the false name of "John C. Shumway." As the real Mr. Shumway is a former state senator, a member of the Illinois World's Fair Commission and an entirely reputable citizen, he was naturally annoyed when he began to receive letters of condolence and suggestions telling him how to proceed to secure a pardon.

ELECTRIC LIGHTING.

The Mentone Electric Light and Power Company of Mentone, Ind., has been sold through the J. S. Maurer & Co. agency to J. H. O'Rourke of Algonac, Mich.

Proposals for the street and public lighting of the city of San Antonio, Texas, will be received by the city clerk until April 16th. The term will be for two years, with the privilege of five, and the bids may be for gas or electric light or both.

Sealed proposals will be received until April 28th for furnishing and placing the lighting fixtures for the United States mint (new) at Denver, Colo., in accordance with drawings and specification, copies of which may be obtained of James Knox Taylor, supervising architect, Treasury Department, Washington, D. C.

E. E. Sayles of Cullom, Ill., has been granted a 20-year franchise by the town of Saybrook, Ill., for the operation of an electric-light and heating plant in Saybrook. Mr. Sayles will begin the construction of the plant within 30 days and is in the market for a 90-horsepower second-hand engine.

Joseph J. Henry of Denver, Colo., has bought the Shawnee Light and Power Company of Shawnee, Okla., the Oklahoma Gas and Electric Company of Oklahoma City and the New Gas and Electric Company of Guthrie, Okla. Mr. Henry has also, within the last 90 days, completed the building of a traction system at Shawnee.

The Shawnee (Okla.) Light and Power Company has secured a franchise and is constructing its lines from Shawnee to Tecumseh, Okla., for the purpose of furnishing light and power from the central station at Shawnee to the city and commercial patrons at Tecumseh. This company, rather than the one at Enid, will probably be the first among Oklahoma companies to carry out plans for transmitting electrical energy to other towns.

Suit to set aside the $20,000,000 consolidation of the Missouri Electric Light and Power Company, the Union Electric Light and Power Company and the Citizens' Electric Light and Power Company of St. Louis, now constituent corporations of the North American Electric Company of Philadelphia, alleging that the merger was effected by fraud, has been instituted by Morgan Jones of Denver, Colo., in the United States Circuit Court. A restraining order and the appointment of a receiver are asked for.

A financial report covering the year ended January 31, 1904, gives the earning of the following-named electric companies in which Stone & Webster are interested: Terre Haute Electric Company, Terre Haute, Ind.; Tampa Electric Company, Tampa, Fla.; Edison Electric Illuminating Company, Brockton, Mass.; Lowell Electric Light Corporation, Lowell, Mass.; Savannah Electric Light Comppany, Savannah, Ga.; Minneapolis General Electric Company,

Minneapolis, Minn.; Houghton County Electric Light nah, Ga.; Minneapolis General Electric Company, Seattle, Wash.; Houghton County Street Railway Company, Hancock, Mich. It is interesting to note that all but one of the companies named show increases in net earnings compared with the preceding year.

The report of the superintendent of the municipal electric-light plant at Jamestown, N. Y., for the year ended February 29, 1904, states that the cost of operating 347 1,200-candlepower street arc lamps for the year was $12,250.71; this included 1,266 16-candlepower incandescent lamps and 12 arc lamps for the City Hall and Fire Departments. The superintendent says: "By measurements with meters these two departments have used during the last fiscal year 60,400 kilowatts. The charge of four cents a kilowatt-hour, which I consider a low rate, brings the amount for lighting to $2,416, and for supplies furnished $35.86, making the total for the year, $2,451.86. Deducting this amount from the expense of street lighting, which in the foregoing is shown to be $12,250.71, will leave a net cost for each street light of $28.34 a year."

ELECTRIC RAILWAYS.

President Sells of the Manitou and Pikes Peak Cog Road has announced that the work of converting the cog road up Pikes Peak into an electric line will be commenced this summer in order to have the job completed by the beginning of the tourist season of 1905. The work, it is estimated, will require an expenditure of $200,000.

The motormen of the Metropolitan Street Railway Company of Kansas City are asking for a stool, that they may rest during the intervals of their 12-hour run, asserting that if they are permitted to rest a few moments they will be able to give better service. The matter has been referred to the legal department, as the officials of the company are willing that the request be granted.

The project to connect Antwerp and Brussels, Belgium, by a high-speed electric railroad has been abandoned for the present, and instead a limited charter has been granted to a stock company to build and operate a standard-gauge steam railway, the trains of which are to have a maximum speed of 90 kilometers (55.9 miles) an hour. The Belgian government has the right of buying up the road at any time.

The board of county commissioners has passed the franchise asked for by the Topeka (Kan.) Railway Company for a period of 30 years. But one change was made in the franchise as drafted by the railway people, and that was the insertion by the commissioners of a clause making all extensions of lines over county roads and highways in the future "subject to the approval of the county commissioners first obtained."

When Judge Grosscup returns to Chicago next week the Union Traction Company receivers will ask permission to purchase another lot of 100 new electric cars. Extensive plans for carrying North and West Siders farther into the heart of the city and the abandoning of horse cars will also be laid before the court. The receivers have retained A. G. Artingstall to draw plans and make estimates for the lowering of the tunnels under the river, which, it is roughly estimated, will cost $5,000,000.

The stockholders at the annual meeting of the Lake Street Elevated Railroad Company, Chicago, have voted to change the name to the Chicago and Oak Park Elevated Railroad Company. The company was organized in 1888 and now has 9.72 miles of double track. Every ingenuity has been exercised to place the property on a paying basis and the stockholders will now at least get rid of a name under which the road has not been productive of dividends. The annual report, it is said, will be given the stockholders on April 20th.

The St. Louis Transit Company in preparing its system for the great demands which are sure to be made upon it during the coming summer has adopted among other things a system of storage air brakes instead of equipping the cars with individual air compressors. The company has ordered 1,500 car equipments for storage air-brake apparatus and also 40 motor-driven compressors. These compressors will be placed at 18 different compressor stations. According to the officers of the Transit company the storage system was adopted because of the smaller investment required for the equipment of the road and the greater economy in the maintenance and operation of a few stationary compressor plants as compared with those of a compressor on each car. The officials also state that they consider the system more reliable and less likely to fail on the road than the individual-compressor system.

PUBLICATIONS.

"Ten Minutes for Lunch" is the title of a pretty photograph-lithograph postal card now being mailed as a reminder from St. Marys, Pa., to the friends of the Speer high-grade carbon motor brush.

The Electrical Magazine, a new London publication, edited by Theo. Feilden, two numbers of which have appeared, is a monthly periodical devoted to electrical engineering and science. It contains much of technical and news interest and will no doubt be received with hearty appreciation. One of the special features is the student's section, which, among other things, contains questions and answers exchanged between students and the professors having charge of the section. The typographical design and execution of the magazine are particularly excellent.

"Commercial Japan in 1904" is the title of a monograph just issued by the Department of Commerce and Labor at Washington, D. C., through its Bureau of Statistics. It shows that the trade relations between the United States and Japan in recent years have grown with greater rapidity than between Japan and any other nation.

The eighth annual report of the International Association of Municipal Electricians has just been issued, containing the proceedings of the convention held in Atlanctic City last September, with all the papers. The volume contains a list of officers and also their portraits interspersed throughout the pages. In the back is a copy of the constitution and by-laws. The whole is substantially bound in cloth. Frank P. Foster of Corning, N. Y., is the secretary of the association.

"Two Stories of Zinc" is the title of a carefully prepared pamphlet from the Lanyon Zinc Company of New York city and St. Louis, of which Mr. F. E. Drake, a well-known electrical man, is president. "The Story of Spelter" and "The Story of Sheet Zinc" are the titles of the two sketches embodied in the pamphlet. The manufacture of spelter from the raw ore through all the different processes through which the material must pass to the finished product is described in the first story. In the second the processes gone through with in the manufacture of sheet zinc from spelter are described. The stories are well illustrated and the pamphlet contains a map of the United States showing the zinc-ore districts.

SPACE TELEGRAPHY.

The balance sheet as of January 31, 1904, of the Marconi Wireless Telegraph Company of America places the total assets of the company at $6,231,232. The item, cost of stations, is given at $175,606. Patent rights, good will, etc., are valued at $5,318,494.

What is said to be the longest message transmitted up to that time by space telegraphy appeared in the London Times of March 21st. It was about 1,400 words in length and had been transmitted wirelessly from the Times dispatch boat with the Japanese fleet to Wei-hai-wei, and thence by ordinary cable. The De Forest system was used.

Judge La Combe handed down his decision on March 29th, denying the application for preliminary injunction of suit brought against the American De Forest Wireless Telegraph Company by the National Signaling Company. The suit concerned the alleged infringement by the De Forest company in using a type of electrolytic receiver which the complainant asserted to be a "liquid barreter," on which Reginald Fessenden was granted a patent last June.

MISCELLANEOUS.

About $25,000 will be spent at Vinewood, Kan., for extensive improvements. Among the improvements will be an electric fountain at Vinewood Park, the cost of which will be $3,000.

When the Royal Geographical Society's Antarctic expedition crossed, for the first time in the world's history, the eightieth parallel of south latitude, Captain R. F. Scott, R. N., declares the compass needle pointed due south, exactly the wrong way.

The latest Board of Trade returns show that there are 296 tramway undertakings in the United Kingdom, which have cost $200,000,000. These have nearly all been created in the last 25 years. Of the total number 142 are owned by municipalities and 154 by private companies. The municipal undertakings, though less in number, have more mileage and cost about $120,000,000; the private, over $80,000,000.

The Japan Times of recent date, in an article setting forth the goods that will be regarded as contraband during the present war between Japan and Russia, says that materials for the construction of telegraphs, telephones and railways will be treated as contraband of war in case they are destined for the enemy's army or navy, or in case, from the nature of the locality in the enemy's territory to which they are bound, they may be considered to be intended for the use of the enemy's army or navy.

B. H. Warner, Jr., United States Consul at Leipzig, Germany, writes: "The Great Leipzig Street Railway Company, the most important line in the kingdom of Saxony, has decided to grant all employes an annual leave of absence with pay. To those motormen and conductors who have been in the service two years and less than five years, three days a year will be allowed; those who have served longer than five years will be given five days. Said leave is to be so arranged that it will be taken immediately after the regular 'off day' in a week, which is given to every man."

Professor T. S. C. Lowe of Pasadena, Cal., is said to have invented a process by means of which bituminous coal can be converted into anthracite. Ovens are employed and a great intensity of heat is applied to effect the crystallization. It is asserted by the inventor that five tons of bituminous coal can, by the process now being used by a plant in operation in San Francisco, be converted into four tons of the anthracite product, and the seeming waste of 20 per cent. is taken up in the gas produced, so that there is little loss.

There has been some discussion in Chicago financial circles recently concerning the Cosmopolitan Electric Company's franchises. The company operates a small plant for the production of electric current, but has never made use of its telephone rights. It is argued that the Cosmopolitan telephone franchise has not been utilized nor offered for sale because it may be useful in some future consolidation deal. This opinion is offered in view of the fact that the Chicago Telephone Company's franchise expires a few years hence. The Cosmopolitan Electric is owned by the People's Gas interests.

Governor Odell of New York, in a letter to the Niagara River Improvement Company, assures that body that work on the authorized $101,000,000 barge canal across the state will be prosecuted until completed. He states that a commission of engineers to supervise the work has been appointed, that preliminary surveys and estimates have been and are being made, and it is expected by the first of May the state will be prepared to advertise for the bids for the actual construction work. The letter was written in connection with the proposed ship canal around the rapids at the head of Niagara River at Buffalo.

Plans for the construction of the proposed Riga-Cherson Canal, involving an estimated expenditure of $180,250,000, have just been worked out and presented to the czar by the well-known Russian engineer, W. von Ruckteschell, who proposes to connect the Baltic with the Black Sea by a canal for ships of heavy draft, starting from Riga, a port on the Baltic Sea, and ending at Cherson, a port on the Black Sea. It is proposed to build one large lock on the River Dnieper about one-third of a mile distant from the town of Kopys, and also to have locks on the tributary rivers of the Dnieper. Electrical power for lighting the canal and for towing the ships can be had from the waterpower of the falls produced by these locks. By lighting the canal with electricity continuous moving of ships can be maintained. If the average speed should be eight knots per hour, as allowed on the Suez Canal and on the Kaiser Wilhelm Canal, the time required for passing through the Riga-Cherson Canal, a length of 1,468 miles, will be 160 hours, or seven days.

TRADE NEWS.

Dr. Emil H. Grubbe of Chicago announces the removal of the Illinois X-ray and Electrotherapeutic Laboratory from the Champlain Building to No. 52 State Street, Chicago.

The Benjamin Electric Manufacturing Company, now located at 141 South Clinton Street, Chicago, will soon move to larger quarters in the Atlantic Building, corner Jackson Boulevard and Canal Street.

J. D. Campbell, R. W. Ashcroft and K. K. McLaren are the incorporators of the Field Multiplex Telegraph Insulation Company, which will have headquarters at Jersey City, N. J. The company is capitalized at $20,000.

The Los Angeles Electrical Specialty Company has been incorporated for the purpose of manufacturing various kinds of electrical machinery. Those interested in the company are D. W. Coons, Russell Gage, E. A. Miller, C. C. Bowen and A. W. Coons, all of Los Angeles. The capital stock is $25,000.

G. L. Crosby has opened an office at 426 Williamson Building, Cleveland, Ohio, and will handle Weston instruments and "G I" circuit-breakers. Mr. Crosby will cover Ohio, Western Pennsylvania and Michigan, and having been with the Cutter company for about 1½ years, is thoroughly familiar with the circuit-breaker and instrument business in that territory.

United States Consul Cuneo, writing from Turin, Italy, says that while the field does not seem inviting for the sale of American railway and telegraph supplies, he would suggest that it would be well for American manufacturers to send expert agents there to view the situation. In some other lines of goods, he says, American products have practically the monopoly of the trade. Vigorous efforts, low prices, and long-time payments might result in capturing some of the trade in the line of railway and telegraph supplies.

The Yost Electric Manufacturing Company of Toledo, Ohio, writes: "We note the appearance of the Perkins Electrical Switch Manufacturing Company's advertisement in several of the electrical publications, advising the buyers generally, or the sellers of Yost sockets, that suit has been decided against J. F. Buchanan & Co. for selling Yost sockets, and that the sellers of Yost sockets are infringers on their patent No. 626,927. This is not true. The Yost Electric Manufacturing Company never made this socket on which J. F. Buchanan & Co. were sued for infringement and are not making it now. It is

not the Yost socket, but was known as the Dixon socket, made by the Yost-Miller Company and not by this company at all."

BUSINESS.

Self-starting alternating-current motors are manufactured by the Emerson Electric Manufacturing Company of St. Louis in sizes from one-twentieth to one-sixth horsepower. These motors are made with two sizes of frames and operate at a constant speed of 1,700 revolutions per minute. They are described in bulletin No. 3052, issued by the company, and as they have been on the market for several years they are by no means in the experimental stage.

The Trumbull Electric Manufacturing Company of Plainville, Conn., is especially recommending to the trade two of its specialties, a magneto and battery switch for gas and gasoline engines and a type of panel cut-out. The latter is made to carry 15 amperes at 115 volts, and can be used on either a two or three-wire system and for any number of circuits.

F. N. Manross of Forestville, Conn., states that in order to handle the increase in his business he has been obliged to double the capacity of his building and add to the number of employes. The goods manufactured are hair-springs for electrical instruments. Mr. Manross asserts that the trade in this line has been the largest in his experience of 25 years.

The Gregory Electric Company of Chicago says that it has some desirable generators suitable for central stations. This company reports business as exceedingly brisk, and now asserts that it has the largest stock of dynamos and motors in this country. It issues regularly a monthly "bargain sheet," in which all of this apparatus is described, which is sent to all people interested in electric matters, without charge.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) March 29, 1904.

755,630. Bell. William W. Dean, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed March 24, 1902.

Adjustable pole pieces are arranged for the cores of a magnet capable of a fixed and permanent adjustment. In operative relation with the pole pieces is an armature, the adjustment of the pole pieces serving to vary their positions with respect to the armature. A support for the armature is secured in unvarying relation to the forward ends of the cores by the pole pieces. The bell tongue is operated by the armature.

755,642. Electric Accumulator Plate. Chaimsonovitz P. Elieson, Paris, France. Application filed October 16, 1903.

In an electric accumulator plate are several strips of thin flexible lead in juxtaposition and free at one end. A conducting rib is united to the ends of the strips on one side and has a longitudinal groove in its opposite side, a tube of conducting material being constructed to be received in the groove and there secured.

755,643. Process of Making Electric Accumulator Plates. Chaimsonovitz P. Elieson, Paris, France. Application filed October 16, 1903.

The process of making an electric accumulator plate consists in superposing on a suitable supporting plate a series of strips of thin flexible lead of such length that their ends shall protrude beyond the edges of the plate. The protruding ends of the strips are fused and divided transversely into two sections of equal area and united at their fused edges.

755,646. Multiplex Telegraphy. Stephen D. Field, Stockbridge, Mass. Application filed March 5, 1903.

A transmitter adapted to reverse the current on line is provided with means whereby the reversal will take place by a series of potential gradations from a maximum of one polarity to a maximum of the opposite polarity. Means are also provided for changing the strength of current on the line. Receiving devices are responsive respectively to current reversals and currents varying in strength.

755,647. Multiplex Telegraphy. Stephen D. Field, Stockbridge, Mass. Application filed March 24, 1903.

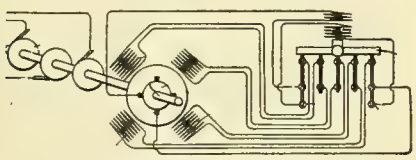
Connected to the main line is a duplex-tuned receiver having its coils reversely wound. Two tuned vibrators actuated by the receiver, a tap circuit from between the two coils, a condenser in the tap circuit and a rheostat to which the tap circuit is connected are the other parts of the apparatus.

755,659. Electric Water Heater. James F. Hathaway, San Francisco, Cal., assignor of two-thirds to Felix B. Mulgrew and Julius M. Alexander, San Francisco, Cal. Application filed August 10, 1903.

The electric heater comprises an outer casing, an inner hollow core integral with the head of the casing and extending slightly beyond the bottom and a detachable bottom centrally apertured to receive the lower end of the core. A heating coil is interposed between the core and the interior surface of the casing, with means forming a connection between the coil and a source of electrical supply.

755,669. Current-selector for Charging Secondary Batteries. Miller R. Hutchison, New York, N. Y., assignor to the Hutchison Acoustic Company. Application filed May 5, 1903.

A branch circuit leading from the main circuit includes in series a translating device, a storage battery to be charged and an electrolytic cell capable of preventing flow of current in one direction and permitting it to flow in the opposite direction.



NO. 755,791.—FIELD CIRCUIT-CLOSER.

755,691. Telephone Selective System. Noble S. McKinsey and Anton R. Nelson, Susanville, Cal. Application filed June 15, 1903.

A main wire having a switch at each telephone station co-operates with a return wire. A bridge at each telephone station, between the main and return wires contains a secondary winding and ear telephone. A break in the circuit is closed by the opening of the main line. Making a second brake operates two closures, one of the closures being made by a revolving wheel. Only one of the closures is operatable at a time for all the wheels and the second closure is made by an independent switch.

755,697. Electric Incandescent-lamp Socket. Guy H. Proctor and John B. Daley, Somervillle, Mass., assignors to the New England Electric Manufacturing Company, Somerville, Mass. Application filed July 30, 1903.

In an incandescent-lamp socket are combined a slotted shell, a slotted cap, an insulating support for the make-and-break mechanism, a connecting-bar T having perforated arms and carried by the insulating support, and holding screws for the shell, cap, insulating support and connecting bar.

755,708. High or Low-pressure Signal Alarm. Frank H. Schmitz, New York, N. Y. Application filed September 4, 1903.

A piston moving in a cylinder and actuated by pressure exerted within the cylinder carries a contact maker which at a predetermined pressure makes an electric circuit ringing an alarm bell.

755,731. Controller for Electric Motors. Magnus W. Alexander, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 13, 1903.

The contact arm of the controller is moved by a spring to its off position. An independent actuating lever is provided with a pawl adapted to engage a segmental ratchet on the arm. A latch lever pivoted upon a stationary part is adapted to engage the ratchet and hold the contact arm in the respective positions to which it is moved by the actuating lever. Current-controlled means independent of the actuating lever trip the latch lever and pawl to release the controller arm and permit it to return to its off position under the stress of its spring.

755,732. Electric Motor. Ralph E. Barker, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 7, 1903.

An end shield is formed with the bearing for the armature shaft. A brush-holder yoke is supported on the end shield, the yoke having a central opening. The commutator, mounted on the shaft, extends within the opening in the brush-holder yoke, the brushes being mounted on the side of the yoke farther from the armature.

755,739. Maximum-demand Indicator. Harry W. Brown, Boston, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 2, 1902.

An electrical indicator, comprises a conductor which is magnetic at low temperatures but non-magnetic at higher temperatures with means for connecting the conductor in circuit. The variation of magnetism effects an indication on a scale.

755,740. System of Electrical Distribution. Harold W. Buck, Niagara Falls, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 4, 1902.

A synchronous alternating-current motor drives generator. Inductive supply mains lead to the motor with means for varying the excitation of the motor in response to variation of load on the generator, thereby producing a regulation of voltage in the alternating-current system.

755,744. Controller. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 1, 1902.

A rotatable drum or cylinder of magnetic material contains a fixed magnet core arranged adjacent to the drum with means for magnetizing the core. A row of contact fingers is arranged on each side of the core in the path of the magnetic flux produced in the core, the fingers being adapted to engage with the contact segments on the periphery of the drum.

755,757. Multiple-rate Meter. Alexander J. R. Fiego, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 21, 1903.

In a multirate meter is an electromagnetic device for changing the manner of recording, comprising two electromagnets, a pivoted cam rocked thereby, arms carrying contacts bearing on the cam, and means whereby the movement of the arms when the cam is shifted opens the circuit of the magnet which caused the movement and closes a connection to the other magnet.

755,766. Transformer. Walter A. Hall, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 29, 1902.

Four bundles of iron laminæ arranged radially to abut each other at the center form the transformer core, each bundle constituting a magnetic circuit. Two of the bundles of laminæ directly abut each other, the second two bundles abutting the opposite sides of the joint between the first. The legs of the second two bundles of laminæ are of less width than the legs of the first two in order to make the center of the core cruciform in cross-section.

755,771. Electric Switch or Circuit-breaker. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 29, 1900. Renewed May 7, 1902.

The circuit-breaker, comprising an electric motor, a movable switch member operated by the motor to close the switch, a cut-out for the motor circuit operated when the switch is closed and a switch-opening spring strained when the switch is in closed position. Connections for releasing the spring by a further movement of the motor, and means for closing the motor circuit independently of the cut-out are further specified.

755,772. Switch. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 14, 1903.

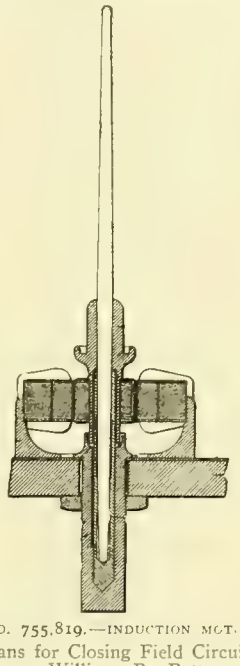
Means for closing the field circuit of a generator through a resistance shunt, comprise a main switch blade, a handle independently pivoted at the same point and serving as an auxiliary switch blade, a spring connection between the two blades, and an auxiliary shunt terminal on which the auxiliary blade closes before the main blade opens.

755,774. Electric Clock. Frank Holden, London, England, assignor to the General Electric Company, Schenectady, N. Y. Application filed April 16, 1900.

Details are described.

755,782. Electrical Contact Device. John Lindall, Boston, Mass. Application filed October 8, 1903.

Carried by the car truck is a shoe beam upon which is mounted a contact shoe. Stirrups or hangers secured to the shoe beam normally support the contact shoe. A flexible conductor is secured to one of the stirrups or hangers.



NO. 755,819.—INDUCTION MOTOR.

755,791. Means for Closing Field Circuits of Rotary Converters. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 17, 1903.

A switch is adapted to connect the field of the converter to its armature, while a polarized electromagnetic device operates the switch. Means for impressing on the device a voltage proportional to the potential across the commutator brushes of the converter are further specified. (See cut.)

755,792. Inertia Damper for Electric Measuring Instruments. William H. Pratt, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 14, 1902.

Combined with a rotary converter is a switch adapted to connect the field of the converter to its armature. A polarized magnet armature trips the switch, and an electromagnet retracts the magnet armature.

755,793. Starting Device for Induction Motors. Henry G. Reist and Arthur W. Henshaw, Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Application filed June 27, 1902.

Contact blocks mounted in groups project from one end of a rotatable member with the corresponding contact faces of the blocks of a single group located in the same plane. The contact blocks are adapted to be electrically connected to the sections of a starting resistance, a number of contact brushes being mounted [illegible] as to engage the contact faces of the blocks.

755,800. Transformer. Louis M. Schmidt, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 19, 1902.

A core in the form of a [illegible] shell is formed of laminations, the end portions of the [illegible] being extended beyond the body of the [illegible] form supporting feet. A winding surrounds the shell, except adjacent the supporting feet [illegible] winding being brought out [illegible] jacent the feet.

755,807. Braking System. Charles P. [illegible], Schenectady, N. Y., assignor [illegible] Electric Company, Schenectady, N. Y. Application filed September 23, 1903.

The method of [illegible] braking generator consists in locally closing the circuits of sections of the secondary winding of the motor, thereby

forming an induction machine, and operating the machine with its primary winding connected to the source of supply for the motor at a speed above synchronous speed.

755,814. Coupling Electric Motors. David P. Thomson, Rugby, England, assignor to the General Electric Company, Schenectady, N. Y. Application filed September 8, 1903.

Connected to the supply mains are a number of direct-current motors, each of the motors having a winding connected both to a commutator and to collector rings. Connections are placed between the commutators and the supply mains, and equalizing conductors are inductively connected between the collector rings.

755,815. Electric Arc Lamp. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 19, 1901.

A self-inductive coil is connected in series with the arc and a solenoid is also placed in series with the arc. An armature is arranged movably in the solenoid and polarized thereby. A magnetic core adjacent to the armature is magnetized by the self-inductive coil.

755,817. Electrical Igniting Mechanism for Explosive Engines. Daniel M. Tuttle, William H. Lindley and William H. Tuttle, Canastota, N. Y. Application filed October 27, 1902.

Sparking terminals are enclosed in the combustion chamber.

755,819. Induction Motor. Pendleton G. Watmough, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 2, 1902.

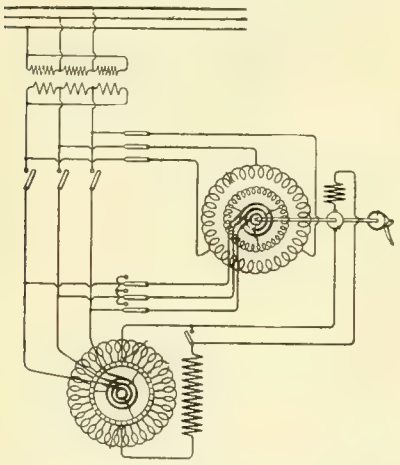
The stator has a core comprising a main portion formed of laminated punchings assembled to form an annular ring. Formed coils of wire are placed on the main portion, with means for maintaining the coils in radial planes, the means comprising intermediate annular punchings of less diameter than those forming the main core portion and forming part of the magnetic circuit of the stator. (See cut on preceding page.)

755,822. Train-control System. George P. Whittlesey, Washington, D. C., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 26, 1902.

One or more standard car controllers are mounted on each car, with an electric motor geared to the controller. Two motor-supplying train wires are connected by a switch alternatively with the motor. Means for operating the switch at predetermined points in the rotation of the controller cylinder are also required.

755,824. Means for Starting Alternating-current Dynamo-electric Machines. Jonathan E. Woodbridge, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 11, 1901.

A frequency changer supplies current to the dynamo-electric machine for starting it. A direct-current generator is driven by the frequency changer, and means for initially exciting the field of the dynamo-electric machine from the direct-current generator are provided. (See cut.)



NO. 755,824.—STARTER FOR ALTERNATING-CURRENT MACHINES.

755,825. Railway-brake Apparatus. Granville T. Woods and Lyates Woods, New York, N. Y., assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed December 31, 1902.

Carried on the vehicle are means adapted to change the direction of motion of the motor or motors together with means to control the delivery of energy to the motors. Brake apparatus is mounted upon the vehicle, and normally inert check apparatus operates independently of the energy controller and is adapted to cause a change in the condition of the energy-controlling device, for the purpose of stopping the delivery of energy to the motors, and to cause the brake apparatus to act after the condition of the controlling device has been changed.

755,827. Rheostat. William C. Yates and Paul Zimmer, Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Application filed July 25, 1903.

A rheostat is provided with a series of resistance units and a contact device for cutting them into circuit progressively. Means operated by a handle vary the resistance at intermediate points of the series by fractional parts of a unit without affecting the contact device.

755,828. Rheostat. William C. Yates, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 22, 1903.

A rheostat with base plate having a groove carries resistance zigzagged back and forth across the groove. A row of pins on each side of the groove to which the resistances are connected, and a filling of insulating material surrounding the resistances are the other features.

755,829. Controlling Induction Motors. Arnaldo P. Zani, Milan, Italy, assignor to the General Electric Company, Schenectady, N. Y. Application filed June 30, 1900.

Means for starting an induction motor consist of a device in circuit with the winding on the induced member of the motor, having a winding constituting a single path for the current induced in the motor winding. The device comprises a coil or coils surrounding massive cores of magnetic material, with means for reducing the self-induction of the device as the speed of the motor increases. (See cut.)

755,830. Tub for Electric Baths. Josef Zwiebel, Neu-Ulm, Germany. Application filed November 24, 1903.

Rods of conductive material on the sides of the tub for stringing up the electrodes carry the electrodes provided at certain distance with isolation material, such as hard rubber, etc., suitably fitted in recesses for the purpose of cutting off the different electrodes from the current by sliding on isolating parts.

755,840. Detector for Electrical Disturbances. Jagadis C. Bose, Calcutta, India, assignor of one-half to Sara Chapman Bull, Cambridge, Mass. Application filed September 30, 1901.

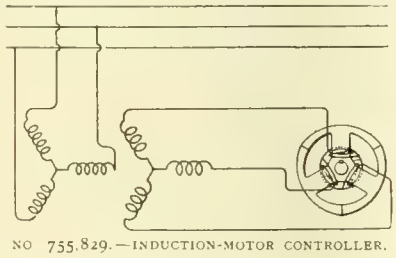
In a coherer or detector of electrical disturbances, Hertzian waves, light waves or other radiations is a sensitive substance having a characteristic curve (giving the relation between an increasing impressed electromotive force and the resultant current passing through the sensitive substance), which is not straight but is either convex or concave to the axis of electromotive force and in which the return curve with a decreasing electromotive force, when taken slowly, approximately coincides with the former curve.

755,845. Electric Time-switch. Frank W. Cherry and Henry F. Radke, San Francisco, Cal. Application filed January 25, 1902.

Details of the mechanism of a time switch operated by clock-work are described.

755,853. Electric-power Transmission System. Max Déri, Vienna, Austria-Hungary, assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed May 28, 1902.

In a system of electrical power transmission are combined motor, a series generator in circuit with the motor, a separately excited field winding on the generator wound in opposition to the series winding, and means whereby the field winding of the motor may be separately and adjustably excited.



NO 755,829.—INDUCTION-MOTOR CONTROLLER.

755,868. Telephone System. Robert Hamilton, Milton, Mass. Application filed February 7, 1903.

Means for controlling the telephone circuit comprises a rotatable wheel, a stop-engaging member adjustably connected with the wheel, a movable stop normally occupying an operative position in the path of the member, and means controlled by the receiver holder for shifting the stop out of and then back into the path of the member when the receiver holder is moved in one direction.

755,889. Electric Rail-bond. Jang Landsing, Brooklyn, N. Y. Application filed April 25, 1900.

The bond is composed of several strips formed into loops and provided with end pieces for fastening to the rails.

755,890. Electric Signaling Device. Thomas C. Laney, Toledo, and Charles S. Longnecker, Delta, Ohio. Application filed November 24, 1902.

Electric lamps are situated within a case and connected to a branch circuit, the lamps being connected so as to give different signals as controlled by the circuit.

755,897. Electric Lock. Frank Lombardi, Brooklyn, N. Y. Application filed December 19, 1903.

Cooperating with an electromagnet adapted to actuate a catch and cause it to release bolt are means for holding the catch out of engagement with the bolt, and electrical means for releasing the catch holder.

755,899. Electric-railway System. Timothy Mahoney, San Francisco, Cal. Application filed April 20, 1903.

A surface-trolley rail is used with a series of cooperating magnets on the car, successive magnets in the series being of opposite polarity. A switch is disposed relative to each section of the trolley rail and in the vertical plane of and out of physical contact with the magnets.

755,905. Electric-traction. System for Railways. August Meuschel, Montreal, Canada. Application filed May 4, 1903.

A motor case is mounted between each pair of longitudinal truck beams. A pair of longitudinal motor shafts and motors within the cases actuating the shafts comprise the apparatus. A driver being journaled between each pair of longitudinal beams and geared to the respective shafts, supporting the motor cases.

755,954. Electric Lamp and Socket. Albert N. Soden, Trenton, N. J. Application filed December 10, 1902.

The filaments of the lamp are arranged on the surface of a conical-shaped reflector inside the bulb.

755,999. Electric Trolley Head. John T. Cherry, Plymouth, and Edward H. Clive, Devonport, England. Application filed November 3, 1902.

Details are described.

756,000. Brake for Vehicles. William H. Cooley, Brockport, N. Y. Application filed December 9, 1902.

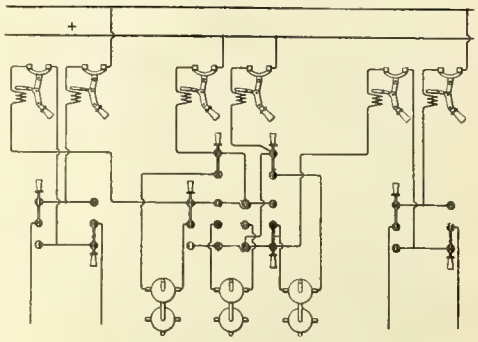
In an electric braking system is combined a magnet for applying the brakes and means whereby the increased slack resulting from wear of the parts is taken up, as it occurs from time to time, by the adjustment of a member not subjected to any mechanical strain by the braking apparatus during the process of the adjustment.

756,025. Electric-light Circuit Protector. Stanley Kalbach, Wildwood, N. J. Application filed May 12, 1902.

A protector for arc lamps, comprises an electromagnet with which one of the circuit wires is connected. A binding post with which the other circuit wire is connected is provided with a contact extending into the path of the armature of the magnet, an electrode connected with the lamp and magnet and another with the lamp and binding post, and a resistance connected with the armature and with the circuit wire with which the magnet is connected are the other essential parts.

756,045. Shunt Controller for Electric Machines. Nels O. Nelson, Chicago, Ill. Application filed July 13, 1903.

Co-operating with the field plates and collecting bars are a pair of inductor bars arranged in adjacent relation to the collecting bars, and means for forming a shunt circuit between the inductor bars.



NO 750,107.—BOOSTER CONTROL.

756,049. Switch for Incandescent Electric Lamps. Conrad M. Pitel, Meriden, Conn. Application filed November 23, 1903.

Switch contacts are located in a case while a switch block operated by a thumb lever turns the switch.

756,050. Coupling for Incandescent Electric Hanging or Suspension Lamps. Conrad M. Pitel, Meriden, Conn. Application filed November 23, 1903.

A coupler for hanging incandescent lamp fixtures is described.

756,119. Electric Resistance. Hans von Kramer, Bath, England. Application filed September 1, 1903.

An electric resistance comprises a body formed of a mixture of conducting and non-conducting and binding materials, a central core of sand, a mantle of non-conducting and binding materials surrounding the body, layers of highly-conductive material internally concave at the ends of the body, carbon plugs in the layers and contact poles embedded in the carbon plugs.

756,156. Signal Apparatus for Trolley Railways. Almo L. Cheatham, Louisville, Ky., assignor of three-fourths to Robert V. Cheatham, Louisville, Ky. Application filed August 8, 1903.

Alongside the track is arranged a conductor and a signal is electrically connected with the conductor intermediate the ungrounded ends of the latter and also connected with earth. A tilting hanger supported above the trolley wire, means for suspending the trolley wire from one end of the hanger, a contact arranged in the path of the free end of the hanger and electrically connected with the conductor, and means for raising the free end of the hanger into engagement with the contact when the trolley wire is lifted by the trolley and thus complete the circuit from the trolley wire to the signal are the other essentials of the apparatus.

756,167. Controlling Electric Boosters. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed August 31, 1900. Divided and this application filed October 20, 1902.

In a system of electrical distribution are combined a main source of current, a number of boosters, a number of feeders with which the boosters may be connected, and switch connections for transferring any booster to any feeder. (See cut.)

756,176. Protective Sheath or Envelop for Storage-battery Plates. Achille Meygret, Paris, France. Original application filed June 29, 1903. Divided and this application filed July 27, 1903.

A coating or sheath for retaining the active material on the plate of a storage battery consists of a mixture of castor oil, essence of turpentine, and nitrates of cellulose.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on April 5, 1904:

360,447. Electric Annunciator. John C. Kunkle, Hoboken, N. J.

360,448. Electric Annunciator. John C. Kunkle, Hoboken, N. J.

360,492. System of Electrical Distribution. Francois Van Rysselberghe, Schaerbeek, Belgium.

360,528. Quadruplex Telegraphy. Francis W. Jones, New York, N. Y.

360,532. Connection for Carbon Elements in Galvanic Batteries. William P. Kookogey, New York, N. Y.

360,538. Electric-lighting System. Joseph A. Powers, Langingburg, N. Y.

360,567. Insulating and Protecting Cables. Thomas H. Dunham, Boston, Mass.

360,570. Electric-instrument Protector. Isaiah H. Farnham, Malden, Mass.

360,626. Telephone Receiver. Jos. H. Tabony, New Orleans, La.

360,638. Railway Electric-Signaling Apparatus. Geo. Westinghouse, Jr., Pittsburg, Pa.

360,660. Electric House Bell. Edward G. Coleman, St. John's, Newfoundland.

360,662. Electric Arc Lamp. Charles F. Cooke, Buckingham Works, County of York, England.

360,696. Electric Gas Burner. Charles W. Holtzer, Brookline, Mass.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, APRIL 16, 1904 No. 16

The Louisiana Purchase Exposition.

One of the most important events in the history of the United States was the purchase of the Louisiana territory from France, which was consummated in 1803, principally through the diplomacy of President Thomas Jefferson, and partly, also, through the fear of Napoleon that the territory might eventually fall into the hands of the English. By this gigantic "real-estate deal" 875,025 square miles, or 560,016,000 acres, of the rich lands of the Mississippi Valley were acquired by the United States for the sum, insignificant in comparison, of $15,000,000. At the present time this great region, which comprises approximately one-third of the area of the United States, has a population of 15,000,000 people, with an assessment value in 1900 of $6,616,642,829—a fairly good return on the capital invested, as will be acknowledged even by the present-day "promoter."

The Louisiana Purchase Exposition, which is to be held in St. Louis this year, in view of the magnitude of the event which it is to commemorate, has been designed along lines which will place it first in many respects among the expositions the world has thus far seen. It was the original intention to hold the exposition in 1903, 100 years from the date of the Louisiana Purchase, but so great was the undertaking that it was found necessary to postpone the event until 1904. President Roosevelt at noon, St. Louis time, of April 30th, will press the button, at his desk in Washington, which will close an electric circuit to throw into active operation various departments of the great exposition, which will continue until December 1st.

Great as has been the magnitude of previous world's fairs, they will be eclipsed in point of actual area covered and in floor space by the St. Louis fair. The grounds in Forest Park, situated on the extreme western edge of the city, and the leased grounds to the west of the park which will be given over to the fair, comprise in all 1,240 acres, of which 250 acres will be under cover. A map of St. Louis, showing the location of the grounds, is given on page 306 of this issue.

Mere size of grounds and buildings alone, however, does not constitute an exposition, and upon this the fair at St. Louis is not dependent for making a favorable impression upon the visitor. In point of artistic design and harmonious grouping of the buildings it will compare favorably with any yet held. The principal buildings are arranged in the form of the sector of a circle, the apex of which is Festival Hall, which, with its great dome, 144½ feet in diameter, and facing out on the Grand Basin, forms a magnificent centerpiece for the "main picture."

Electricity will perforce be a conspicuous feature of the exposition, and in order of importance may be classified into three main groups—electrical exhibits, both foreign and domestic; electrical power generation and transmission, and spectacular electric-lighting features. On page 307 is a map of the grounds, the points which will be found particularly interesting to those interested in electricity being designated by arrows.

Naturally, in the Palace of Electricity will be centered most of the electrical features. This building is situated north of Festival Hall, and is five-sided in form, enclosing a large central court. It covers approximately 350,000 square feet, and was erected at a cost of $399,940, and in it will be installed electrical exhibits exclusively. It is expected that the electric lighting features of the exposition will be very beautiful, though only trial can demonstrate what the actual effect will be. The colors orange, purple and green will be used with a system of control which, if all goes well, will enable the light to be turned on and off gradually and to blend in various combinations of tints and intensities that should furnish an unforgetable spectacle.

One of the features which will doubtless interest many who have not had the opportunity to see the apparatus in operation will be a space-telegraph station of the most powerful kind, by which messages may be sent to surrounding cities, and possibly as far as to Chicago.

Air-ship tests will form one of the most interesting and valuable attractions at the exposition. In connection with these tests an effort will be made to transmit power, to the extent of a tenth of a horse-power or more, through the ether.

Congresses for many purposes will have their meeting place at the exposition, and one of the chief of these will be the International Electrical Congress. The period set for this congress is the week from the 12th to the 17th of September, which is the week just preceding the great Scientific Congress, appointed by the exposition authorities. At the Electrical Congress distinguished engineers and scientists from foreign countries will be present, and the great engineering problems of the day will be discussed.

So great a magnet are the educational advantages and spectacular attractions of the Louisiana Purchase Exposition that a large number of engineering and technical societies throughout the country have selected St. Louis and the period of the fair as the place and time for their conventions of this year. Among these societies are the American Institute of Electrical Engineers, the American Street Railway Association, the National Electric Light Association and the Northwestern Electrical Association.

Executive officers of the exposition are: President, David R. Francis; secretary, Walter B. Stevens; treasurer, W. H. Thompson; general counsel, James L. Blair; director of exhibits, Frederick J. V. Skiff; director of works, Isaac S. Taylor; acting director of concessions, Norris B. Gregg; medical director, Leonidas H. Laidley; commandant Jefferson Guard, Major Edward A. Godwin. Under the director of exhibits are chiefs of the different exhibit departments. Of these, W. E. Goldsborough is chief of the Department of Electricity and Thomas M. Moore is chief of machinery. Among the heads of the Department of Works are Henry Rustin, chief electrical and mechanical engineer, and R. H. Phillips, chief civil engineer.

Prospective visitors are asking whether the hotel accommodations and transportation facilities of St. Louis will be equal to the strain imposed upon them. Many are doubtful, but it is asserted that hotels with accommodations for 150,000 guests and railways capable of handling 80,000 passengers an hour will be available.

In the following pages an attempt is made to give the readers of the Western Electrician a general idea of the electrical and allied features of this great exposition.

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NIGHT VIEW OF PALACE OF VARIED INDUSTRIES, LOUISIANA PURCHASE EXPOSITION.

Showing First Test of Decorative Lighting.

Electrical Exhibits Installed in the Palace of Electricity at the Universal Exposition of 1904.

By Winder Elwell Goldsborough.

In instigating the development of the exhibits which are being installed in the Palace of Electricity the prime object has been to have these exhibits tell a story in simple language—one that all can understand—of the realm of electricity.

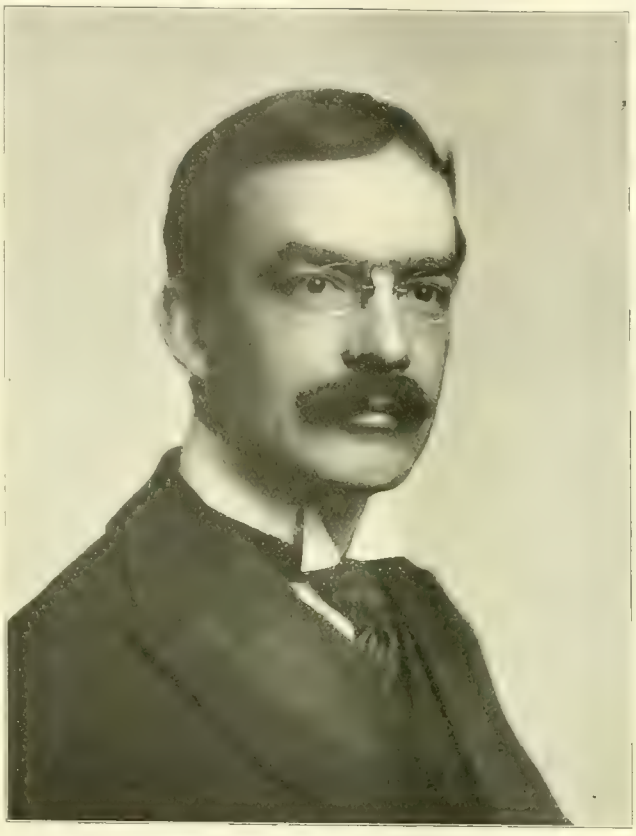
The rapidity with which the use of electricity is to be extended will depend very largely upon the instruction which the public receives regarding, not only the use of electricity, but also the nature of electricity. When the public shall feel as familiar with electrical phenomena as it now does with coal oil, gas, steam and the other work-a-day utilities, electricity will be about the only agent depended upon for the necessities, conveniences and luxuries of life. Those who are enthusiastic about electricity should work to the end of removing, in so far as possible, all of the mystery which surrounds electrical phenomena and the use of electricity. The effort should be to make the general laws of electricity matters of every-day and casual knowledge, and to bring the diffusion of electrical information to the point where the young engineer in knickerbockers will have absorbed many of the principles of electricity through his skin before he contemplates, with fear and some trepidation, the toilsome path that leads up to the mathematical analysis of electrical phenomena.

The exhibits in the Palace of Electricity have been developed with the aim of making them, so far as possible, a stepping stone in the accomplishment of the above stated result. Every method of persuasion which the ingenuity of the Electrical Department could devise has been utilized to strengthen the arguments with intending exhibitors which would result in the accomplishment of this end; and the result, although it may not measure up to the ideal, nevertheless embodies the essence of what it has been the desire of the department to accomplish.

The building contains not too much and not too little of the machines, of the instruments, of the apparatus, and of the miscellaneous appliances which go part and parcel with the different branches and divisions of the electrical engineering profession, as gauged by both science and practice.

To be impressed by the commercial possibilities of the great electrical generators, the visitor must seek a portion of the electrical exhibit installed elsewhere than in the Palace of Electricity, but if it is the desire to become familiar with electric generators in the sense of understanding them from shaft to field ring, an inspection of the heavier exhibits in the Palace of Electricity will give to the visitor very definite ideas covering all of the essential points involved. The construction of such machines is shown; the assembling of such machines is demonstrated; the testing of such machines is constantly going on, and the commercial operation of such machines is an important element of the exhibit organization.

From the dynamo to the motor is but a step, but with the motor, the possibilities of electricity begin to unfold. In the Palace of Electricity almost every conceivable use to which the electric motor has thus far been placed is brought out in some form of working exhibit. In all, about 1,000 horsepower will be constantly required in operating the electric-motor-driven working exhibits, and these exhibits will bring out the ramifications of the methods of control and motor operation which have placed the electric motor without a peer in that portion of the industrial field, where certainty, economy and regularity of operation are matters of prime importance.



WINDER ELWELL GOLDSBOROUGH, CHIEF OF DEPARTMENT OF ELECTRICITY, ST. LOUIS EXPOSITION.

The working exhibits demonstrate the application of electric motors in the operation of all forms of machine tools, industrial appliances, household appliances, signaling appliances and railway appliances. Planers, boring mills, lathes, multiple drills, buffers, grinders, pumps, cranes, hoists centrifugals, dough mixers, wringers, sewing machines, coffee mills, candy machines, dental engines, cable machines, wire machines, printing presses, grooming machines, clipping machines, and a wide variety of other items have been installed in the Palace of Electricity for the purpose of bringing out the good, bad and indifferent points of direct-current and alternating-current electric motors. In these cases, the machinery and industrial items mentioned must not be taken as exhibits in any sense of the Palace of Electricity: they are merely the means to an end, the end being the demonstration of the universal adaptability of the electric motor, and in each and every case it is the electric motor and the system of control associated therewith that is the important element to be considered by the visitor.

The exhibits, taken collectively, will probably represent as fine a demonstration for the benefit of the student of systems of electrical operation and control as has ever been brought together.

In the discussion of the electric motor thus far, no mention has been made of its applications to transportation, as these applications are deemed a separate and distinct department. The use of the electric motor and its auxiliary appliances in connection with industrial locomotives, mining locomotives, heavy traction locomotives and street traffic are all presented in attractive working installations. The direct-current motor, as well as the newer alternating-current motor, have both received a generous share of attention with their associated systems for the operation and control of electric cars and trains.

In demonstrating the utility of electric wires and cables and other miscellaneous construction materials, such as poles, cross-arms, cable heads, conduits, etc., elaborate preparations have been made by exhibitors to bring out to the interested observer, in a concrete way, the direct value of each item. Conduit systems and manholes, with cables installed, as in the case of heavy and light subway construction, are erected in position with every consideration for the details and requirements of practice. The use of the climber by the lineman, the methods of stringing wires, with the associated assortment of reels and other special appliances for facilitating this work, are brought out in a very unique exhibit, in which a pole line, including the raising and placing of the poles, is constantly under construction.

In the field of electric lighting, substantial progress has also been made by the exhibitor in means and schemes for bringing out, in a popular and educational manner, the salient features of the various systems of lighting presented. In all, eight distinct systems of electric lighting, several of which are uncommon to the public, are presented, and their presentation involves not only the usual display of lamps, but a complete photometric demonstration, with the most modern appliances, of the possibilities of these lights in commerce.

The electric light has, up to the present time, not been fully appreciated or understood. The public generally must be made to value rightfully electricity by comparison with other kinds of illuminants before the load on our modern lighting stations will ever begin to approximate its ultimate maximum.

The electric-lighting exhibits will show, in a lavish way, the results to be obtained by good and bad systems of lighting; and the use of lamps in relation to methods of placing them in rooms and apartments to obtain the best results will be strikingly brought out. One does not realize what electric lighting means until he has stepped beyond the field of every-day observation and associated himself somewhat intimately with the more scientific aspect of the problem. It is to this aspect of the electric-lighting exhibits that the Palace of Electricity introduces the public, and introduces it in a generous way.

The public, however, is not only interested in light and power. We hear much, spasmodically, of the use of electricity in heating and cooking. It is only recently that household and industrial electric-heating appliances possessing real merit have appeared in any number. The price of electricity hampers their introduction. (Why should not electricity for lighting and electricity for heating be sold at different rates, the heating rate being below the lighting rate? An arrangement of this kind would introduce one of the greatest of all modern comforts to the public that present conditions make possible.)

The exhibits of model kitchens in the Palace of Electricity will do much to gain the sympathy of the housewives in support of the suggestion made above. In point of cleanliness, in point of convenience, and in point of healthfulness, the electric kitchen is pre-eminently superior to any other form of kitchen yet devised.

Not only, however, have we to thank electricity for improving the chances of long life by improving

STATUE OF FRANKLIN, PALACE OF ELECTRICITY.

STATUE OF HENRY, PALACE OF ELECTRICITY.

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THREE VIEWS OF THE PALACE OF ELECTRICITY ST LOUIS EXPOSITION.

culinary methods. The treatment of diseases by electric means is very effectively and finely demonstrated in the exhibits of the electrotherapeutic section. X-ray apparatus for bringing out very vividly internal structural conditions, various means and appliances for treating patients with electric-light rays, many ramifications of treatment by oscillatory currents —in fact, a bright and liberal presentation of electrotherapeutics — are embodied in the electrotherapeutic section. The day of the quack electromedical practitioner has practically disappeared, and only that which is good, and real good, is brought to the attention of the public in these exhibits. In the treatment of cancer, skin diseases, internal affections, surgery, defective hearing and defective eyesight, electricity is proving to be a true godsend to mankind; and if, in any measure, the electrotherapeutic exhibit shall unfold to the general public the story of the good that electricity can do in relieving the ailments of humanity, a great step will have been accomplished.

We should all strive to eliminate every element and detail associated with electrotherapeutics which tends in any way to produce a false impression in the professional or public mind. The work which has recently been done by eminent electricians in assisting the medical profession generally to a greater appreciation of electrical terminology has placed the medical profession upon far safer ground in handling electrical problems, and it is only fair to feel that we are just entering upon the time when electricity in the hands of the skilled practitioner and specialist will do much in continuing to broaden the field of medicine and surgery.

The new departments of electricity, that is to say, the real new departments of electricity, have to do more particularly with chemistry and the transmission of intelligence. Within the last few years electrochemistry has assumed unusual proportions as a factor in commerce and industry in the United States, and it will be gratifying to both chemists and electrical engineers to know that a number of electrochemical processes are presented in the exhibits of the Palace of Electricity in a way to make them thoroughly interesting as operative exhibits. Further than this, the unfolding of the development of chemical methods, culminating in electrochemistry, is one of the chief and most interesting of the evolutionary collective exhibits presented.

The telegraph and the telephone are now well known; they are, to the public, old friends, and the public possibly feels on better terms with these utilities than even with the electric light. The Morse instrument is an old story to every schoolboy, and the telephone is almost as much a plaything.

When we enter the field of wireless telegraphy and wireless telephony, we border on a work which still holds many fascinating possibilities for scientists and the public alike. Demonstrations of wireless telephony in the Palace of Electricity are on an unprecedented scale. They have been developed with the most painstaking care for detail, and, in the half-dozen systems shown is meat for reflection for all.

ALLEGORICAL GROUP, "LIGHT AND DARKNESS," CROWNING EACH OF SIX TOWERS OF PALACE OF ELECTRICITY.

Even more fascinating is the problem of wireless telephony. It is not fair to say that much has been accomplished; but it is hoped that the public will learn a lesson from wireless telephonic apparatus, designed to be placed in the hands of the public, which will be far-reaching in its effect upon the ultimate development of wireless telephonic processes.

The court of the Electricity Building is to be equipped so that the observer can receive his wireless message with his own portable set, and thus be brought into active personal contact with wireless telephony in a way which will eliminate every doubt or suspicion with reference to this new development.

Education, education, education! If the exhibit in the Palace of Electricity, measured as a whole, shall fail, as one pulsating, throbbing, working demonstration of electrical possibilities, to interest and animate the public mind, it will fail, and fail utterly, of the purpose for which it has been and is created.

Locomotive Testing at the Exposition.

One of the features of the exposition from an engineering standpoint will be the locomotive-testing laboratory of the Pennsylvania railroad, now in process of construction in the western end of the Transportation Building. An area 45 by 75 feet is required for the testing pit, the bottom of which is 15 feet below the floor level. A 20,000-pound locomotive crane is used in installing the machinery and to assist in handling the locomotives. The testing plant will be similar in nearly every respect to that located at Purdue University, which for the last 12 years has furnished a large amount of valuable material to the railroading world. A comprehensive scheme for tests has been worked out, and 10 or more American and foreign locomotives will be tested. Each test will have a duration of 10 hours, and the plant will be given a warming-up test the latter part of April, so that it will be in perfect running order on the opening day. This installation will involve an expenditure of practically half a million dollars, all of which is defrayed by the Pennsylvania Railroad.

Military engineers of France are making trials of space telegraphy from the Eiffel Tower and hope to be able to establish communication with a squadron in the English Channel, 120 miles from Paris.

Electric Transportation within the Grounds.

There will be an innovation in transportation facilities within the exposition grounds at St. Louis, and, judging from the popularity that has attended the operation of electric automobiles during the pre-exposition period, it is safe to say that the World's Fair Automobile Transit Company will find it hard to accommodate all those who wish to see the exposition from the top of an electric tallyho. For several months this company has operated a line of electric vehicles seating from 12 to 20 persons, these making a trip about the main part of the grounds

ELECTRIC LAUNCH AT ST. LOUIS EXPOSITION

occupying about 30 minutes. Stops are made at frequent points of vantage, during which the operator points out the different buildings and interesting features. These have been largely patronized, and the 15 vehicles which are operated are nearly always filled. The new vehicles, which were used last week for the first time, will seat 40 passengers, and are similar to those used in New York for sightseeing tours. During the exposition the company will operate 75 vehicles, including 18 hansoms and broughams. All the large tallyhos will, after stopping at each of the important hotels in the business part of the city, run to the exposition grounds, a distance of over four miles, over the finest boulevards of the west end. The fare from the city is $1, which includes admission to the grounds; i. e., the visitor can board a tallyho in the heart of the city and ride to and through the exposition grounds without dismounting. The route will be arranged through the exposition grounds similar to one now used, so that on the trip all of the important buildings can be seen. The company has a large generating plant, with downtown headquarters, and three gas-driven units aggregating 150 horsepower at its World's Fair station, located just outside the main entrance. Two batteries will be provided for each vehicle, and 25 miles will be made on each set.

Electric launches will be operated as at Chicago, although the craft will differ a little from those used at the exposition of 1893. Forty launches in all have been ordered, each 30 feet long and seven-foot beam; each will be equipped with 46 cells of Willard battery, which is sufficient for a run of 60 miles at nine miles an hour. The launches will make regular trips around the lagoons in the form of a figure 8, the total run being about a mile.

The intramural railroad has already been briefly described in the Western Electrician. It is designed to carry visitors between any of the important exhibit palaces and to other parts of the grounds, the total length being about six miles. There are no special engineering features of this installation; in fact, it is rather ordinary, the cars being of the common summer type. Instead of a third rail, a trolley will be used, and the road differs from that of the World's Columbian Exposition in that it is partially elevated and partially surface. It has been, however, so located that it does not break into the grounds at any point so as to detract from the architectural beauty. The current is supplied from Crocker-Wheeler generators, constituting a portion of the Exhibitors' Power Plant.

Electrical and Other Features of the St. Louis Exposition.

On the opposite page is a map or ground plan of the Louisiana Purchase Exposition, on which are indicated the principal points of electrical interest. The map itself is an excellent one, copyrighted by O. Schrowang of St. Louis and reproduced here by permission. The special electrical features were drawn in especially for this World's Fair issue of the Western Electrician. Referring to the numbers indicated by arrows, the following is a key:

(1) Festival Hall.—Largest dome in the world, 144½ feet in diameter; top of dome 274 feet above the Grand Basin. In the auditorium of Festival Hall concerts of all descriptions will be given during the exposition, the finest bands, orchestras and musical organizations of Europe and America having been engaged. A picture of Festival Hall, not quite completed, is given on page 311.

(2) Cascade Pumping Station.—This is located under the east cascade, and contains three 2,000-horsepower induction motors, direct connected to centrifugal pumps, each set having a capacity of 30,000 gallons a minute, working against a head of 100 feet. These pumps are the largest of their kind in the world, and are built especially for this installation. (See picture on page 314.)

(3) Power Plant, Machinery Hall.—This plant includes excellent examples of every kind of prime mover connected to generators of all types. The largest item is the Bullock-Allis-Chalmers 3,500-kilowatt engine-generator. In this area is also included the exposition power plant, consisting of two General Electric and two Westinghouse generators of 2,000 kilowatts each.

(4) Steam, Gas and Fuels Building.—This building, constructed of cinder concrete, contains a large installation of Babcock & Wilcox boilers, erected under contract with the exposition, in addition to a large number of other boilers, both foreign and domestic. Gas-generating apparatus will also be exhibited in the west end.

(5) De Forest Wireless-telegraph Mast.—This is the high-power, long-distance transmitting and receiving station of the De Forest Wireless Telegraph Company. It consists of a single mast 200 feet high, with a 50-foot outrigger at the top, from which hang the aerial wires. This will be the most powerful wireless-telegraph station in the world, the transformers having a capacity of 90 kilowatts.

(6) Ferris Wheel.—This wheel, the mechanical wonder of the World's Columbian Exposition of 1893, is now being erected for the third time. From the top of the wheel, the Ozark Mountains in the central part of Missouri may be seen.

(7) German Outdoor Railway Exhibit.—This will consist of several thousand feet of track, equipped with signaling and block devices in use on the government railroads of Germany. It will be in operation, and will afford an excellent basis of comparison with American practice.

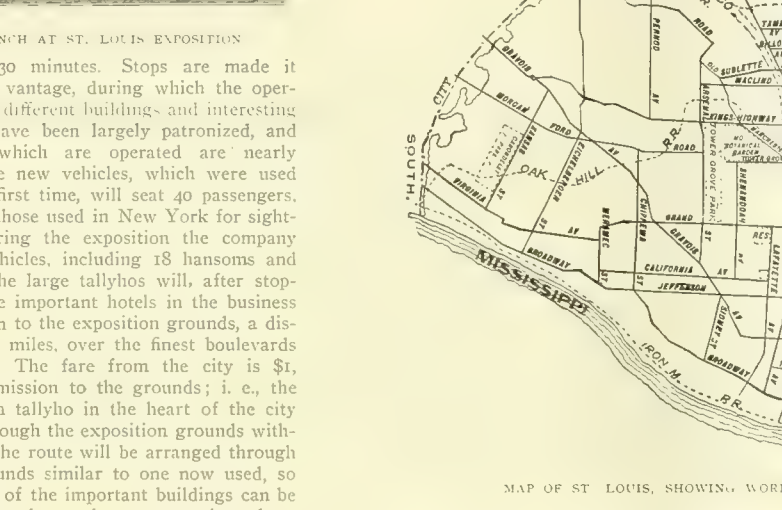
(8) Pennsylvania Locomotive Testing Laboratory.—This laboratory is equipped for working tests on locomotives of any size or type. The most comprehensive series of tests ever made will be run during the exposition season. The locomotive drivers are supported by wheels attached to water brakes, while the drawbar pull is measured by a delicate yet very large dynamometer.

(9) Outdoor Mining Exhibit.—In the gulch located south of the Mines and Metallurgy Building will be shown working mines, stamp mills, concentrators, etc., designed to show the most modern methods of mining and working gold, lead, coal, etc. In addition to this, native Mexicans will illustrate the primitive methods still in use in some of the mines of their native country.

(10) De Forest Observation Tower.—This steel tower 325 feet high, in addition to being equipped with a complete De Forest wireless-telegraph installation, will be provided with electric express elevators, by means of which visitors can ascend to the platform at the top, from which a view of the exposition and St. Louis can be obtained.

(11) Headquarters Western Electrician.—The Western Electrician is an exhibitor in the Palace of Electricity under group 71 of the classification. Its booth is located just east of the main entrance in block 1, and it will be "at home" to its subscribers and patrons from April 30th until December 1st.

(12) Electric-railway Test Track.—This stretch of track, located north of the Transportation and Varied Industries Buildings, will be equipped for making tests upon electric-railway equipment of both direct and alternating type. Several prominent manufacturers in the United States are building cars to be tested by the Electric Railway Test Commission, of which Mr. J. G. White is chairman.



MAP OF ST. LOUIS, SHOWING WORLD'S FAIR SITE AND UNION STATION.

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PALACE OF MINES AND METALLURGY, ST. LOUIS EXPOSITION.

A Great Searchlight.

Some facts about the world's greatest searchlight, which is to crown the dome of a building near the fair grounds, will be of interest. The lens is seven feet across, and the estimated candlepower is 6,000,000. The dome of the building is 135 feet from the ground and the ground at that point is 116 feet above Broadway, St. Louis. The lamp is mechanically arranged so that at the touch of a key it will recede into the dome and be completely covered. The operation is hydraulic. It can be directed at any angle in every point of the compass by a simple manipulation of keys from the office. Several months were required to grind the lens.

PLAN OF GROUNDS AND BUILDINGS, ST. LOUIS EXPOSITION. (ARROWS INDICATE POINTS OF ELECTRICAL INTEREST. SEE KEY ON PRECEDING PAGE.)

MAIN EXHIBIT BUILDINGS.

Administration ... G 9
Agriculture ... D 7
Educat'n & Social Economy ... E 3
Electricity & Machinery ... F 4
Festival Hall & Terrace of States ... D 4
Fine Arts ... D 4
Forestry & Game ... F 9
Horticulture ... C 8
Liberal Arts ... E 1
Machinery ... F 6
Manufactures ... F 2
Mine & Metallurgy ... D 2
Transportation ... G 6
Varied Industries ... G 4

STATE BUILDINGS.

Arizona ... A 1
Arkansas ... A 2
California ... B 7
Connecticut ... A 2
Georgia ... D 6
Illinois ... E 7
Indiana ... A 2
Indian Territory ... A 1
Iowa ... A 1
Kansas ... B 1
Kentucky ... C 3
Louisiana ... C 1
Maine ... B 3
Maryland ... B 2
Massachusetts ... B 1
Michigan ... C 2
Minnesota ... B 1
Mississippi ... A 1
Missouri ... C 1
Montana ... B 2
Nevada ... A 2
New Jersey ... A 1
New Mexico ... B 2
New York ... B 1
Ohio ... B 1
Oklahoma ... B 2
Oregon ... C 4
Pennsylvania ... B 2
Rhode Island ... A 2
South Dakota ... C 3
Tennessee ... D 7
Texas ... C 3
Utah ... A
Virginia ... D 6
Washington ... C 2
West Virginia ... B 2
Wisconsin ... C 1

GOVERNMENT BUILDINGS.

Alaska ... G 10
Argentine ... H 8
Austria ... H 8
Belgium ... G 8
Brazil ... G 8
Canada ... F 9
China ... G 8
Cuba ... G 8
France ... F 8
Germany ... D 3
Great Britain ... G 8
Italy ... G 9
Japan ... E 6
Mexico ... G 8
Nicaragua ... G 8
Philippine ... D 10
Siam ... G 8
Sweden ... H 8
United States ... C 1

SPECIAL AND MISCELLANEOUS BUILDINGS.

Boiler House ... F 7
Bonded Warehouse ... D 12
Buffalo Tower ... F 1
Coal Chute ... A 4
Congress Hall ... B 8
Cook & Sons ... D 6
Disciples' of Christ ... C 3
Engine Houses, F7, A2, E1 ... G 3
Dairy Barns ... B 8
Express Office ... A 1
Express Warehouses ... H 8
Fraternity Building ... D 7
German Railroad Exhibit ... G 9
Garbage Crematory ... D 12
Green Houses ... F 11
Hoo Hoo ... D 3
Inside Inn ... A 2
Lavatories, E 1, D 4, G 3, H 5
Locomotive House ... A 4
Military Mess Room ... G 11
Model City ... F 1
Mexican Barracks ... B 10
Music Pavilions D 2, G 3 & G 5
Park Commissary Bldgs. ... C 3
Police Station ... E 1
Power House ... H 10
Press Building ... E 1
Refrigerating Plant ... E 7
Stock Barns & Pens ... A 8 & B 9
Swedenburg ... C 4
Swedish Tourist Club ... H 8
Temple Inn ... E 7
Trav's Protective Ass'n ... C 1
U. S. Fisheries ... C 2
U. S. Live Saving Exhibit ... F 8
U. S. Marine Corps ... E 1
U. S. War & Field Hosp'l ... E 1
Warehouses ... B 11, 12, C 12

RESTAURANTS AND LUNCH ROOMS.

A1, B2, B7, C2, C3, C4, D4, D6, E1, E5, E7, E9, F7, F9, G8.

OUTSIDE EXHIBITS.

Aeronautic Concourse ... H 11
Anthropology Exhibit ... E 11
Athletic Field ... G 12
Bird Exhibit ... B 3
Floral Clock ... E 8
Live Stock Forum ... B 8
Missouri Game ... F 10
Nursery ... F 12
Outside Exhibit U. S. Bureau Plant Industry ... E 10
Outside Mining & Metallurgy ... B 3
Sunken Garden ... D 2
U. S. Bureau Forestry Tree Planting ... E 10
U. S. Forestry ... C 9

PLAZAS, ETC.

Plaza of Orleans ... E 2
Plaza of St. Anthony ... G 5
Plaza of St. Louis ... F 3
Plaza of States ... B 1
Parade Grounds ... G 10
Government Hill ... C 1

THE PIKE AND CONCESSIONS.

Ancient Rome ... H 4
Baby Incubator ... H 5
Battle Abbey ... H 7
Boers ... C 7
Cairo ... H 6
Ceylon Tea Garden ... [illegible]
Chinese Village ... H 6
Cliff Dwellers ... H 6
Constantinople ... H 6
Creation ... H [illegible]
Crystal Cafe ... E 5
Esquimaux & Laplanders ... H 6
Fair Japan ... H 4
Fire Fighters ... H 7
French Village ... H 5
Galveston Flood ... H [illegible]
Glass Workers ... H 4
Grant's Log Cabin ... D 4
Hagenbecks ... H 4
Hereafter ... H [illegible]
Hunting in the Ozarks ... H 3
Irish Village ... H [illegible]
Jerusalem ... E 6
Lincoln Exhibit ... E 7
Magic Whirlpool ... H [illegible]
Moors ... H 4
Moving Pictures ... H 4
Mysterious Asia ... H [illegible]
Naval Exhibit ... H [illegible]
New York to North Pole ... G [illegible]
Observation Wheel ... F [illegible]
Old St. Louis ... H [illegible]
Palais du Costume ... [illegible]
Poultry Farm ... [illegible]
Roller Chairs ... [illegible]
Scenic Ry. ... [illegible]
Seville ... [illegible]
Siberian R. R. & Divers ... H 6
Tyrol in Alps ... [illegible]
Under & Over the Sea ... H 6
Water Chutes ... H 6
Wireless Telegraph ... [illegible]

Arrangement of Electrical Exhibits in the Palace of Electricity.

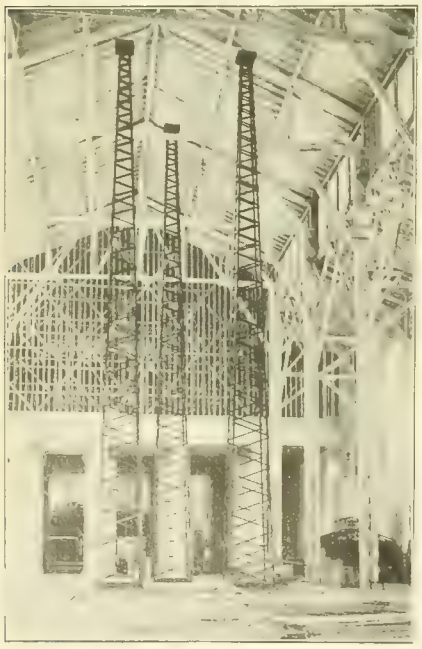
By Paul F. Williams.

The accompanying ground plan of the Palace of Electricity indicates the manner in which the aisles and sections have been laid out in the building. All the exhibit space is on the ground floor, with ample head room; in fact, over the center sections the roof is 80 feet above the floor. Over blocks 1 and 2 is a gallery 22 feet wide by 250 feet in length, which is divided and furnished as offices for the department, jury and committee rooms. Beneath the gallery are the main offices of the telegraph companies, through which the news will be sent from the exposition, and also the booths of the technical press. High-speed telegraph systems are shown in operation by Patrick B. Delany and Walter P. Phillips, while a transmitting typewriter applied to telegraph work is exhibited by

UNLOADING EXHIBITS IN PALACE OF ELECTRICITY.

Charles E. Yetman. The Gray telautograph or writing telegraph, reproducing at a distance drawings or writings, also exhibited here, is a very ingenious application of electricity to the transmission of intelligence.

A very fine collection of electrotherapeutic exhibits occupies the eastern end of block 4. Near the center of this block is located the sub-station that contains the transformers, switchboards and rotary converters through which the high-potential alternating current is received from the service power plant, and transformed to a lower voltage or converted into direct current for distribution throughout the building. This machinery was furnished largely by the General Electric and Westinghouse Electric and Manufacturing companies. Adjoining the station the latter company has one of the largest exhibits in the building, embracing varied types of electrical ma-



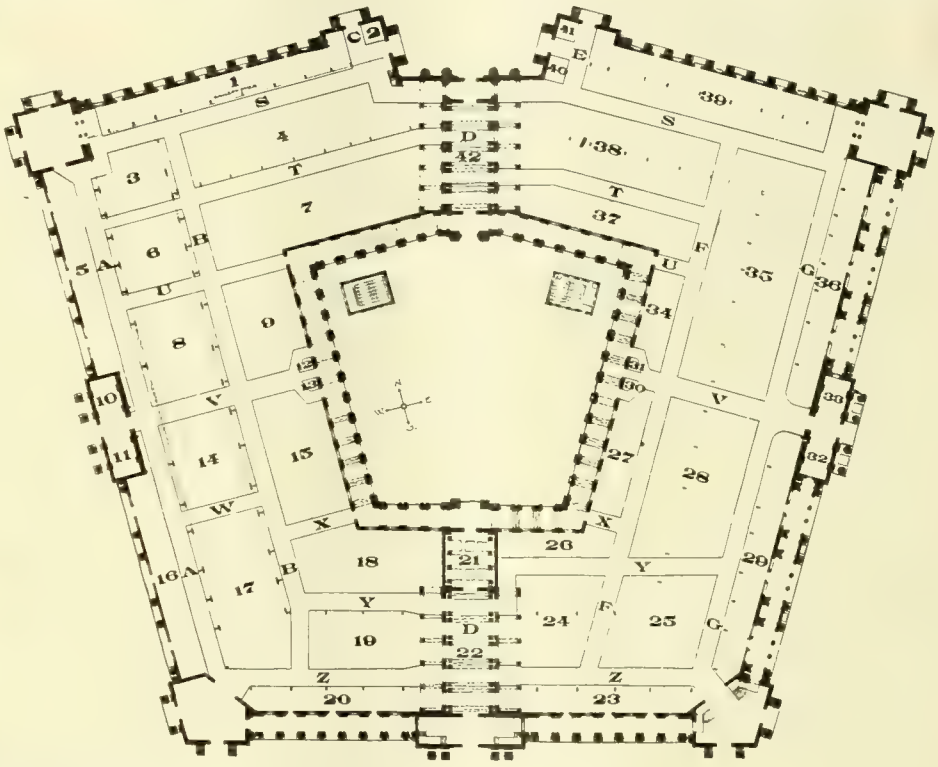
WORKING MODEL OF SEATTLE WIRELESS STATION PALACE OF ELECTRICITY. (TOWERS ARE 75 FEET HIGH.)

chinery and apparatus. Across aisle B are the electric railway trucks and locomotives of Burnham, Williams & Co. Along the north side of block 3 the Standard Underground Cable Company has installed a model conduit system, such as is used in the best city construction, showing the method of placing cables in conduits. A very conspicuous object is a Burdett-Rowntree electric dumb waiter running from the floor to the roof above block 3. Its operation is automatic, starting or stopping in response to a push button.

Over blocks 3 to 17, along the west side of the building is the craneway with a span of 57 feet 5½ inches. Upon this is a four-motor, 30-ton electric traveling crane, furnished by Pawling & Harnischfeger. A 20-horsepower, 220-volt motor gives a horizontal speed of 250 feet per minute; an eight-horsepower motor gives a trolley transverse speed of 150 feet. The main hoist is equipped with a 30-horsepower motor with a speed of 25 feet, and the auxiliary hoist with a 15-horsepower motor, and has a travel from 30 to 90 feet per minute. The crane has proved very serviceable in the installation of exhibits, and will be used in handling heavy machinery when exhibits are dismantled. With one exception the heavy exhibits are installed under or adjoining the craneway.

In the northwest quarter of the building are several displays of electric-railway equipment. The Westinghouse single-phase railway system and the electric air-brake apparatus of the National Electric Company are shown.

Block 9 is equally divided between the Fort Wayne Electric Works and the Wagner Electric Manufacturing Company, both having working exhibits. The Fort Wayne display consists of a line of direct-current machinery, transformers, fan motors, wattmeters and a series arc-light system. The Wagner



INSTALLATION PLAN, PALACE OF ELECTRICITY.

space contains a variety of single-phase alternating-current power motors running under different conditions, motor generator sets charging a storage battery, static transformers and indicating switchboard instruments.

The remaining space adjoining the court is occupied by the Bullock Electric Company, and contains one of the notable machinery exhibits. Power at 6,600 volts alternating is received and transformed to 340 volts for a rotary converter to supply 500 volts direct current for operating street-railway apparatus. Other motor generators and balancing sets furnish current for the multi-voltage system, as applied to speed control of machine tools. The individual feature of this exhibit is a model testing floor, indicating the best factory methods of testing electrical machinery before it goes to the consumer.

In section 14 the Northern Electrical Manufacturing Company has a most complete demonstration of the adaptation of the electric motor to many forms of industrial machines. In this exhibit the manufacturing of motor parts is carried on to show the convenience and increased efficiency of motor drive for tools.

All of block 17, under the craneway, is taken up by the Western Electric Company. Near its center is a large 100-kilowatt motor generator set, which, with a compensator, furnishes 110 and 220-volt direct current throughout the exhibit. There are several direct-connected marine sets, transformers and regulating apparatus. On the opposite side is a series alternating arc-light equipment with ornamental lamps and stands.

There are two collective exhibits, one supervised by the Wesco Supply Company of St. Louis, in block 8, and another by the Ewing-Merkle Company of St. Louis in block 14. In the former a large Warren synchronous motor drives a Triumph generator supplying power for the motors and apparatus in operation. In the second exhibit the Commercial Electric Company has a number of direct-current motors of from 1¼ to 35-horsepower, and a 30-kilowatt, three-bearing generator, direct connected to a gas engine, furnishes power to these items.

The western entrance embraces two large spaces, which are occupied by unique exhibits. The Carmen Projector and Specialty Company shows stereopticons, lanterns, projectors and automatic electric curtain-hoists in operation. Opposite is the electroplating exhibit of the Hall Gold and Silver Plating Works. The different processes of plating and finishing of plated wares are shown in a most attractive manner.

The Gould Storage Battery and Gould Coupler Companies have a fine combination exhibit in section 16, which will include motor-generator sets and rotary transformers, arranged so that many ingenious applications of batteries to different lines of work can be illustrated. An interesting item is a motor-driven unipolar dynamo, charging two immense cells at from 3,000 to 5,000 amperes at about five volts.

The northern half of block 16 is devoted to the artistic exhibit of Japan. This electrical apparatus was designed and made by Japanese, most of whom received their education and training in this country.

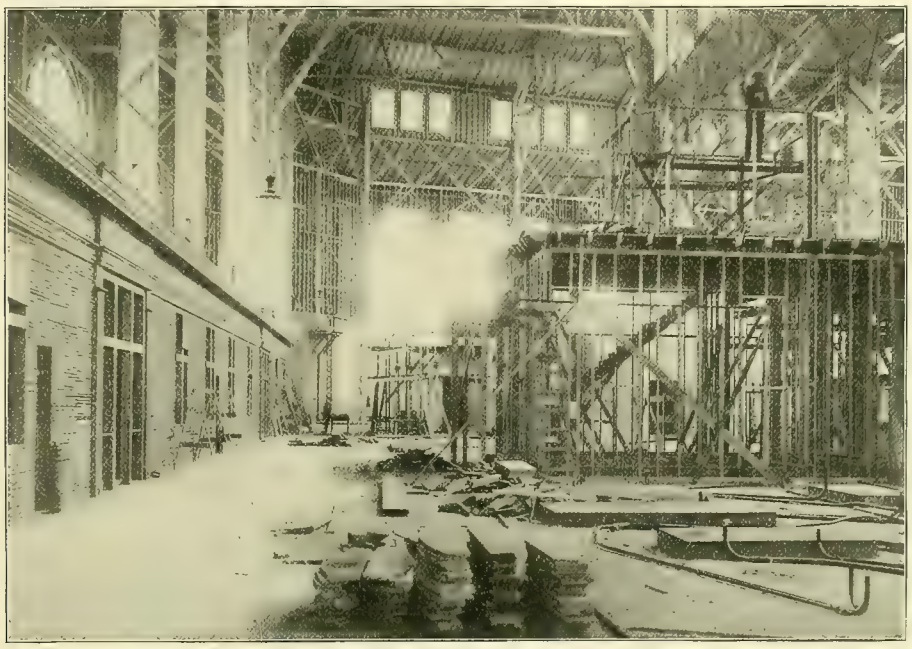
The Italian space, occupying block 18, is especially worthy of notice on account of the scientific and electrical measuring instruments it contains.

A model central-station storage-battery plant, in a fire and acid-proof enclosure, is shown by the Electric Storage Battery Company. A conspicuous feature is an immense map of the United States, showing the location of between 1,600 and 1,700 plants installed by this company, the railway, lighting, telephone and isolated installations being indicated by different colored lamps.

In section 19 three 75-foot towers by the De Forest Wireless Telegraph Company support the antennæ from which wireless messages will be sent and received from other stations in the building and to the large station in the Model City. The T. E. Clark Wireless Telegraph-Telephone Company also shows a line of wireless apparatus in operation, as well as the adaptation of such apparatus to fire alarms and safety signaling on railroads.

Two telephone operating exchanges are located in the south side of the building, both enclosed by handsome booths. That part of block 17 not covered by the crane is occupied by the exchange of the American Telephone and Telegraph Company. This connects with the local and long-distance lines of the

Bell company, so that there is direct communication from the building to all parts of the grounds and city and all points reached by telephone lines. In block 24 the exchange of the Kellogg Switchboard and Supply Company gives a similar service through its connection with the Kinloch system of St. Louis. Recent developments in automatic and semi-automatic telephone systems are shown in a thorough manner by the Automatic Electric and the Faller Automatic Telephone Exchange companies, and an instructive historical collection of telephone apparatus is shown by



A VIEW IN WEST CORRIDOR OF PALACE OF ELECTRICITY DURING CONSTRUCTION.

B. F. Wasson in block 25. Two wireless telephone stations at opposite ends of the building will be used by A. F. Collins to demonstrate the newest application of electricity to the transmission of intelligence.

The Hutchison Acoustic Company exhibits the "acousticon" and "massacon," giving daily exhibitions of deaf mutes being made to hear and taught to speak through their instrumentality. M. R. Hutchison also demonstrates a wonderful adaptation of the wireless telephone. Around the court of the electricity building is a circuit of wires connected to a booth in block 23. Before a telephone transmitter in the booth music will be played. In the court no sound of this is heard until a pocket telephone receiver, without any wire connection, is placed to the ear, and then the music becomes audible. At any point in the court music can be heard by the aid of the receiver.

Two beautiful booths in block 25 are those of the Holophane Glass Company and the Western Electric Instrument Company, the latter showing a full line of standardizing electrical instruments. The brilliant illumination of the Holophane exhibit will be most conspicuous, as 1,000 incandescent lamps will cover the exterior and interior of the handsome structure.

The laboratories of the National Bureau of Standards, covering a space of 23 by 200 feet, contain over $50,000 worth of instruments for testing every kind of electrical machine and apparatus. About 20 government experts are connected with the laboratories to conduct tests and investigations. No preceding exposition has ever had such facilities for making complete records or for assisting the juries in making their awards.

The largest individual exhibit is that of the General Electric Company, embracing block 28, and covering a quarter of an acre of floor space. The great variety of electrical apparatus manufactured by this company is shown in operation. The Edison exhibits are in blocks 26 and 27, and include the iron-nickel storage battery and a historical collection of great merit.

The purification of water by electricity is shown by the Standard Water Purifying Company, in block 33, and water absolutely free from forms of organic life will be served to visitors.

In the northeast part of the building are the German and French collections of electrical exhibits; the former is especially strong in electrochemistry. The French have the most comprehensive display of any foreign country, covering as it does every classification. In the eastern half of block 7 England has an excellent showing of its electrical products.

Foreign Electrical Exhibits at World's Fair.

Brazil.

Brazil's exhibit will be devoted largely to the telegraph system and fire-alarm system used by the Brazilian government. Insulators and telegraph and telephone apparatus will constitute the greater part of the exhibit.

Denmark.

The principal exhibit from Denmark will be primary batteries, and an extensive display will be made by the Copenhagen works.

France.

France will occupy an area of approximately 25,000 square feet, just east of the main entrance to the Palace of Electricity, this being the largest section allotted to a foreign country. It is gratifying to note that a large number of the most important manufacturers of electrical apparatus are represented in the French section, although the protective policy of this country and the consequent difficulty of competing with American manufacturers at home has dissuaded many manufacturers whose exhibits would have increased the French representation. Notwithstanding the unfavorable trade conditions, which, of course, apply to all European countries, France has, in response to the request for representative machines for use in the Exhibitors' Power Plant, come to the front by contributing two generating sets, second in size only to the Allis-Chalmers-Bullock 3,500-kilowatt unit. These two machines will command more than ordinary attention, in that they are the finest types of two widely differing classes of European practice, one being a low-speed horizontal set somewhat similar to American machines of this size, while the high-speed vertical machine is an excellent sample of a type recently developed abroad, but as yet unknown in large sizes in this country.

The former, built by the Societe Alsacienne de Constructions Mecaniques, consists of a three-phase alternator, built at the shops in Belfort, France, which is direct connected to a horizontal tandem compound engine, built at the Mulhouse shops (Alsace) of the same company. This engine is rated 1,000 horsepower at 94 revolutions per minute. The steam pressure is 150 pounds per square inch; the generator is of the flywheel revolving field type, generating three-phase current at 2,300 volts 50 cycles.

The second set has been contributed by the Societe Delaunay-Belleville and the Societe l'Eclairage Electrique, of which the former are the engine builders, the latter constructing the generator. The accompanying illustration of this set was made from a photograph taken in the Belleville construction shops at St. Denis (France). The engine is a triple-expansion vertical high-speed machine, rated at 1,500 horsepower, normal speed 330 revolutions per minute and taking steam at the comparatively high pressure of 250 pounds per square inch. A characteristic feature of the engine is the system of forcing oil circulation through the shaft and bearings by means of a geared pump.

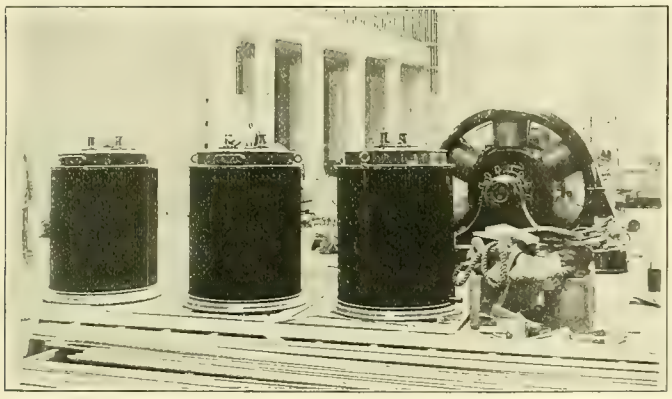
In addition to its exhibit in the power plant the Societe Alascaienne de Constructions Mechaniques shows different types of machines of different sizes in the Palace of Electricity, among which the most noticeable, perhaps, is a type of multiple-speed alternating-current motor, which is covered by patents owned by this company. An alternating-current booster and other machines for special purposes are shown.

The Societe Gramme, which has stood pre-eminent among the electrical manufacturers since the very earliest days in history, will make one of the most interesting and valuable exhibits. This company is now building the most modern types of generators, and, as a special feature of its historical exhibit, will show the first dynamo built in Europe by Zenobé Gramme in 1869. The evolution of the generator from this first crude machine to the latest types is also shown by a carefully arranged series. The exhibit includes several of the company's latest multi-speed direct-current motors, covered by original patents, as well as a new and improved magneto, developed for automobile use.

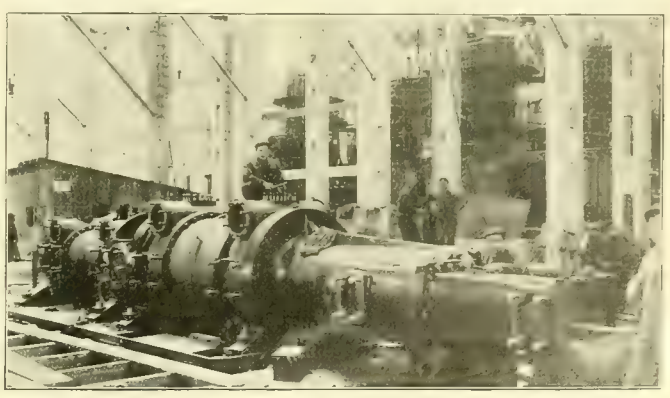
Grammont and other well-known builders are also well represented in the class of electrical machinery.

Electric cables and wires are exhibited by the Cie des Tréfileries du Hâvre, François & Grellon, Societe des Telephones, Geoffroy & Delore, as well as Grammont and the Societe Francaise des Cables Elect Berthoud Borel, which manufactures the so-called peripheral cables.

Special carbons for dynamo brushes, batteries, microphones, etc., will be exhibited by J. A. Berne; the Compagnie Française de Charbons pour l'Elec-



Transformers and Rotary in Bullock Exhibit, Palace of Electricity.



Mulhouse Engine in Course of Erection in Palace of Machinery.

CHARACTERISTIC EXHIBITS AT ST. LOUIS.

tricite, which also makes a fine display of carbons for lighting purposes.

Dynamo brushes and brush-holder mechanisms are exhibited by Mr. Bourdreaux, who will also show a patented safety nut which is meeting with great success in electrical and mechanical construction abroad.

The Dolter system of surface contact for electric railways will be exhibited. Contact pieces will be shown assembled and in sections, and a sample model will illustrate the working of this ingenious system. Among the new and genuine inventions shown should be mentioned an ingenious fuse, which is renewed by pressing a button. This has been tested under adverse circumstances and results are satisfactory. A new form of permanent wire connectors is also shown.

The electrochemical display will consist largely of primary and secondary batteries, and several new French types of the latter will deserve the attention of engineers. Provision will be made for tests on these batteries, and at least two are shown for which very broad claims are made.

The arc lamp section will include standard devices and novelties. Among these the most recent and interesting creation is the Blondel flame lamp, which is meeting with great success in France. The Indle des Telephons, which supplies nearly 90 per cent. of the telephones used in France, will exhibit a large line of its apparatus.

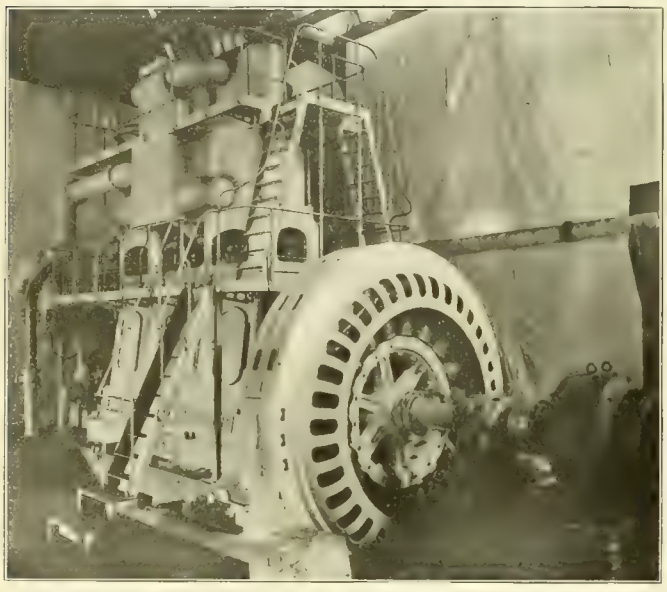
The Ducretet physical electrical apparatus and space-telegraph sets will attract considerable attention, especially as the list will be in working order.

France will appear at her best in the section which includes electrical measuring instruments, as the productions of Depres d' Arsonval and Carpentier & Richard are of world-wide reputation. The Richard exhibit is especially broad-guage, as measuring apparatus of all classes demonstrative of his inventive genius will be shown. N. N. Chauin & Amox are equally well-known manufacturers of portable instruments, indicating and integrating such high quality that they may be seen in a number of installations in this country.

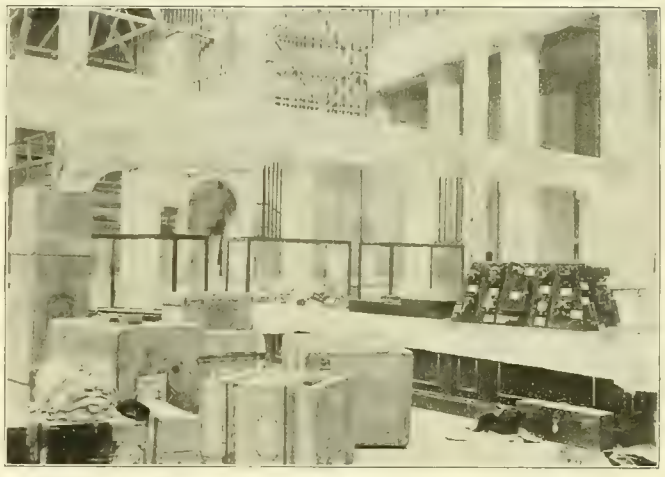
Of course, the French exhibit would not be complete without the Blondel oscillograph, and one of these direct from the laboratory of Blondel will be shown in use in his exhibit.

The Sartiaux Mors signalling system now in use on the Northern Railway of France, together with the Rochefort system of telegraphy, will be exhibited by the Societe Mors. A special type of transformer for high-tension, high-frequency work, together with wireless apparatus, will be shown by the same Rochefort, who has brought out some interesting types of apparatus. Mr. Ancel will exhibit systems of space telegraphy and telephony, and will also show striking applications of radium.

Altogether, there will be nearly 100 exhibitors in the French section, whose apparatus is now being installed under the direction of Paul Letheule, electrical engineer of the French section.



French Vertical High-speed Generating Unit for Exhibitors' Power Plant



Unpacking Exhibits in British Section Palace of Electricity

IN THE FOREIGN EXHIBIT SECTIONS.

excellent regulation obtained from the regular commercial types exhibited by Bardon Vigreux & Brillie and others may be somewhat of a revelation to those unaccustomed to the niceties of the regulation which prevails in French arc lighting.

The most effective demonstration of French taste in artistic lighting is offered by the magnificent display of bronzes and brasses shown by Milde, Guinier & Boulanger, who are famed the world over for artistic electroliers and fixtures. A striking and spectacular display is made by Paz & Silva, the well-known pioneers in the line of signs and other methods of decorative lighting. Weissmann, who has recently brought out the so-called "electric pearl" system of lighting, will have a display, the parallel of which has certainly never been seen in this country.

It is to be regretted that no projectors will be exhibited. However, drawings and photographs of the best works of Henry Lepaute will make an attractive exhibit; he will also show a line of electric clocks. The Compagnie Generale de Electricite, one of the largest manufacturers of French incandescent lamps and electric supplies of all kinds, insulators, etc., will make a complete and interesting display. Another well-known exhibitor of supplies, possessing equal attractiveness, is the Appareillage Grivolas.

Parville and the Societe de Folembray will exhibit insulators for both high and low tension, telephone and telegraph work. The French government, which controls the telegraph and telephone system of France, will make a display of the apparatus in common use, among which the Baudot and Picard are well-known types. A number of others, which have been officially adopted by the French government, will demonstrate the excellent qualities of the French apparatus, which are said to be exceptionally fine. Mr. Darras, who also manufactures apparatus for the government, will exhibit telephone apparatus and several relays for special purposes, while the Societe

Germany.

The section allotted to Germany, in the east corridor of the Palace of Electricity, will be one of the finest in the department; it was laid out under the direction of Prof. C. Harries of the First Chemical Institute of Berlin. The installation is under the supervision of Dr. Zwingenberger of Leipsic.

In working out the exhibit scheme the greatest stress has been laid on the group devoted to electrochemistry, and an exhibit has been developed with characteristic thoroughness and attention to detail that is designed to show the progress which German chemistry and electrochemistry have made in the last 150 years. The arrangement of the exhibit is made with a view of comparison, and, walking from one end to the other and return, one can trace the development of one of the most important sciences, which has, since the era of electrical research, passed from the laboratory stage to a commercial basis, until today the field of electrochemistry is one of the most important from the viewpoint of commercialism as well as from that of the scientist and electrician.

A fact worthy of note is that the exhibit contains nothing but purely German inventions and products, and it is again interesting to note that this portion of the exhibit was made without any idea of commercial gain, but simply from an educational and scientific standpoint.

Entering the German pavilion from the south, one finds at his right the laboratory of an alchemist of the fifteenth century. This laboratory is equipped with relics loaned by the "Germanischen Museum," in Nuremburg, Germany, nearly all being genuine. In the next room the development of inorganic chemistry begins. The most important exhibits are by Professor Hempel of the Technical High School of Dresden and Professor Bunte of Carlsruhe, who show some very fine apparatus for analyses of gases. The Royal Prussian Porcelain Works of Berlin contributes a very fine collection of apparatus for chemical laboratories, electrochemical purposes and the electrical industries. In the same section are shown the simple apparatus of Schott-Genossen, Jena.

There are also installed some work benches for qualitative and quantitative anyalyses, put up according to the specifications of the First Chemical Institute in Berlin. On one of these tables, which is nine feet long, is shown the development of apparatus for measuring the density of vapors, according to Professor Viktor Meyer, who shows original apparatus of high value. Another table shows a series of apparatus for the measuring of molecular weights, after Professor Beckmann, Leipsic. Professor Nernst, Göttingen, is exhibiting, in a separate section, the molecular balances used by him in his laboratory.

In the section for pyrochemistry a very interesting collection of chemical apparatus is shown, which are made from platinum and quartz; these are the first appliances ever made out of quartz, and will no doubt attract considerable attention. Similar apparatus is exhibited by the Vereinigtefabriken für Laboritoriumsbedarf of Berlin.

A section which will be of great importance for this country contains the apparatus for the demonstration of the welding processes of Theodore Goldschmidt of Essen.

Schmidt & Haensch of Berlin are exhibiting a collection of apparatus for spectral analyses, and there are also shown some original compositions made by Clemens Winkel leading to the discovery of germanium.

There follows a section of apparatus for the investigation of steel and iron, and a dark room for demonstrating the properties of radioactive substances.

Professor Beckmann exhibits apparatus for spectral analyses, which is of the latest type.

Then there are shown the models for the teaching of technical science, and a model for the manufacture of sulphuric acid anhydrite. In the pyrochemical section there are also shown some electric furnaces, built according to the ideas of Professor Barchers in Aixe-la-Chapelle.

A special electrochemical exhibit has been arranged under the corporation of Professor Nernst of Göttingen, Professor Ostwald of Leipsic, Professor Drude Giesen and the well-known firm of Siemens & Halske. In the middle of this section is an excellent collection of apparatus of Dr. Robert Lüpke, deceased. All this apparatus will be very attractive for the technical public and the scientific world, as the names of these scientists are of world-renowned reputation.

Siemens & Halske are exhibiting modern apparatus for the manufacture of ozone by electricity. As this application of electricity is one of the very latest, it will be of great interest to see the results which have been attained by this prominent German firm.

On the right side of the entrance, just opposite the laboratory of the alchemist, is shown a reproduction of the laboratory of the well-known chemist, Professor Liebig, for analytical chemistry as he used it

in 1835 at the University in Giessen. In viewing this laboratory the visitor is struck by the enormous simplicity of the equipment, and it is astonishing how this man could accomplish things of such great scientific value with such a primitively equipped laboratory.

Hugo Bremer of Neheim is exhibiting his new system of arc lamps—the so-called Bremer lamps—for which the patents have been acquired by the Westinghouse company, Pittsburg. In these lamps a special kind of carbon is used. These carbons are impregnated with some chemicals, having the effect to increase very largely the amount of light generated by these lamps. The lamps, therefore, give a larger amount of light under a smaller current compared with the ordinary arc lamp. The economy of current is about 50 per cent. The light has also a peculiar color, which is more agreeable to the eyes than the often white-blue light of the enclosed-arc lamps. Mr. Bremer has built up a whole new system of arc lamps, which have been in use for quite a while in Europe and have given very satisfactory service.

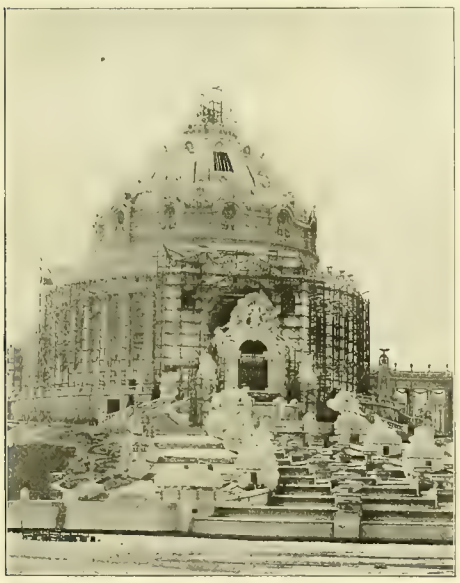
Great Britain.

As is the case with other foreign exhibits, that of Great Britain cannot in any way be considered representative of the electrical industry of that country, as the high tariff of the United States bars any attempt on the part of the British manufacturer to sell electrical machinery in this country.

Expositions are usually regarded by manufacturers from a commercial and business standpoint, but the exhibit of Great Britain is necessarily the result of interest in the exposition and good will toward the United States rather than any serious attempt to introduce their heavier electrical products into this country. However, with the exception of dynamo-electric machinery, the British exhibit will consist of apparatus used in almost every branch of the industry, exhibited by various makers, on the invitation of the British Royal Commission, to illustrate in a measure the present practice as well as the advance which has been made in recent years in testing, measuring, calibrating and recording electric phenomena both in the laboratory and in actual work.

The space allotted to Great Britain, comprising several thousand square feet, to the right of the main entrance of the Palace of Electricity, is fronted by imposing and dignified facades. The exhibit, nearly all of which has been received, is being set up and arranged.

Nearly all of the instruments exhibited have been tested at and have received certificates from the National Physical Laboratory and the laboratories of Lord Kelvin and Dr. Muirhead, the latter dealing especially with submarine-telegraph instruments.



FESTIVAL HALL IN PROCESS OF CONSTRUCTION.

The General Postoffice exhibits a set of instruments illustrating the progress made in the transmission of telegraphic messages from 1883 to the present time.

An interesting working exhibit is a model of F. B. Behr's mono-railway, a high-speed car authorized by act of Parliament for the railway between Manchester and Liverpool, a distance of 70 miles. This car is designed to run at a speed of 110 miles an hour; the entire distance will be covered without a stop; the road is practically straight, the sharpest curves having a radius of 1,500 feet.

The Consolidated Electrical Company will make a fine display of switchboard apparatus.

Messrs. Sherard and Cowper-Coles will exhibit samples of electrochemically made reflectors and copper tubes, and also samples of electroplating.

Various lamps, X-ray and high-frequency apparatus will be exhibited by A. C. Cossor, while Muirhead & Co. will show an extensive line of submarine telegraph apparatus with the latest Kelvin syphon recorders.

The Cambridge Scientific Instrument Company has a representative exhibit, consisting of oscillographs, temperature and various electric recorders for laboratory use.

Potentiometer sets, accurate to a remarkable degree, are exhibited by R. C. Crompton & Co.

Elliott Brothers have a fine exhibit of switchboard instruments of all kinds and types, while Nalder Brothers and Everett & Edgecumb also exhibit on the same line.

The India Rubber and Gutta Percha Company, which is known all over the world for its cable work, is showing an extensive collection. This company has supplied cables for various American and other cable companies.

Mr. Darton exhibits a 10-inch induction coil, one of the finest instruments of its kind shown in the Electricity Building.

Lord Kelvin and James White, whose reputation is world-wide, exhibit a typical line, which covers all of the finest instruments they manufacture.

Nalder Brothers and R. Paul are showing some extremely accurate testing and laboratory instruments, while the Synchronome Company has a full line of its electrically operated clocks, which are extremely simple.

Japan.

While Japan has been represented at previous expositions in the Department of Electricity, the St. Louis Exposition is the first one in which it has shown electrical machinery of Japanese design and construction, and its exhibit, located in the southwest corner of the Palace of Electricity, will contain several articles quite advanced in design and workmanship.

Probably the greatest interest will be attracted by the 150,000-volt testing transformer, designed by Mr. Iijimas and built at the Shibaura Engineering Works in Tokio. This same company will also exhibit a direct-current generator, direct-connected to a steam engine. While this is not a large set, still it shows that the Japanese are actually and successfully taking up the building of generators, engines and similar classes of machinery.

While it is not out of the commonplace to think of the Japanese as builders of small electrical apparatus, yet when it comes to the intelligent design and construction of electrical machinery of this class, one is more than ever impressed with the high ability of the Japanese along mechanical lines, as well as in the field of art.

The largest exhibitor is the Oki Company of Tokio, its exhibit including a Morse ink writer, a double-current key, several Tervil telephone transmitters, solid-back transmitters, a transmitter designed by Iwata, desk telephones, self-restoring annunciators and switchboards. This company also makes cables for various uses, and wires for use in telephone work. It will show single and double-core telephone cables, three and five-core cables and subscribers' receiving cords. Its exhibit of electrical instruments will include a Wheatstone bridge, tangent galvanometer, differential and astatic galvanometers, etc.

Tanaka & Co. of Tokio will show electromedical instruments.

The Japan Electrical Association of Tokio exhibits a table showing the status of electrical industry in Japan, while the Kioto City Council sends plans and photographs of a canal route, with waterpower electric plan.

LOOKING DOWN MAIN CASCADE, ST. LOUIS EXPOSITION. ELECTRIC FOUNTAIN NOZZLES SHOWN IN FOREGROUND.

Several models of a hydraulic electric power station in Iyo, as well as photographs of the same installation, will be exhibited by Saiga Tokichi.

Native workmen are now erecting a Japanese pavilion in the Palace of Electricity, and it is of characteristic design and workmanship.

Mexico.

Mexico is one of the foreign countries exhibiting in the Palace of Electricity. It will show an interesting collection of maps and plans of electrical installations.

Spain.

But one exhibit is entered from Spain, consisting of a collection of insulators for telegraph and telephone work.

Illumination at the Exposition.

Electrical illumination has become one of the chief attractions in all the latest expositions, and the St. Louis Exposition promises some new departures in this direction. Incandescent lamps have been used with unusual liberality, and the scene at night will be a most impressive one.

Machinery Hall alone is illuminated by 20,000 electric lamps, which will cause the palace-like structure to stand out in lines of light, every salient point of the architectural design being brought out by tiny glow points. On the Varied Industries Building there are 17,000 lights, and on the Transportation Building 10,000. The colonnades around the central avenue and also the columns of the principal buildings furnish a noteworthy example of subdued effects. These columns which in the daytime are white and majestic, in the night stand out darkly against walls of light which are produced by hundreds of lamps concealed from the direct gaze in the rear fluting of the columns.

Mural paintings will be placed in the cloisters of the buildings and in the night these will stand out in a blaze of light from lamps concealed in the recessed portions of the cloisters.

The central cascades will be the great attraction at night, the falling water being illuminated with the most elaborate electric-light effects in beautiful and varying colors.

The interior of the great exhibit buildings will be lighted by arc lamps. All incandescent lamps will be of eight candlepower.

A test of the dec[illegible] on the night of April 9th, at which President Fran-

cis, Director of Works Taylor, Colonel C. R. Edwards of Washington, chief of the Bureau of Insular Affairs, and Dr. W. P. Wilson, chairman of the Philippine exposition board, were guests. The test lasted about an hour and all were highly pleased with the result. The glare on the sky was seen for miles around, the statues on the summit of Art Hill were surrounded by a band of light and the lagoons and avenues were made as light as day.

Some of the Officers of the St. Louis Exposition.

Herewith are presented portraits of David R. Francis, Isaac S. Taylor and F. J. V. Skiff, who are, respectively, president, director of works and director of exhibits of the Louisiana Purchase Exposition. In addition are given portraits of the leading men connected with the electrical and machinery departments, with the exception of Professor Goldsborough, chief of the Department of Electricity, whose picture is printed elsewhere in this issue.

Mr. Francis is one of the well-known public men of the country. He was born at Richmond, Ky., in 1850, and graduated from Washington University in the class of 1870. He immediately entered commerical life, and in 1884 he founded the well-known D. R. Francis & Brother Commission Company, becoming identified with many of the most important business institutions of St. Louis. In 1885 he was chosen mayor of that city, and three years later he was elected governor of Missouri. In 1896 Governor Francis was called by President Cleveland to his cabinet as secretary of the interior. When the World's Fair enterprise came to be considered, by the common consent and the absolute unanimity, Governor Francis was called on to head the gigantic

DAVID R. FRANCIS, PRESIDENT.

enterprise, and the wisdom of this choice has been amply verified.

Isaac S. Taylor, director of works, was born in Nashville, Tenn., in 1851, and graduated from St. Louis University in 1868, with class honors. He is an architect. The Southern Hotel, still one of the finest and largest hotels in St. Louis and the first fireproof hotel in the city, was erected after Mr. Taylor's plans, and he has since built some of the largest and most pretentious buildings in St. Louis, including the National Bank of Commerce Building, the Public Library Building, the Globe-Democrat Building, the Republic Building, the Mercantile Club, and the Planters' Hotel. Mr. Taylor, as director of works, has absolute charge of the buildings of the exposition, and the rigorous rules which he has promulgated and enforced, are, no doubt, largely responsible for the fact that not a fire of any consequence has yet occurred. Mr. Taylor also designed a number of exposition buildings.

Frederick J. V. Skiff, director of exhibits, was born in Chicopee, Mass., in 1851. He early decided to enter the journalistic field, and after seven years of newspaper work at Lawrence, Kan., moved to Colorado, where he was employed upon and finally became manager of the Denver Tribune. At the World's Columbian Exposition in Chicago in 1893 he was chief of the Department of Mines and Mining, and later was appointed deputy director of exhibits. At the close of the Columbian Exposition he was appointed director-in-chief of the Field Columbian Museum, which position he now holds. In 1900 Mr. Skiff accepted the important position of director-in-chief of the United States Commission to the Paris Exposition, and, in recognition of his services at Paris, he was decorated with the Cross of the Legion of Honor by the French government. Mr. Skiff received a bronze medal from France and a gold medal from Germany in recognition of merit in exposition work. He is a member of the American Association for the Advancement of Science, the American Institute of Mining Engineers, International Museums Association of England, National Geographical Society and other societies. Mr. Skiff's high executive ability, tact and business qualities are recognized by those with whom he comes in contact, and have been the means of maintaining harmony among the chiefs of the exhibit departments of which his division is composed.

Thomas M. Moore, chief of the Department of Machinery, was born in New York city and received his education at Rutgers College. For a number of years he was engaged in business in the East, his first experience in exposition work being in connection with the Pan-American Exposition, where he was at first given charge of the Machinery Department, at later periods being given the management of the Department of Transportation of Exhibits, Agricultural Implements, Graphic Arts and Ordnances. He was appointed chief of the Department of Machinery of the St. Louis Exposition in February, 1902.

Professor W. E. Goldsborough, the chief of the Department of Electricity, is a well-known figure among electrical men. He was born in Baltimore in 1871 and much of his boyhood was spent in China, where his father was an American consul. He returned to his native land to finish his education, and in 1892 was graduated from Cornell with the degree of M. E. He became connected with the electrical work of the International Correspondence Schools at Scranton, Pa., and then was made professor of electrical engineering at Arkansas University. Later he went to Purdue University, where, in 1897, after serving as assistant and full professor of electrical engineering, he was elected director of electrical engineering, which position he still holds. In connection with his university duties he has been engaged in professional consulting-engineering work, besides making some valuable tests. He was a member of the International Electrical Congress at the Chicago World's Fair and was appointed one of the delegates of the American Institute of Electrical Engineers to the Paris Exposition of 1900. He has given much attention to exposition work and served as a juror of awards at the Buffalo Exposition. Professor Goldsborough is a member of the leading engineering societies in this country and several abroad. He has served in his present position for over two years. To his acumen, electrical knowledge, wide acquaintance and enterprise the success that seems in store for the electrical exhibit features of the exposition will be in great measure due.

Henry Rustin, chief electrical and mechanical engineer, was born in Omaha, Neb., in 1865. He graduated from Yale in the class of '86, and spent the next year in charge of the Omaha Street Railway. From 1889 to 1894 he was in charge of construction of the Portland Consolidated and Multnomah Railway Company at Oregon. In 1897 he began exposition work at Omaha, where he had charge of the construction and designing of all the electrical effects of the Trans-Mississippi Exposition. Mr. Rustin's work at Buffalo, where, with the late Luther Sieringer, he built up for the Pan-American Exposition the most gorgeous electric-lighting spectacle known in the history of expositions, demonstrated his ability in this line of work, and the lighting effects of the St. Louis Exposition, which will surpass anything previously attempted, are his conceptions from start to finish. For the last seven years Mr. Rustin has devoted practically his entire attention to the study of lighting effects, and he is today probably the best-informed man on this subject in the United States. It is to be regretted that, owing to overwork, Mr. Rustin was compelled several months ago to give up his active duties, as he was deeply interested in every step of the work, and had hoped to carry the project to completion. Several months in the Adirondacks have resulted in slow but sure improvement, and Mr. Rustin will undoubtedly return to the exposition to see the glories of its lighting.

Richard H. Phillips was born at Columbia, Mo., in 1866. He entered the University of Missouri in 1881, and four years later took the degree of topographical and civil engineer. The following year he spent in Park County, Colorado, as United States

I. S. TAYLOR, DIRECTOR OF WORKS.

THOMAS M. MOORE, CHIEF OF MACHINERY.

HENRY RUSTIN, ELECTRICAL ENGINEER.

E. B. ELLICOTT, CONSTRUCTING ENGINEER.

F. J. V. SKIFF, DIRECTOR OF EXHIBITS.

F. H. PHILLIPS, CIVIL ENGINEER.

CHARLES F. FOSTER, OPERATING ENGINEER.

P. F. WILLIAMS, SUPT. OF ELECTRIC LIGHTING.

CLOYD MARSHALL, SUPT. OF ELECTRICAL MACHINERY.

assistant deputy mineral surveyor. From 1886 to 1901 he was engaged in railroad construction, during which he designed and erected several large steel bridges in Illinois and Missouri. He has also designed a number of sewer and water systems, pump houses, public plants, etc. In September, 1901, he was appointed chief engineer of the Civil Engineering Department of the Louisiana Purchase Exposition. The work falling under his supervision includes all topographical surveys, location of buildings, etc. He designed and constructed the fire-protection system, including fire-engine houses, the layout of all pipe lines, including domestic water, sanitary sewerage, gas, etc. He designed and constructed all bridges, viaducts and subways, and the entire installation of the Intramural Railroad, as well as the layout of World's Fair terminals, classification yards and trestles; all roadway construction of all kinds; storm-water drains, which include the changing of the channel of the Rivière des Pères into its present discharge flume, 20 by 60 feet. By means of this subterranean canal, the waters of the river, which formerly followed a very tortuous route through the exposition grounds, are now diverged and carried from one end of the grounds to the other through this great flume.

Edward B. Ellicott is the chief electrician and mechanical engineer of the fair. He was appointed to the position after a thorough search had been made to fill the vacancy caused by the resignation, on account of poor health, of Henry Rustin, chief electrical engineer. Mr. Ellicott left Chicago in November last, to assume charge of all the electrical and mechanical construction work at the exposition. At the time of his appointment he was, and still is, city electrician of Chicago. His department ranks as one of the best in the city government and his good executive ability and thorough technical training have been likewise beneficial to the exposition. Mr. Ellicott is a native of New York, 37 years of age. He came to Chicago in 1890, and at the time of his appointment as city electrician held the responsible position of superintendent of construction of the Western Electric Company. He was frequently consulted as an electrical expert during the building of the Chicago World's Fair. Many novel lighting effects have been devised by him and he is the holder of quite a number of patents on electrical devices.

Paul F. Williams, superintendent of electric lighting, is a native of Indiana. He received a technical education at Purdue University, graduating in 1897, after which he became identified with the Chicago Edison Company, and later with the Chicago Edison and Commonwealth companies. In 1901 Mr. Williams was made assistant general-inspector for these companies, having charge of the inspection of interior electrical installations and engineering of overhead construction. In February, 1904, he was granted a leave of absence, to permit him to accept the position he now holds. Besides being superintendent of one of the most important groups in the classification of the Department of Electricity, Mr. Williams, as acting superintendent of the Palace of Electricity, has charge of all exhibit installations. This not only includes the installing of the exhibits on the floor, but the handling and the expedition of material from the time it arrives at the grounds.

Cloyd Marshall, superintendent of electrical machinery in the Department of Electricity of the Louisiana Purchase Exposition, is well qualified for the position he now holds. He graduated from the School of Electrical Engineering of Purdue University in 1895, remaining there after graduation as assistant in the electrical laboratory. He left Purdue to accept a position as electrical editor of the Street Railway Review of Chicago, also serving as secretary of the Chicago Electrical Association. For two years he held the position of designing and testing engineer with the Jenney Electrical Manufacturing Company of Indianapolis, afterward taking up experimental work for the Railway Materials Company of Chicago. In 1901 he accepted the position of plant engineer for the C. W. Hunt Company of New York, and later of engineer of the sales department of the same company, resigning this position to accept the appointment with the World's Fair. Mr. Marshall is a progressive engineer and business man, and has rendered excellent service to the department with which he is connected.

Franz Welz, who is serving the Department of Electricity in the capacity of technical clerk, is a native of Germany. Mr. Welz is well versed in electrical engineering, having graduated at the Royal Bavarian Realschule, after which he spent two years at the Royal Bavarian Technical College at Munich. In 1894 he entered the employment of the Allgemeine Elektricitaets Gesellschaft of Berlin, in the branch office at Munich, and in 1896 was transferred to the office of the same company at Hanover, in the capacity of electrical engineer, where he had considerable experience in designing and constructing all kinds of electrical installations, especially central power stations and power transmissions. He later was placed in charge of a branch office of the Allgemeine company in Cassel, where he remained two years, and then accepted a position with the same concern in Brussels, Belgium, where he had charge of large electrical power installations for direct and three-phase current in French and Belgian factories. Mr. Welz resigned this position in 1902 and came to the United States, securing a position in the office of Mr. W. J. Hammer of New York. He remained in this position until December, 1902, when he accepted the position he now holds. Mr. Welz is a member of the Verband Deutscher Elektrotechniker, the American Institute of Electrical Engineers and the Societe Belge d'Electriciens.

Percival E. Fansler, chief clerk of the Department of Electricity, was born in Grand Rapids, Mich. After graduation from Purdue University in 1901 he spent a year in the study of electric interurban traction, and in the spring of 1902 carried out an elaborate series of tests on the Union Traction Company of Indiana. These tests were made the subject of papers presented to the American Institute of Electrical Engineers and constituted a valuable acquisition to existing literature on this subject. In 1903, the degree of electrical engineer was conferred upon him by Purdue University. Mr. Fansler has occupied his present position since June, 1902, which period practically covers the activities of the Department of Electricity. He is an associate member of the American Institute of Electrical Engineers and is a contributor to the English, French and American technical press. Mr. Fansler is a fine type of the quick-thinking, enterprising, good-humored young American citizen. He is essentially of the United States and the twentieth century—a hard-working, cheery hustler, technically equipped. He is very popular with exhibitors and others with whom his duties bring him in contact.

Charles F. Foster, who has recently been appointed chief operating engineer of the power plant at the Louisiana Purchase Exposition, was born in Boston, Mass., on September 28, 1852. During his early life he was engaged as a mechanical engineer in Manchester, N. H., principally in the line of mill work. In 1880 Mr. Foster became a resident of St. Louis and was made superintendent of the St. Louis Cotton Mills. Later he became vice-president and general manager of the Heine Safety Boiler Company of St. Louis. With the opening of the Chicago World's Fair in 1893 Mr. Foster was appointed its mechanical engineer, and after finishing his duties there became connected with the National Supply Company of Chicago, of which concern he is now vice-president and one of the consulting engineers. Mr. Foster is a member of the American Society of Mechanical Engineers, the St. Louis Engineers Club and the Western Society of Engineers.

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PALACE OF MACHINERY, ST. LOUIS EXPOSITION.

FRANZ WELZ, TECHNICAL CLERK, DEPARTMENT OF ELECTRICITY.

P. E. FANSLER, CHIEF CLERK, DEPARTMENT OF ELECTRICITY.

Palace of Machinery.

The above illustration presents an excellent view of the Palace of Machinery, which is one of the main buildings, a neighbor of the Palace of Electricity. As shown by the map on page 307, it contains the exposition and exhibitors' power plants.

What Was at Chicago in 1893; What Is at St. Louis in 1904.

By Richard H. Pierce.

Great expositions are great instructors not only of the general public, but also of those skilled in the various arts there represented. They have wisely been chosen as ideal places at which to exhibit new and novel appliances and processes, and to display apparatus and products which represent the highest state of the art, in lines already established and developed.

Each great exposition seems to show to us the development of possibilities shown at the preceding one and to indicate the lines along which we are to look for developments to be displayed in the one to follow. The Centennial Exposition of 1876 showed the beginnings of the telephone, arc lamp, and, in fact, contained in embryo many appliances and systems, which, at Chicago in '93, seemed to have almost reached a state of perfection. Hardly a day of the Chicago fair passed in which the writer did not say to himself, "This is the development of what was suggested in Philadelphia. What is here that will lead to a corresponding development to be displayed at our next world's fair?"

R. H. PIERCE.

The expositions which have been held since '93 have been, to a large extent, echoes of the World's Columbian Exposition, although Buffalo showed the progress which has been made in electricity along certain lines. The Louisiana Purchase Exposition of 1904 will, for the first time since '93, make a display which can be fairly taken as representing the state of the art. To make a comparison of the electrical exhibits at Chicago and what may be shown at St. Louis would be to review the entire field of electrical engineering.

There are, however, certain points which come most prominently to the mind of one whose connection to the Chicago exhibition was so intimate that he naturally uses its date as a division of time, just as old settlers in Chicago fix the date of an occurrence by saying, it was so many years before or since the fire.

Electric Lighting.

In electric lighting at Chicago, where, owing to the large areas to be lighted, it seemed necessary to resort to arc lighting, the direct-current open-arc system was shown in about its highest stage of development. The alternating-current open-arc lamp was there first used in this country commercially and on a large scale. A few years only elapsed, and the open arc disappeared from view. Its place is now in a museum, not in an exposition. The Nernst lamp has since arrived and seems to occupy an intermediate position between the enclosed arc and the incandescent. Its showing at St. Louis should pretty well determine its field and limitations. Tesla's most interesting display at Chicago of high tension and static effects seemed to indicate the coming of some kind of vacuum lamp to replace the incandescent. This, however, still appears to be a field of possibility.

The chief development in lighting has been in the line of distribution. The old question of alternating versus direct current has been settled. The lion has laid down with the lamb, and although those who are in what was the alternating-current camp may be inclined to proclaim that the lamb is inside the lion, nevertheless, to all except salesmen of electrical apparatus, it is now pretty well known what the field is for each system. The great progress in lighting since '93 has been in the development of alternating-current systems of high-tension transmission. When we consider that the switchboard cost of electricity for lighting is only about five per cent. of the average selling price, in large cities, it is evident how important is the development of transmission systems which permit of the centralization of plant with the rapid growth of business and the enormous increase of areas to be supplied.

The maximum working alternating-current pressure at the Chicago Exposition of 2,000 volts has been raised, until 40,000 and 50,000-volt systems are in common use and 13,000 is a standard voltage without the use of step-up devices. The apparatus and devices for producing, controlling and regulating electric energy at these high pressures will make an exhibit at St. Louis which will be most interesting and instructive both to engineers and to the public.

It is to be hoped that St. Louis will offer something new and practical in an electric lamp. It seems that the time is right for the appearance of some lamp that will give more candles per horsepower. The first Edison lamp, using 75 watts for 16 candlepower, at one cent per lamp-hour, gave illumination for the same price as a five-foot gas burner using 16-candle gas at $2 a thousand feet, the prices which prevailed in the early '80's. In '93 we had 23-candle gas and a 50-watt lamp, so that the ratio remained about the same. In the last few years the incandescent mantle has come into quite general use, so that to-day a cubic foot of gas gives three times the illumination it gave in '93. As the cost of gas in the holder has probably decreased since that time more than the cost of a kilowatt at the switchboard, it would seem that some improvement in the electric lamp must be made, if electric lighting is to hold its own with gas, unless some method of producing electricity appears which will be less wasteful than our present outfit, comprising the use of furnaces, boilers and steam engines.

Power Applications.

Considering the transmission and application of power by electricity, in '93 we find the direct-curernt motor substantially perfected; it did all the work both of construction and operation at the Chicago exhibition. The possibilities of the polyphase motor were indicated by exhibits. The development which has since taken place in high-tension transmission and apparatus already referred to, has enlarged the field of the alternating-current motor and enormously increased its use. At St. Louis the polyphase motor will be shown in a form which appears to be almost perfection for most classes of stationary work.

Electric Railroading.

In electric railroading at the Chicago Fair the Intramural Railway, crude and uncommercial as it was, demonstrated the possibilities of electric elevated railroading and the haulage of trains by electricity. Standard apparatus exhibited at St. Louis will undoubtedly include multiple-unit-control systems and equipments capable of operating trains at the running speed of 60 or 70 miles an hour; in fact, perfected systems for elevated roads and equipments for interurban roads which will give better results than steam under steam-railroad conditions.

The rotary transformer was exhibited at Chicago, and recent years have seen it developed and adopted as a link between alternating-current transmission and direct-current distribution. St. Louis should show us the beginning of systems using alternating-current railway motors which will eliminate the present form of sub-station, with its attendants, moving machinery and wasteful double transformation. It is doubtful if in this country we will be greatly guided by European models in railway practice, but we will certainly "get there" pretty soon with something simple and practical, and it is about time to look for the start.

Generators and Prime Movers.

Considering electric generators, it is to be remarked that at Chicago the power plant at Machinery Hall fairly represented standard practice, and was at that time up to date.

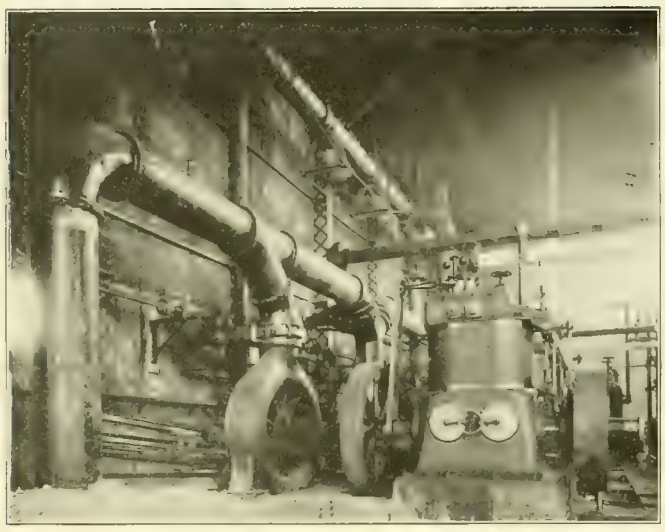
The 3,000-volt, 10-ampere series machines which furnished current for the arc lighting have long been junked or gone back to the woods. Among direct-current generators, the 500-volt Westinghouse generator, direct-connected to 500-horsepower, cross-compound, Corliss engine, represented the limit of direct-current machinery in design, and very nearly in size. This type has not materially changed.

It is in the alternating-current generators that advancement is most apparent. The biggest thing in '93 was the 2,000-horsepower Corliss engine, belted to two two-phase generators, rated at 1,000 horsepower each. This outfit occupied a space of about 35 by 135 feet. When we consider that at about this time the Niagara vertical generators of 5,000 horsepower were built, it must be conceded that the advance has been chiefly in prime movers. As against the equipment just described, we may see at St. Louis (if the manufacturers consider it of sufficient novelty to exhibit) a turbine-driven alternator of 5,000 kilowatts, or 7,500-horsepower, capacity occupying a space only about 18 feet square, or, in round numbers, about two per cent. of the floor space per horsepower of the older type. The weight per kilowatt of the turbo-alternator shows an equally wonderful ratio to that of its predecessor, together with an improved steam economy.

It is, however, to the internal-combustion engine that all eyes are turned in hope, and many in faith, that here we shall find a solution of the problem of economy; that this type will materially reduce the number of British thermal units required to produce a kilowatt-hour. The automobile has created an increased confidence in the reliability of this type of engine, and whatever is shown at St. Louis will be scanned with eager interest.

Telephony and Telegraphy.

At the Chicago exhibition we had the first great demonstration of long-distance telephony, connecting New York city with the exhibition grounds. The switchboard there exhibited was a revelation to nearly everyone outside of the Bell company. Since '93 the growth of the Independent movement has stimulated invention, and this branch of engineering should be prominently represented at St. Louis. The



Direct-connected Centrifugal Feed-water Pump.

Installing 2,000-horsepower Pump Motor for Cascade.

INTERESTING PIECES OF MACHINERY AT ST. LOUIS EXPOSITION

automatic switchboard ought to be a notable feature.

The fact that progress may be expected at any line and in any time will be demonstrated at St. Louis, by exhibits showing the wonderful and radical development in the oldest branch of electrical work. While telegraphy presented nothing new at Chicago worthy of note (unless a possible exception could be made in the case of the telautograph), the St. Louis Exposition will show wireless telegraphy in practical use and on an unusual scale. This again is a practical development based on what in '93 was merely a suggestion.

DECORATIVE ILLUMINATION AND VARIOUS APPLICATIONS.

In addition to standard lines of electrical work, we may expect many interesting and novel applications at the coming fair. I note that we are promised by those in charge elaborate color effects in decorative illumination. The manner in which visitors at Chicago crowded from the grounds, where (with the exception of the electric fountains) the lighting was at set piece, and filled the Electricity Building, where there were changing lights and light effects, indicated possibilities, which have been taken advantage of to some extent at San Francisco and Buffalo. The most spectacular effect can be produced without offending the artistic taste of the designers of the buildings and grounds; such effects will greatly increase night attendance and prove of great value to the exhibition.

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TOWER OF PALACE OF MACHINERY, ST. LOUIS EXPOSITION.

The promised display of electrochemical processes will show the development of electric application in a field which has been developed almost entirely since '93. At expositions all processes are eagerly watched by the public, and these exhibits will prove most interesting, and will indicate almost limitless possibilities, many of which we may look to see realized in the near future.

The proposition of exhibiting an ozone process of purifying the Mississippi River water should be welcomed by St. Louis people, but it is highly probable that it will not be shown on so large a scale as to bring the article into general use at the exposition, and it is fair to assume that most visitors will be content with the beverage which has contributed toward making St. Louis famous.

When we think of the marvels of engineering skill at the Chicago Exposition, which learned scientific gentlemen decorated with blue ribbons and which were said to represent perfection in the art, and remember that aforesaid "marvels" have, for the most part, been relegated to the scrap pile, and that in many cases the companies which produced them have vanished or been absorbed by more successful competitors, we realize that although "Time is short and art is long," 11 years is a long time in the art of electrical engineering. We should all note well the novelties in engineering at the St. Louis Fair. They will indicate the possibilities of the next decade and foreshadow the passing of most of what will there be displayed as the perfection of the art.

The Scientific Work of the International Electrical Congress of 1904.

BY PROFESSOR HENRY S. CARHART.

The readers of the Western Electrician have been kept informed relative to the progress made by the official committee of organization of the International Electrical Congress to be held in St. Louis next September. About 1,300 persons have already signified their desire to become members and to receive the Proceedings. It is now estimated that the Proceedings will fill three volumes of 800 pages each. The programmes of the several sections are nearly complete, and they include papers from distinguished writers at home and abroad, such as Professors J. J. Thomson, Sir Oliver Lodge, Fleming, Drude and Zeeman.

The official body, composing the Chamber of Delegates, while not absolutely assured, is almost certain to convene, since the Department of State at Washington has issued instructions to our representatives abroad to invite official representation by accredited delegates. In fact, the Mexican government has already made its appointment. The promoters of the Chicago congress of 1893 remember the difficulty encountered in persuading the secretary of state to appoint official delegates for the United States, and little or no help was obtained from that quarter in securing official representatives from other countries. Nevertheless, properly accredited delegates from 10 governments were present and formed the "Chamber of Delegates," a name adopted for that occasion. Certainly the prospects for a goodly number of official members of the congress are now much better than they were during the early months of 1893.

A decade is certain to demand some modifications in the adopted units or nomenclature of a science which is developing as rapidly as the subject of electricity and its technical applications. The Paris congress of 1881 confirmed the electromagnetic units already tentatively adopted by the British Association by the official recognition of the volt and the ohm. It added, as everyone knows, the ampere, the coulomb and the farad; and it relegated to an international committee the duty of determining the length of the thread of mercury, under standard conditions, and one square millimeter in cross-section, which should serve as the material representative of the ohm. Up to the present this work has not needed revision.

In 1893 the Chicago congress adopted all these units, including the length of 106.3 centimeters for the length of the mercurial column to represent the ohm, a number which had been unofficially agreed upon the preceding year at an international conference during the meeting of the British Association in Edinburgh. The Chicago congress added the Clark standard cell, with its accepted value of 1.434 volts at 15° C., as the international standard of electromotive force, and the henry as the unit of inductance.

Since that time not only has the adopted value of the electromotive force of the Clark cell been called in question many times, but the Weston (cadmium) cell has been thoroughly investigated, particularly at the Reichsanstalt in Germany, and its superiority over the Clark standard cannot now be successfully disputed. Its almost negligible temperature coefficient, or change of electromotive force with temperature, is alone sufficient to warrant its adoption in place of the Clark element. This is a question which the Chamber of Delegates may well take into serious consideration.

It has been known for some time that the most marked variations in the electromotive force of both Clark and Weston cells arise from some obscure trouble with the depolarizer, the mercurous sulphate. Curiously enough, chemists have not investigated this salt and its methods of preparation as thoroughly as the merits and importance of standard cells justify and require. I am glad, therefore, to say that this subject has been taken up with thoroughness by one of my colleagues, Dr. George A. Hulett, and myself, with the most gratifying results. The preliminary account of this investigation, conducted by means of a grant made by the trustees of the Elizabeth Thompson Science Fund of Boston, was read at the recent meeting of the American Electrochemical Society in Washington. The American Institute of Electrical Engineers has appointed a committee to draw up specifications for the cadmium cell; and it is now quite certain that this committee will be prepared to report to the Institute and to the Chamber of Delegates by next September. Even though the Chamber of Delegates does not accept these specifications as final, it may commit the preparation of such specifications to an international committee. This was done at Chicago, in the case of the Clark cell, and the only reason why the committee never reported was the death of its distinguished chairman, Professor Helmholtz.

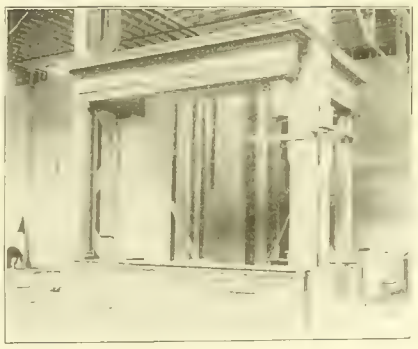
In applied electricity, great interest is taken in the subject of standardization. Committees in different countries are now at work. If substantial agreement shall have been reached on the main features, it would be helpful for the Chamber of Delegates to recommend them for international adoption. This subject is of prime importance from a commercial point of view, by reason of the world-wide distribution of machinery secured by every large manufacturing company.

Finally, the official body of the congress should take some action touching the mooted question, whether the primary measurement of current should be made by means of the silver voltameter, or by measuring the drop of potential over a standard resistance. In the former case, the primary definitions are the ohm and the electrochemical equivalent of silver; in the latter, the ohm and the electromotive force of a standard cell.

Aside from the fact that the silver voltameter method is not one for the direct measurement of current at all, but of quantity, it is very limited in its range and more uncertain than the use of a potentiometer, a standard cell and a standard resistance. The latter method is quick, reliable, and is applicable to currents of any size.

Western Electrician's Booth.

The Western Electrician will be "at home" to its readers and friends who visit the exposition in a handsome booth just to the right of the main entrance of the Palace of Electricity. The exhibit will be tastefully fitted up to display the products of the Electrician Publishing Company. There will be bound volumes of the Western Electrician and many of the technical books published or handled by the Electrician Publishing Company. Current issues of the Western Electrician will also be found on file. An attendant will be ready at all times to give information regarding the grounds, buildings, etc., and the readers and patrons of this journal are extended a hearty invitation to visit its headquarters during the exposition.



WESTERN ELECTRICIAN'S BOOTH DURING CONSTRUCTION.

The accompanying illustration shows the Western Electrician booth during the process of construction.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

Iowa Electrical Association (annual meeting), Savery House, Des Moines, April 20th and 21st.
National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.
Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.
International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.
International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.
American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.
American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 12th and 13th.
Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

A TRULY GREAT exposition is about to be opened in St. Louis to commemorate the purchase of the Louisiana territory 101 years ago. It is planned with intelligent foresight by experienced men on a very large scale. It will be worthy of the important historical event which it celebrates, worthy of the country and worthy of the third year of the twentieth century. The holding of this exposition is an event of much interest to all the people of the United States, a considerable proportion of whom will no doubt inspect and study it. Visitors will be attracted by the desire to avail themselves of its educational opportunities, to feast their wondering eyes on its beauties or to enjoy the unique amusement features which are provided. The average sojourner within the gates of the exposition will be influenced to some extent by each one of these motives. But it is the educational value of the World's Fair, and particularly of the electrical exhibits, which will be of greatest importance to the readers of the Western Electrician, and it is with this fact in mind that the present issue of this journal, devoted largely to the exposition, has been prepared.

As the only electrical journal in the West, the Western Electrician has taken a particular interest in the development of and preparations for the Louisiana Purchase Exposition in St. Louis. It has been a pleasure to us to lay before our readers, from time to time, accounts of the great work in progress to make this exposition worthy of its object. In obedience to this impulse we have heretofore published, in the shape of illustrated articles and news notes, more about the electrical and allied features of the exposition than has appeared, perhaps, in any other technical journal. But now that the formal opening of the exposition is only two weeks away we have determined to signalize the event by this special World's Fair issue, which will give the reader, we think, a good idea of the scope of the exposition, particularly as it relates to electricity.

Among a number of interesting features we particularly commend to the reader Professor Goldsborough's thoughtful, earnest article explaining the plan on which the electrical exhibits have been solicited and are presented. It is no haphazard hodgepodge of dynamos and motors, wires and lamps, which will be shown to the visitor. Instead, there is a homogeneous collection of working electrical apparatus, designed to teach something to the general spectator as well as to interest and instruct the technical man. The plan adopted is a highly commendable one, and the electrical display ought to be, and no doubt will be, of great and lasting benefit to the electrical industry. Education is the keynote of the exhibit plan of all departments, but Professor Goldsborough has caught the idea and is intelligently carrying it out with an enthusiasm and energy that are worthy of high praise.

Mr. Williams tells in clear and succinct fashion how the exhibits in the Palace of Electricity are arranged, and a useful installation plan adds greatly to the value of his article. Another article of considerable length tells what the visitor may expect to see among the foreign exhibits. Mr. R. H. Pierce, who was the electrical engineer of the World's Columbian Exposition of 1893, gives a comparison of the Chicago Exposition of 11 years ago with that of St. Louis. The development shown is most interesting and instructive. Dr. Carhart writes of the scientific aspect of the International Electrical Congress. Other articles, with pictures and maps, help to make this special issue valuable both to the electrical man who contemplates a visit to the exposition and to him who must forego that pleasure but is nevertheless eager to learn all he can that the exhibition has to teach.

Probably the exposition will not be completed on the opening day; probably it will be hot in St. Louis this summer; probably the hotels will be overcrowded, and very likely the transportation facilities will be overtaxed. But these drawbacks are relatively unimportant. The first is almost unavoidable, the second quite so. We may hope that the St Louis people will rise to the occasion in facing the housing and railway problems. However, the great thing is the exposition itself. It is a big, fine, epoch-making affair. It is distinctly creditable to St. Louis and to the American people. The latter should give it a cordial and hearty support, both for their own sake and the sake of the exposition, even at the risk of a little discomfort. And there may be no discomfort at all. Chicago, with memories of the never-to-be-forgotten White City, has a fellow feeling for St. Louis, and will not be found wanting in appreciation and co-operation.

WE observe a number of sprightly contributions to the columns of our esteemed contemporary, the Electrical Engineer of London, under the initials B. C. H. J. Can it be that our own local celebrity, Bath House John Coughlin, is instructing the Britishers? The similarity of initials is certainly striking. If Alderman Coughlin is really the author of these articles, a new and unsuspected tie binds together Ireland, England and the United States.

DISAPPOINTING in attendance, the general meeting of the American Electrochemical Society held in Washington last week was nevertheless rich in scientific and technical output, as may be judged from the report of the convention, with synopses of the papers, presented in this issue of the Western Electrician. Particularly valuable were the contributions of H. S. Carhart and G. A. Hulett on "Preparation of Materials for Standard Cells and Their Construction" and of William S. Weedon on "The Study of the Electric Arc." These papers, in full or in comprehensive abstract, will be given in a later number.

The society elected as its president Prof. Henry S. Carhart of the University of Michigan, and in doing so is to be congratulated. Dr. Carhart is one of the leading physicists of the country and a man of the highest character. The honor sits worthily upon him. We hope that his administration will be as successful as it deserves to be. But perhaps the society may find, as other electrical societies have discovered aforetime, that its busy members cannot afford the time to attend more than one general convention a year.

MAYOR HARRISON'S annual message to the City Council contains, of course, a long review of the traction situation. This portion of the message is rather despairing in tone. "The controversy prior to the last city election was certainly complicated enough. This election, however, has added further complications to an involved situation." The "further complication," of course, is the adoption by the voters of the Mueller law permitting municipal ownership, the passage of which was so zealously advocated by the mayor a year ago. But the mayor still believes in municipal ownership, "not," as he rather darkly remarks, "as an ephemeral fad, nor as a catch-penny device for currying public favor, but as a practical essential to good municipal government." He does "not care for bogus municipal ownership; I am not willing to accept, in lieu of the real article, municipal-ownership husks devoid both of substance and nourishment." No, no. What the mayor wants is the real thing, but he doesn't know how to get it. A plan, to meet his approval, should be "something more than a hazy dream or a succession of high-sounding words and phrases signifying nothing." Evidently somebody is getting hit by this; the mayor talks as though some of the municipal-ownership advocates were simply blatherskites. His honor proposes, somewhat dispiritedly, two plans. One is for a grant to the companies with a guaranty that "at a certain stipulated time before the expiration of the full grant, and upon payment of a fair price, the municipality could acquire ownership of the properties." The second plan provides that the properties be bought with "Mueller-law certificates," but as these could not be floated in the market, the first plan will propably be adopted. It simply puts off the municipal-ownership question for perhaps 20 years, so that the mayor's pessimism is not without warrant.

AMERICAN ELECTROCHEMICAL SOCIETY.

The fifth general meeting of the American Electrochemical Society was formally opened on Thursday morning, April 7th, in the chapel of the Columbian University Building, Washington, D. C. Among the prominent electrochemists present were Professor Henry S. Carhart of Ann Arbor, Carl Hering of Philadelphia, Joseph W. Richards, president of the society, and Dr. F. A. Wolff of the Bureau of Standards, Washington. The attendance consisted of 40 members and guests. This number was increased to 80 during the day.

The meeting was formally opened by Dr. Richards, the president. Action was taken on the following amendment to the constitution: "The president, vice-presidents and managers shall, after the expiration of the full term of office to which they were elected be ineligible for immediate re-election to the same office." This amendment was adopted. The treasurer reported that the finances of the society were in a very healthy condition, amounting to an equity, including about 300 unsold Transactions, to $3,500. The secretary's report was to the effect that the membership had reached 660 full members, being an increase of 186 for the last year.

Papers were then read and discussed. The first was "Standard Cells," by Dr. F. A. Wolff. This paper was a description and comparison of the various types of standard cells, as tested in the Bureau of Standards, Washington. The author favored the Weston cell. In connection with this paper the author displayed an apparatus for the preparation of mercurous sulphate electrolytically. It consisted of a flat-bottomed dish containing mercury about a centimeter in depth. The mercury was covered with dilute sulphuric acid to considerable depth. A platinum wire protected, except at its end, by a glass tube, made contact with the mercury, which served as an anode; the cathode was a piece of platinum in the H_2SO_4 solution. A stirrer was rotated by an electric motor to keep the mercury surface exposed. This apparatus was subsequently described by Professor Carhart in his paper, in which he laid claim to the originality thereof.

This paper was followed by an elaborate article by Dr. H. S. Carhart and Dr. G. A. Hulett upon the "Preparation of Materials for the Clark and the Weston Standard Cells. The authors noted that in the preparation of standard cells the chemical side of the problem has hitherto received little attention. The paper gave the details of the preparation of mercury, cadmium sulphate, cadmium amalgam, mercurous sulphate and a full description of the construction of the cadmium cell. The method for the preparation of mercurous sulphate produced a material free from any nitrate. With the materials prepared as described in his paper Professor Carhart was able to produce a cell that did not require the aging process to reach its equilibrium in electromotive force; or, in other words, he was able to produce cells which did not vary from the time they were set up by more than one part in 100,000. This was remarkable and showed very careful preparation and an infinite amount of experimenting upon the part of Professor Carhart and his associates.

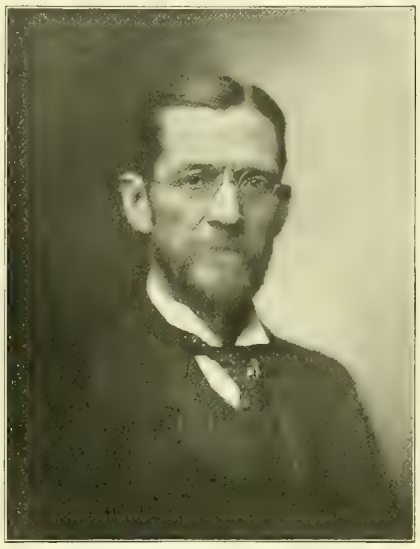
A paper by Mr. W. R. Mott, entitled "Single Potentials of the Halogen Elements," was the third paper presented. The author said that there were many points in the ionization theory that were not in harmony with some of the facts observed in the study of single potentials. This was due to neglect to consider the actual chemical reaction taking place and a failure to appreciate the free and bound energy involved in this reaction as the essential points. The paper included a series of tables and curves giving the decomposition voltages of the various elements and their respective flourides, chlorides, bromides and iodides. A diagram was presented, from which could be determined the total decomposition voltage, the single potential of the ion or the single potential of the cathion when the other two factors were known.

President Roosevelt's Reception.

The local committee, of which Colonel Samuel Reber was chairman, arranged a very elaborate programme for Thursday and Friday afternoons. At 1 o'clock on Thursday afternoon a reception was accorded the members and guests of the association by President Roosevelt at the White House. On Thursday afternoon at three o'clock members visited the various points in Washington on special "Seeing Washington" cars which had been provided by the local committee.

Dr. Richards' Presidential Address.

Thursday evening President Richards delivered his presidential address in the auditorium of the Columbian University. There were present 40 members, including ladies. President Richards spoke of the past achievements of the society and dwelt upon the classification of electrochemical phenomena which had resulted from the annual meetings of the society. He mentioned that the field of electrochemistry was broad and largely undeveloped; that results were needed on the conductivity of different salts, with different electrodes and various other combinations of conditions. Much study and research are still needed in the field of fused salts, the calorimetric value of cells, the deposition of alloys, the effect of gases in solution, redeterminations of the electrochemical equivalents. The application of electrochemistry to industrial needs was then dwelt upon by President Richards, during which he spoke of the reduction of the cost of aluminum from $5 a pound to 30 cents a pound; the reduction of metallic silicon, the production electrolytically of the finer grades of steel, the great calcium carbide industry which had been built up by the cheap production of this substance. In closing Professor Richards remarked that since



HENRY S. CARHART, PRESIDENT AMERICAN ELECTROCHEMICAL SOCIETY.

the production of silicon carbide, uranium carbide, the use of high temperatures now obtainable with the electric arc, that the field of the electrochemist was only now a fraction of what it will be in the time to come. At the conclusion of Dr. Richards' address the meeting adjourned to Rauscher's, where the remainder of the evening was spent at a complimentary smoker.

Friday Morning.

The meeting was called to order promptly at 9:30 a. m., Professor Carhart presiding. Dr. Richards presented the first paper, entitled, "The Composition and Resolution of Voltages." This paper was an exposition of the method for the determination of the actual voltage of a cell undergoing dissociation. The method was developed from a theoretical standpoint and based upon the law of the conservation of energy. In the discussion which followed Mr. Hering remarked that the method was attractive, but that various commercial conditions would vitiate its success if applied. Mr. Richards assumed that the dissociation voltage between two substances, such as nickel and copper, would vary from one extreme to the other, depending upon the amount of alloy present. During the discussion this was proved to be an unwarranted assumption except in one specific case. Furthermore, Dr. Richards neglected to consider the heat of formation of the various compounds which alone would be sufficient to alter the final voltage of the cell. In closing the discussion Dr. Richards remarked that the local action of a cell had no material effect upon the final voltage as calculated.

"Molecular Conductivity," by C. J. Reed, was the title of the next paper, which was to the effect that the system employed by electrochemists for measuring molecular conductivities was inaccurate. Mr. Reed mentioned that the conductance of a solution was measured in most cases and not the molecular conductivity. Experimenters assume that either the conductance or the conductivity of dilute HCl is due entirely to the HCl and not at all to the H_2O. Mr. Reed questioned the above assumption. The author criticized the loose manner in which prominent authors used the terms molecular conductivity when the term molecular conductance should be employed. In the discussion which followed Dr. Reber proved mathematically that the term molecular conductivity was very properly deduced and used by Kohlrousch and the other writers mentioned by Mr. Reed, and that Mr. Reed had misconstrued their significance. Dr. Reber concluded by stating that it was simply a case of measuring conductances in such a manner that you obtained the molecular conductivity, this being possible as the two terms have a very definite relation to each other.

This paper was followed by "The Economic Balance in Electrolytic Copper Refining," a paper presented by Lawrence Addicks. It embodied a criticism from a commercial standpoint of the paper presented by Dr. Bancroft at a former meeting upon the effect of current density and temperature on the cost of electrolytic copper refining, in which Dr. Bancroft drew conclusions as to the most economic current density to employ. Mr. Addicks discussed a number of variables, such as tank resistance, circulation of solution, condition of leads and electrodes. The paper tended to show that in the production electrolytically of metals the lowest cost per ton may not be the cheapest cost per ton, due to the fact that with a current density somewhat greater than that giving the lowest cost per ton the output may be sufficiently increased to give greater savings in spite of the higher cost per unit. Professor Bancroft submitted a discussion of Mr. Addicks' paper, which was read in Professor Bancroft's absence by C. J. Reed. The writer disagreed with Mr. Addicks in his method of solving the various conditions in pairs as put forth by Mr. Addicks in his paper, and he inferred that the only proper method of determining the proper current density to employ in a specific case was to consider all of the variables together. He compared the Anaconda plant with the Great Falls plant, a current density of 35 amperes per square foot being employed in one plant and 11 amperes per square foot being utilized by the other plant.

Louis A. Parsons' paper on "The Energy of Ions" was read by Mr. Sadtler. In the discussion of a paper presented on "Ions and Electrons" at a former meeting by Louis A. Parsons, Mr. Reed questioned the statements made by the author and stated that our conception of the electrolytic dissociation theory should be reversed and that the ions should be considered as devoid of electrical charges. Mr. Parsons' paper gave an exposition of the ionic theory of solutions, in which he stated that the ionic theory had inspired many valuable researches and had led to many important discussions. It seemed absurd to the writer, therefore, to throw away a theory which had been of such benefit to science when he had nothing better to substitute in its place. This paper was much discussed by Mr. Reed, Dr. Reber, Professor Richards and others, the final conclusion being that if the ionic theory had so far proved satisfactory it was advisable to still continue to use it until a better theory had presented itself.

In the absence of Mr. C. I. Zimmerman his paper, entitled "The Aluminum Electrolytic Condenser," was read by Mr. Marvin. This paper was a description of the new aluminum condenser for the conversion of alternating currents into a unidirectional current. The alternating current when passing through the cell forms a film of high dielectic strength over the electrodes. The thickness of this film as determined by interference of light or by observing its color and determining the wave-length was found to vary from .000005 to .00005 centimeter in thickness. The aluminum condenser, as described, is similar to two tinfoil condensers, and when shunted by an inductance direct current may be obtained by connection with the middle of the inductance and an additional electrode submerged in the electrolyte of the cell. The film which forms in the condenser has withstood as high a voltage as 1,250 without disrupting the film; the condenser, however, does not operate satisfactorily with a voltage impressed upon it above 150. The efficiency of the cell is as high as 97 per cent. and averages about 95 per cent. Diagrams were presented showing the resultant voltage curves of the condenser and also its construction and connection to the circuit.

Excursion.

The local committee had arranged for Friday afternoon a visit to the navy yard, where arrangements had been made for the members of the society to see the operation of shrinking a jacket on a modern gun. Separate arrangements [illegible] the Bureau of Standards.

Friday Evening.

A subscription [illegible] evening in the banquet hall of the Shoreham Hotel.

opposite the Columbian University. The decorations on the tables were luxuriantly arranged, beautiful flowers being used in abundance. There were present 32 members and guests, and although the attendance was small a very pleasant evening was passed. Among the speakers were Dr. Wiley, chief chemist of the Agricultural Department; Dr. Needham, Dr. Carhart and Carl Hering of Philadelphia. Professor Carhart spoke of the great growth of the Electrochemical Society. He referred to the typical American characteristics of the younger membership, namely, vigor and non-conservatism, being responsible in a large measure for the success and development of the society. Many toasts were made and the evening was voted a great success.

Saturday Morning Session.

The meeting opened with a discussion of Mr. Zimmerman's paper on the electrolytic condenser by Mr. Mott. The speaker stated that the paper under consideration was the first clear exposition that had ever been published of the aluminum cell. He stated that the difference between a condenser and a rectifier was that the condenser consisted of two plates immersed in a solution, whereas the rectifier was built up of one electrode, such as an aluminum plate, connected to the circuit, and an additional electrode, such as a carbon rod, immersed in the electrolyte but not connected to the same circuit with the single electrode. Dr. Guthe spoke of the gases being formed in the film on the plate and suggested that possibly they were the cause of the tremendous dielectic strength of this film. He mentioned that he had removed the gas contained in the film by means of a vacuum pump and that the result was greatly to reduce this high resistance. That such a film existed was proved by the fact that when the voltage impressed upon the condenser had been raised beyond a certain limit the film would be punctured and sparks would be observed to pass.

Election of Officers.

At the close of the discussion upon Mr. Zimmerman's paper the committee of tellers consisting of Mr. Frederick Dewey, Mr. Frederick Holton and Mr. Raymond Outwater reported the total number of votes cast was 388. The balloting for president resulted in the election of Professor H. S. Carhart of Ann Arbor, Mich., with a total of 191 votes against 102 votes for Carl Hering of Philadelphia. The following-named vice-presidents were elected: C. J. Reed of Philadelphia, 248 votes; E. G. Acheson of Niagara Falls, 168; C. F. Burgess of Madison, Wis., 123. For managers the following votes were cast: W. H. Walker, 98; E. E. Acker, 84; E. Weston of Newark, N. J., 79. Mr. Burgess also received 91 votes, but having been elected a vice-president was ineligible as a manager. P. G. Salom of Philadelphia was elected treasurer, having total vote cast amounting to 265, and S. P. Sadtler received 253 votes for secretary, and was therefore elected.

[Henry S. Carhart, LL.D., the new president of the society, is the well-known professor of physics in the University of Michigan. He is one of the leading electrical scientists of the country, and the honor of his election is well deserved. He was born near Albany, N. Y., March 27, 1844, and graduated from Wesleyan in 1869. He became professor of physics in Northwestern University in 1873 and at the University of Michigan in 1886. His research work, books and writings have made his name widely known.]

Other Papers.

At the close of the report of the tellers Dr. William S. Weedom gave "A Contribution to the Study of the Electric Arc." This paper was the result of an elaborate series of experiments performed upon the electric arc in the research laboratory of the General Electric Company. Arcs had been produced between a large number of substances, including copper and iron. Arcs were formed between electrodes in air and electrodes in gases, such as hydrogen and nitrogen. In one series of experiments electrodes were made in cup form and cooled by means of a jet of water spraying up inside of the electrode. With a current of two amperes passing between the electrodes in this condition under a pressure of 50 volts the author found that the electrodes gained in weight, which was remarkable and contrary to the ordinary arc where the electrodes are usually consumed very rapidly. In this particular case the cathode gained .004 gram and the anode .023 gram. This experiment alone showed the possibility of obtaining an arc lamp with electrodes which would require no trimming as is essential with the carbon arc lamp. Experiments were performed to determine an electrochemical equivalent for the arc with water-cooled electrodes. It was found to be approximately 1-1500 of the Faraday equivalent for solution. An attempt was made by the author to discover whether the cathode determined the character and color of the arc. He found that it was so for a large number of instances, but discovered a few exceptions. The results obtained by the author exhibit very careful study, and the paper is the best article on arcs that has been published in recent years. It may be published in full in a later issue of the Western Electrician. In the discussion of Mr. Weedom's paper Mr. Hering advised the use of batteries instead of a generator in the study of the arc, as the fluctuations in the generator voltage were bound to affect the steadiness of the arc.

A paper entitled "Some Phenomena Observed in Connection with the Use of a Copper Voltameter," by Isaac Adams and Barry MacNutt, was next considered. It consisted of description of a special type of voltameter used in connection with a determination of the horizontal component of the earth's magnetism. The authors had endeavored to determine this constant by a method which was unsuited, as pointed out by Mr. Hering, and had obtained results which did not agree.

In the absence of Professor Burgess his paper on the "Electrolysis of Iron" was read by President Richards. Professor Burgess stated in his paper that he had so far developed a process for the production of electrolytic iron that it could now be produced in such quantities as to make it a commercial object. The use of electrolytic iron is limited at the present time to the facing of dies and electrotypes. The great hardness of the material is due to the occluded hydrogen it contained. This hydrogen could be freed by heat and leave iron which would be pure. He stated that not a pound of pure iron had ever been produced commercially except by this process, and it was therefore of great importance. The electrolytic solution was composed of ferrous sulphate with a certain proportion of ammonium sulphate. A current density of from six to 10 amperes per square foot of electrode was usually employed for dissociation. The temperature of the bath was maintained at 30° C. The greatest difficulty encountered with the old methods of depositing iron was to produce a thick deposit. The surface of the electrode would become pitted and coil up; with the present method a deposit of three-quarters of an inch in thickness was obtained, electrolytic action occurring continuously for four weeks. The iron was deposited at the rate of one gram per ampere-hour, the production per kilowatt-hour being 2.2 pounds. The solution could be kept in working condition without much trouble and the iron could be produced at a cost of one-half cent per pound. The purity of this iron produced electrolytically was 99.9 per cent., the only impurity present being hydrogen. The iron had all the properties of the best Swedish and could be readily welded. It could not, however, be rolled satisfactorily. The melting point of this pure iron is near that of platinum. He also discovered in his experimenting that the presence of hydrogen greatly affected the permeability and hysteresis losses of the iron. The greatest characteristic of the iron is its purity. He closed his remarks by stating that he was now able to produce electrolytic iron upon a commercial basis. In the discussion Mr. Hering called attention to the fact that it was impossible, so far as he knew, to deposit iron from the ore commercially, as it required such large tanks and so much solution. He was glad, however, that Professor Burgess had developed the refining industry.

The final paper presented at the convention was entitled "The Thermoelectric Determination of the Temperature of Reduction of Zinc Oxide," by W. McKay Johns. It consisted of a description of a special form of crucibles for the reduction of the oxide and also an exposition of a method for determining the temperature of reduction thermoelectrically. The temperatures obtained varied from 1,022° to 1,084° Centigrade. The author stated that he intended determining the latent heat of the vaporization of zinc and intended building an electric furnace for high temperatures. The convention was then adjourned, arrangements having been made for a trip to Mt. Vernon and the Bureau of Engraving in the afternoon.

Among the papers presented but not discussed, owing to the limitation of time and the absence of the writers, was a paper on "Electric Smelting Experiments for the Manufacture of Ferro-nickel from Pyrrhotite," by Ernst A. Sjostedt. It consisted of a description of an electric furnace built by the author to be used for the reduction of poorly roasted pyrrhotite in the manufacture of ferro-nickel metal. The problem which presented itself to the author was to utilize nickeliferous pyrrhotite of the Sunbury district and save the sulphur, iron, nickel and copper contained in the ore instead of allowing the sulphur to escape and the iron to be fluxed off and wasted in the slag. The author found by electrosmelting different proportions of finely crushed ore and coke that raw pyrrhotite was only partially and with difficulty converted into metal; that a partially roasted pyrrhotite in a mixture of lime and coke or charcoal will be reduced to a metal, and that the larger the lime charge the smaller will be the amount of sulphur in the metal produced. An estimate was given as to the cost of operating a 200-horsepower furnace which would show a net profit of $5 per ton of metal reduced. Another paper presented but not discussed was that of William H. Davis, describing a method employing alternating current at 60 cycles for the recovery of cyanogen from the double salts of a cyanide solution. The author found that a chemical process was out of the field of profit, due to the solubility of sulphur cyanides in excess of potassium cyanide and the fact that the solution had either to be rendered acid or an excess of the precipitate added. There being no cheap precipitant of cyanogen, recourse was made to electrochemistry. Direct current was tried and failed, but with the use of alternating current at 60 cycles the author was able to produce the desired precipitate of the basic metals where an excess of free alkali was present, the alternating current raising the osmotic pressure so that complete dissociation was not present. S. W. A.

Space Telegraphy in Russo-Japanese War.

Space telegraphy in the present eastern war has become a valuable adjunct to the war correspondent in news collecting and has proved an efficient means for escaping a rigid press censorship. During the recent demonstration of the De Forest wireless telegraph before the British postoffice between Holyhead, England, and Howth, Ireland, arrangements were made by the De Forest Wireless Telegraph Company with the Times of London and Captain Lionel James, its famous war correspondent, then about to start for Yokohama. This contract demanded that two complete sets of space-telegraph apparatus, manned by two expert operators, should be shipped to the front. Within 10 days after the arrangements with the Times the full outfits, including even two kerosene oil engines, and weighing all told over four tons, were shipped express to Vancouver, where the men just caught the steamship Empress of Japan. From Yokohama the expedition, unique in the history of warfare and journalism, sailed at once for Shanghai, China. There Captain James had chartered the little Chinese steamer Hai-num, a two-master, on which top-masts had been rigged to the height of 75 feet, all the vessel could safely carry. There the apparatus was transferred, and during the voyage north to Wei-Hai-Wei the two De Forest experts, Athearn and Brown, both New York men, worked unceasingly until the ship's set was completely installed and in operation.

Captain James' lieutenant, Mr. Fraser, had preceded him to Wei-Hai-Wei, and there the men found nearly complete a bamboo mast, 180 feet high, rigged in the best possible fashion, considering the unsatisfactory wood which alone could be obtained for that purpose, and the great dearth of necessary supplies. A pair of rough bungalows were thrown together by coolie labor, and the task begun of moving the engine and heavy machinery from the dock to the promontory where stands the station. This point is some 10 miles east of the town of Wei-Hai-Wei.

Just three weeks from the date of landing at Wei-Hai-Wei the London Times printed a column dispatch from James, headed "Via De Forest Wireless Telegraphy." Since that time numberless dispatches have been flashed from the masts of the little Hai-num, far out in the Korsan Gulf, near Chemulpo, or even in company with the Japanese fleet in battle off Port Arthur.

Each set is of one kilowatt capacity and comprises a 2½-horsepower Secor oil engine, a 60-cycle, 500-volt generator with separate exciter, oil transformer delivering 20,000 volts, oil transmitter key, regular Shoemaker-De Forest oscillator and syntonizer, electrolytic receiver with relay and bell attachment and highly-sensitive telephone receivers. The Hai-num being without electric power, carried an oil engine the same as the shore station.

The De Forest apparatus in the Yellow Sea has not been exempt from serious competition by the Japanese wireless stations on board their vessels of war. Whether intentionally to interfere or in the ordinary operation of their stations there has been a continuous stream of wireless signals in that neighborhood, but the novel methods of syntonization employed in the De Forest apparatus, the speed with which the press dispatches are rushed through with the alternating-current transmitter (25 to 30 words per minute, which greatly exceeds the speed of the Japanese system), together with the telephonic methods of sound-reading, have, it is said, enabled the American operators to send the longest wireless dispatches on record, without error or delay. The situation is exactly as during the naval maneuvers off the Maine coast last summer.

Judge Seaman, in the Federal Court, has held that an application for a patent is not part of the assets of a bankrupt.

COMMUNICATIONS.

The Central Station and the Incandescent Lamp.

To the Editor of the Western Electrician:

As I understand it, virtually all of the incandescent-lamp factories are either owned in common, or a pool exists between the various manufacturers, providing for an ironclad agreement to maintain certain fixed selling prices. This, however, does not mean there is no competition in the lamp business, and at the present time there is a healthy competition, even though prices are fixed, competition taking the shape of trying to make a lamp, or at least trying to make the lamp purchaser believe that the lamp of the different manufacturers excels all others.

This competition is more beneficial to the central-station people than competition on price only. I know some lamp manufacturers are earnestly endeavoring to better their product, and I believe progress is constantly being made in incandescent lamps.

The pool agreement regarding prices permits all manufacturers to sell to Edison licensee stations at a lower rate than the ordinary customers. This is discrimination against which the independent stations should rebel. There is no reason why a small licensee Edison station should purchase lamps at a lower price than a large independent station.

The lamp manufacturers have pushed high efficiency to their own, as well as the central station's detriment. The relation between fixed and output cost for each central station must determine the efficiency of the lamps which it should use. If the output costs are extremely low, and the fixed costs high, the greater capacity demanded, owing to the low-efficiency lamps, may demand the use of a high-economy lamp; but with low-output costs (and by this I mean those costs which are proportional to the current sold) and low fixed costs (and by this I mean those expenses which are not proportional to the current sold, such as interest, tax depreciation and executive salaries), then it may be possible to use a low-efficiency lamp and secure a lower cost to the station per mean candlepower-hour supplied. This idea will be found in a discussion on lamp efficiency in the proceedings of the National Electric Light Association for 1901.

One or two large stations sell all, or practically all of their sign lighting and much of their window lights on flat rates, and it is the custom of these companies to use a low-efficiency lamp on these flat-rate consumers during the entire year, except at time of the yearly peak, when the capacity of the station is taxed. An extremely high-efficiency lamp is then substituted for these low-efficiency lamps, and this enables the securement of a much better load factor to the station, on basis of greatest maximum demand compared with yearly output. Where the distributing system is an expensive one it might be possible and economical to use a 2½-watt lamp on these consumers at the time of the yearly peak. This, however, is a problem in economics, and only incidently a lamp problem.

The carbon-filament lamp has not even approached its theoretical efficiency. It should be able to work at a much higher temperature than the highest efficiency lamp now commercially used.

Attention is being paid to "quality" by all of the larger stations; but in the interest of progress in lamp manufacturing, all lamps should be purchased on the basis of candlepower-hours of life, as determined by a certain number of lamps being subjected to a careful test. Only by penalizing bad goods and offering an attractive premium for extraordinarily good goods can progress in this work be secured. The difference between the best and the poorest lamps today is much closer than formerly existed, but there is still a wide range and some lamps could not be sold at a profit, if purchased on merit.

A recent test of various makes of incandescent lamps showed "values" for different makes, when compared with certain recognized standard makes, going as low as 6⅞ cents a lamp against a cost of 15 cents for the standard lamp.

Uniformity of candlepower and wattage is also important, and testing for this feature is so simple that it should be practiced by all central stations.

If the Edison companies can band themselves together and secure favorable rates, class assortment and sell incandescent lamps, the same advantage would accrue to a number of independent companies banding themselves together and buying lamps in the same way. This deserves the serious consideration of all large independent stations at least, and would be equally advantageous on a lesser scale to the small stations. A low cost of maintaining a lamp-testing bureau could be secured by working in conjunction with one of the big universities, such as Purdue, Michigan, or Wisconsin.

Wholesale lamp renewals should be encouraged, as this seems to offer the only solution to perfect electric-lighting service. The crowding of high-efficiency lamps on the central stations has done much to handicap the development of free renewals and has greatly retarded the development of wholesale and periodic renewals, such as is practiced by some stations.

Much confusion now exists in the question of stating the degree of regulation on a percentage basis. It is common practice to assume that, when a regulation of, say, two per cent. is stated, it means that voltage does not vary either two per cent. above or two per cent. below the normal. On this basis, if 110 were the normal voltage and one station varied from 110 to 113 volts, we would have to put that station in the class giving three per cent. regulation; and we would also put the station in the class of three per cent. regulation which varied from 107 to 113 volts. It is plainly unfair to assume that both of these stations are equally good in regulation.

The National Electric Light Association or the American Institute of Electrical Engineers, or both, should adopt as a standard of regulation the percentage basis in terms of minimum voltage. The lamp-testing bureau established by the Edison licensee stations has done much to improve lamp manufacture, and it deserves credit for its work.

Stations not equipped for lamp testing can advantageously use this bureau to determine the relative value of different makes of lamps. They will be well repaid for the cost of the fee charged for testing.

A CENTRAL-STATION MANAGER.

April 4, 1904.

Lamp-socket Litigation.

To the Editor of the Western Electrician:

In a recent advertisement we mentioned that the Perkins socket patent No. 626,927 had been sustained by the United States Circuit Court, which directed the issuance of an injunction against the defendants, J. F. Buchanan & Co., "selling the Yost sockets."

The Yost Electric Manufacturing Company of Toledo, Ohio, complains that we should not have said "Yost sockets," but should have said "the Dixon socket which had been manufactured by the Yost-Miller Company." We agree that it would have been correct to speak of the socket sold by the Buchanans when the suit was commenced in 1902 as the "Dixon socket which had been manufactured by the Yost-Miller Company." A year or more ago, as we understand, the Yost Electric Manufacturing Company succeeded the Yost-Miller Company, acquired from it the Dixon socket patent, and took up the defense of this Buchanan suit, after which the Yost Electric Manufacturing Company, dropping the name "Dixon," put out, under the name "Yost," a socket the same as the Dixon in all essential points now covered by the Buchanan decision. While, therefore, it would have been correct to speak of the enjoined socket as the Dixon socket, we believe it was not improper to identify it by its other name of "Yost." However, the omission to use the name "Dixon" or the name "Yost-Miller Company" was not intentional.

We have now brought suit against the Yost Electric Manufacturing Company on this Perkins patent to enjoin the manufacture and sale of their "Yost" socket.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY.

Bridgeport, Conn., April 9, 1904.

Self-restoring Drops.

To the Editor of the Western Electrician:

In the United States Circuit Court of Appeals, in Chicago, on April 12, 1904, a decision was given in the famous self-restoring patent suit of the Western Telephone Manufacturing Company versus the American Electric Telephone Company, P. C. Burns et al. in favor of the complainants. Judges Jenkins, Grosscup and Baker sat en banc at the hearing. The opinion of the court, delivered by Judge Baker, is broad and sweeping, as covering all switchboard drops located with their associated jacks and adapted to be restored by the operator's plug as it is thrust into the jack automatically. There can be no appeal from this decision, which is final, and reverses the decision of the lower court as rendered about a year ago.

The suit is apt to involve several hundreds of thousands of dollars, and the owners of the patent purpose taking every honorable and full advantage of the exclusive rights conferred upon them by this decision, which has been contested so vigorously and at such an enormous expense during the last eight years.

The court also ordered an injunction prohibiting the manufacture of infringing self-restoring drops and an accounting for those having been put into use. The extensive output of these self-restoring switchboard drops during the last eight years would indicate the great importance of this case and the probability of further proceedings with relation to it.

JAMES E. KEELYN.

Chicago, April 12, 1904.

Iowa Convention Arrangements.

The Chicago party to the Iowa Electrical Association's fourth annual convention in Des Moines will leave over the Rock Island route at 10 p. m. on Tuesday, April 19th. A special car has been secured and arrangements for berths should be made with Mr. W. S. Goll, 623 Marquette Building. The convention will be held in the Savery House on April 20th and 21st. It is said that 125 central-station men have signified their intention of attending the meeting, which promises to be valuable in results.

Boris Sarafoff, the leader of the Macedonian rebels, is said to have ordered an armored automobile, which he intends to use in directing this spring's campaign against the Turks.

Chicago Street-railway Situation.

The result of the recent city election further complicates the Chicago traction situation. In this election a vote was taken on three questions of public policy relating to street railways. In all of these the municipal-ownership point of view was upheld by the voters, as related in the Western Electrician last week. But the city is not prepared to buy the companies' property and rights, no matter how large a majority of citizens may urge such a course. The question now is, What next?

Many and diverse plans for a solution of the problem have been suggested by municipal-ownership advocates. One suggestion is that in order to test the ability of the municipality successfully to operate street railways the city make use of the lines covered by the franchises of the Chicago Passenger Railway Company, which are about to expire. As from time to time the other franchises of this company run out the suggestion is that the city add them to the municipality-operated system, gradually extending the service until a thorough test of public operation has been made. But, it is argued by those in the City Council who have been identified in traction negotiations for several years, that even with the city operating all the franchises of the Chicago Passenger Railway Company the prospect of its obtaining control of all the other surface lines would be as remote as ever. Nevertheless, one of the strongest points in the city's favor is the fact that even should the validity of the act of 1865 (the 99-year act), which is now being contested, be sustained, by no legal method could the influence of that act be construed to cover the franchises granted the Chicago Passenger Railway Company. By the judicious use of these expiring franchises the city hopes to impress the Union Traction stockholders.

The city is unfortunate in being unable to deal with both the Chicago City Railway Company and the Union Traction Company along identical lines. The one company is willing to surrender its alleged rights under the 99-year act in consideration of a 20-year franchise, while the second company stands ready to forego a definite long-term grant in consideration of an official acknowledgment of its 99-year-act claims. On this point Mayor Harrison suggests that when the proper time comes there is nothing to hinder demanding an identical settlement.

According to leading public officials, all attempts at a solution of the tangled situation will be futile or at least beset by insurmountable obstacles until a final decision on the validity of the 99-year claims is made. The city has filed its brief in the case and a decision from Judge Grosscup is looked for soon. Then the matter will be advanced to final hearing.

Some interesting comment on the situation is made in the annual message of Mayor Harrison. In this communication to the new City Council the mayor reviews at length the street-railway situation, and, after pointing out the many obstacles to be overcome, he offers for the consideration of the council, two possible solutions which present themselves. These are, briefly, as follows:

1. The passage of franchise renewal ordinances, providing for fair compensation to the city, with the right to purchase after 10 years, and the creation of a sinking fund with which to buy.
2. The immediate purchase by the city, the property to be paid for by certificates to be issued under the provisions of the Mueller law, and in turn to be leased to the companies; the rent money in this case to be put into a sinking fund to apply to the retirement of the certificates.

In either case the companies are to waive the rights claimed by them under the 99-year act, and no settlement is to be made until it has been ratified by a referendum vote.

The burden of the problem now falls upon the new committee on local transportation. Alderman Frank I. Bennett, who, for a number of years, has devoted his time and energies to this important committee as its chairman, has been made chairman of the finance committee of the City Council and is succeeded by Alderman Foreman. Those well informed on the situation agree that even with the declaration for city ownership, at the recent election the traction problem is no nearer a solution, and municipal ownership is still a long way off.

Institute Announcements.

The 186th meeting of the American Institute of Electrical Engineers will be held at Carnegie Hall, New York city, on April 22d. The following papers will be presented and discussed: "The Mechanical Construction of Revolving-field Alternators," by David B. Rushmore, Pittsfield, Mass., and "Contribution to Theory of the Regulation of Alternators," by H. M. Hobart and Franklin Punga, both of London, England.

"High and Moderate-voltage Lines" is to be the general topic of discussion at the next meeting of the Chicago branch of the Institute which will be held on April 26th. The papers of George H. Lukes, W. C. L. Eglin, Professor Harris J. Ryan and Guido Semenza will be discussed. Abstracts of the papers will be read, as usual, after which written discussions, previously prepared, will be read by prominent members who are well versed in transmission work. J. D. Nies of Lewis Institute will give an elaborate discussion of Professor Ryan's paper. W. A. Blanck will also prepare a discussion upon the paper of Mr. Semenza. Mr. Lukes will be present at the meeting to abstract his own paper and amplify it somewhat as to details.

Fuse-plug Cabinet Panels.

The line of cabinet panels manufactured by the General Electric Company, illustrated herewith, is said to have been received with marked favor by contractors and architects throughout the country. The panels are furnished for 125 and 250-volt service, in a variety of arrangements and circuits, to meet the requirements of practically all installations. The distinctive feature is the employment of the well-known Edison fuse plugs on the different circuits. The plug type of panel seems to have an advantage over the cartridge-fuse type, in that the bus bars and connections are placed considerably below the level of the tops of the plugs, thus rendering very remote the liability of a short-circuit.

The fuse plugs furnished with the 125-volt panels are fitted with a mica cap, which enables one at a glance to know on which circuit the fuses have blown.

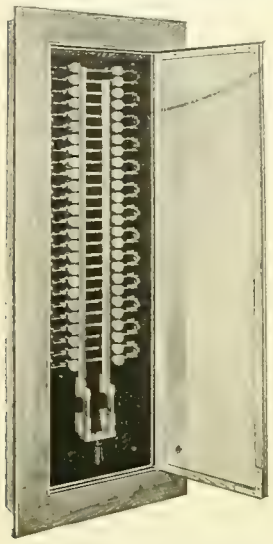


FIG. 1. CABINET PANEL FOR 26 CIRCUITS FROM TWO-WIRE MAINS.

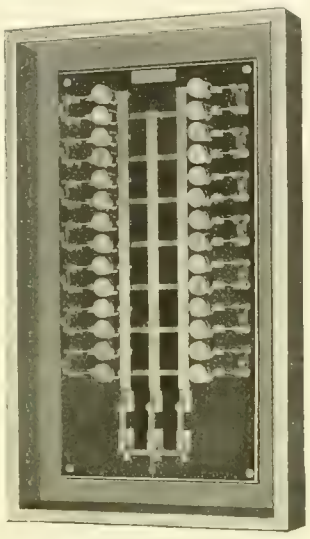


FIG. 2. CABINET PANEL FOR 14 CIRCUITS FROM THREE-WIRE MAINS.

The 250-volt panels are fitted with reloadable type of fuse plug, which are easily inserted without danger or shock. These panels are neat in appearance, compact and well finished, and, due to the nature of the Edison plug, no injury to the panel itself can take place when the fuses blow.

Fig. 1 shows a cabinet panel for 26 two-wire double-branch circuits from two-wire mains, with main and circuit switches, while Fig. 2 shows a somewhat smaller panel arranged for 14 two-wire single-branch circuits from three-wire mains, with main and circuit switches. The spacing of the different panels is in conformity with the rules of the National Board of Fire Underwriters.

New Central-station Work in San Francisco.

Contracts have been closed by the San Francisco Gas and Electric Company for the additional equipment needed at Station "A" in the Potrero district. This will become the main electric generating station for the city, and when the work now planned has been completed its total capacity will be about 14,000 kilowatts. Two of the engines will be moved from Station "B" to the new plant. The contracts just awarded include one additional generating unit, consisting of a General Electric three-phase, 11,000-volt generator, direct-connected to a Union Iron Works compound engine. The additional boiler-plant contract was secured by C. C. Moore & Co. and also the contract to move six Heine boilers from another station to the new location.

The auxiliaries will be supplied and the boiler plant remodeled by the same firm. Individual overhead steel stacks will be put up. Heavy steel piping is to be used throughout. The contract calls for five 700-horsepower Babcock & Wilcox water-tube boilers, with about 50 per cent. overload capacity. Forged steel superheaters are included, giving an increase in temperature of 125 degrees. Two compound duplex Snow feed pumps, with steam cylinders 14 and 22 inch by 16-inch stroke, and 10-inch plungers, will be installed. These will be the largest boiler-feed pumps on the coast, having a capacity of 16,000 horsepower each. One of the pumps will be able to supply the plant, and the other will be available when repairs are necessary. Babcock & Wilcox marine oil furnaces will be installed under all of the boilers, and the oil-fuel system will be remodeled. Two special Goubert oil heaters will be put in.

J. D. Price is among those interested in the formation of the Wycomic Electric Power Company, which proposes the establishing of a power plant near Salisbury, Md.

Electricians' Blowpipe.

An alcohol blowpipe, specially suited to the requirements of electricians and also lead burning, is shown in the accompanying illustrations. The double-jet principle of construction has been adapted to wood alcohol as a fuel, and by this means a non-oxidizing needle-pointed flame of over 3,000 degrees is produced. The device is manufactured by the Turner Brass Works of Chicago. The blowpipe weighs about one pound and is so compact that it can be carried in the pocket or toolbag, as indicated in Fig. 2. The intensely hot non-oxidizing needle flame of this blowpipe is right for soldering fine wires for internal wiring and switchboard work, as the flame can be confined entirely to the point to be soldered without burning the insulation or effecting the surrounding surface.

This device is recommended by its makers for lead burning or the joining together of two or more pieces of lead without the use of solder or flux. Every owner of a lead storage battery can do his own lead burning when supplied with one of these blowpipes, and it is no longer necessary to secure the services of a professional lead burner and pay the very considerable cost of shipping the oxy-hydrogen blowpipe several miles, perhaps for the purpose of installing a battery or making simple repairs, the actual work of which usually consumes but a short time.

Besides being useful for lead burning the blowpipe is suited to many other purposes for which the oxy-hydrogen blowpipe is used, and it will be found specially desirable for laboratory and experimental work. Fig. 1 shows the blowpipe in operation with a wide flame, which, by regulating the valves, may be drawn down to a needle point. The flame can be turned low, like a lamp, and left burning inside the head for any length of time, consuming very little fuel and always ready for instant use by a turn of the needle valves. The operator can leave his work to wait on a customer, for example, without the necessity of relighting or regenerating the burner when he returns.

Alcohol is poured into the reservoir after removing the supply plug and burner. These parts are then replaced and pressure applied to the reservoir by means of the pump (C). The drip cup (D) is then filled with alcohol by opening the valve (B), and when full this valve is closed and the alcohol in the drip cup lighted. When entirely burned out valve (B) is again opened and a light applied to burner opening. Valve (C) is then opened to obtain the desired air blast. Both air and gas are delivered by the two jets to the combustion chamber, and by the proper regulation of the valves perfect combustion is secured, resulting in a non-oxidizing flame and the maximum degree of heat from the fuel. The capacity of the blowpipe is about three-quarters of a pint and it will burn at full blast three hours from one filling. The burner is fitted with a compound swivel, permitting the flame to be directed up or down, or swung around in any position desired.

Fig. 1. Device in Operation.

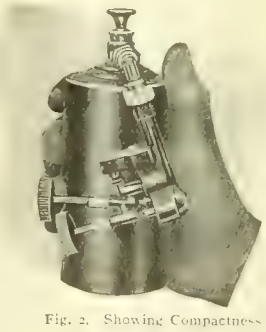


Fig. 2. Showing Compactness

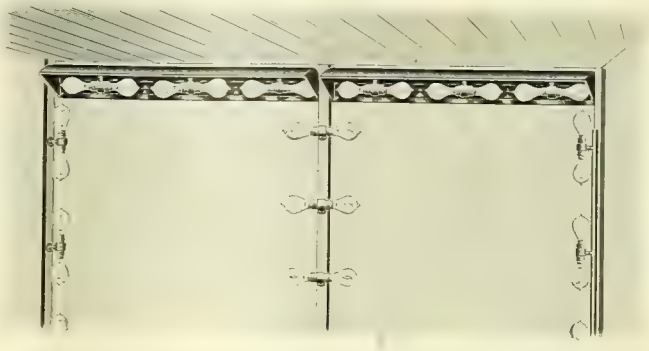
ELECTRICIANS' BLOWPIPE.

Show-window Lighting.

Lighting show windows with incandescent lamps, since it has become almost a necessity in the display of goods, gives ample opportunity for the exercise of ingenuity in the matter of wiring so as to economize in material and time.

The accompanying illustration represents a show window fitted out complete with twin sockets, manufactured by the Benjamin Electric Manufacturing Company of Chicago.

With this system of window lighting, the lamps are always in pairs, which gives a balanced effect, whether used with window reflectors or on the center rail or sides of windows. In all cases, only one-half the number of connections are required for a given number of lamps, for the socket is so constructed that one set of wires feeds both lamps.



SHOW-WINDOW LIGHTING WITH SOCKETS IN PAIRS.

The sockets may be attached to a pipe or tubing by means of threaded nipples, as shown on the right side of the window, or attached to a molding by means of short nipples and flanges, as shown at the left. The socket is fiber-lined and is easily connected, the shell being made in two pieces, which snap together, no screws being necessary. An exhibit of these sockets and other specialties will be made by the company in the Electricity Building at the World's Fair.

Steam Turbine Power Plant for Boston Navy Yard.

An interesting departure in engineering practice by the authorities of the United States Navy, Department of Yards and Docks, is marked by the introduction of steam turbines for furnishing power for lighting the buildings and yards, and power for operating dry-dock pumps and miscellaneous machinery.

The initial installation of this character is in process of construction at the Charlestown navy yard, Boston, Mass., and, for the present, one Westinghouse-Parsons turbine generating unit of 750-kilowatt capacity will be placed in service. This turbine will be of the new short-barreled type and is now under construction at Pittsburg. A Worthington surface condenser will be employed, using salt water for circulation. The condensers will be located between the foundations, which consist of concrete piers. A running vacuum of 28 inches will be secured through the aid of a dry-air pump. Steam will be furnished at 150 pounds pressure by Babcock & Wilcox boilers, in units of 350 horsepower, equipped with Roney mechanical stokers. Coil superheaters in the boiler settings will furnish to the turbine a superheat of about 100° F. The boiler house will be equipped with a complete outfit of coal and ash-handling machinery.

The turbine plant will supply three-phase alternating current at 2,300 volts, this voltage being used for general distribution and for direct use in larger motors, while for lighting, lower voltage will be provided by transformation. The turbine-generator will be served by a 37½-kilowatt Westinghouse compound exciter unit.

The engineering work is under joint execution by the Department of Yards and Docks and the constructing engineers, Westinghouse, Church, Kerr & Co., who are installing the plant.

Hylo "Long-distance" Lamp.

One of the most interesting features of the exhibit in the Palace of Electricity at the World's Fair at St. Louis will be the Hylo turn-down lamp exhibit of the Phelps Company, Detroit, Mich. The turn-down incandescent lamp is an article that appeals to the current-consuming public, as it has direct bearing on the economical use of the electrical current, both in residence and commercial work.

The Hylo turn-down lamp is made in two ways and in various candlepowers. In the turn-bulb style the candlepower is reduced from 16 to one by means of a twist in the bulb. In the pull-string style, the lamp is turned up, down, or out, by means of a neat

HYLO LONG-DISTANCE LAMP.

little string, which serves the double purpose of operating the lamp and bringing it within the reach of the shortest member of the family.

The new invention of the Phelps Company is illustrated herewith, and is known as the Hylo long-distance lamp. This outfit consists of a lamp, a cord and a switch. The cord can be any length desired and, by means of a neat little switch, the lamp can be turned up, down, or out. This lamp is particularly adapted for closed-globe lights, porch lights and high-ceiling lights. In bedrooms it enables the occupant to turn the light up, down, or out, without getting out of bed. New lamps are readily obtainable, which, by a simple operation, can be attached to the cord on which the old lamp has burned out. The claim for the Hylo lamp is that it will burn three times as long as the regular electric bulb.

Ohio Interurban Railway Association.

Brief notice was given in the Western Electrician of April 2d of the organization of the Ohio Interurban Railway Association. The first regular meeting of the association was held on March 31st at the Algonquin Hotel in Dayton. Over 60 railway men were present, representing about 30 companies. The discussion of an interchangeable transportation plan was the main feature of the meeting. It is expected to hold these meetings at intervals of about one month in different parts of the state and one subject is to be presented and discussed at each meeting, which will take up a portion of one day. President Harrie P. Clegg called the meeting to order and delivered an address of welcome. Mr. Merrill, chairman of the committee on interchangeable mileage, then read his report, in which he described the form of mileage coupon book which had been adopted by the committee. After some amendments had been made to the wording on the cover of the book and the coupons contained therein it was adopted by the association.

After this business had been transacted the meeting was opened for general discussion, in which different members contributed experiences of their own in connection with street-railway construction, maintenance and operation. Those taking part in the discussion were F. W. Coen, Mr. Wilcoxon, Edward C. Spring, Theodore Stebbins and George S. Davis.

The vice-president of the association is Edward C. Spring and the secretary and treasurer J. H. Merrill. The next meeting will probably be held in Cleveland about the first of May.

The Boston Convention.

The final list of questions for the forthcoming Question Box at the annual meeting of the National Electric Light Association, to be held in Boston, on May 24th to 26th, has been issued. Since publishing the preliminary list several weeks ago the number of questions has increased to a total of 438, all more or less directly affecting every central-station man in the country. The questions are classified under 24 subjects, and while some of them may seem simple to those of wide experience, the information asked may be of vital importance to someone. Mr. H. T. Hartman, editor of the Question Box, is endeavoring to make this feature of the convention interesting and instructive, and the indications are that he will be very successful. All answers must be in Mr. Hartman's office in the Land Title Building, Philadelphia, Pa., by April 18th.

That the question of hotel accommodations at the convention may be properly dealt with and the members relieved of much of the attendant care and inconvenience, President Edgar has appointed a committee, composed of Charles H. Hodkinson (chairman), James I. Ayer and C. L. Edgar, to assume control of the assignment of rooms and parlors. The Hotel Vendome will be the headquarters, but in addition arrangements have been made with the Hotel Brunswick, Hotel Victoria, Hotel Lennox and Hotel Westminster, all within two blocks of the Vendome, so that accommodations for at least 1,000 guests are assured. If members will make their desires known, as clearly as possible, to this committee, they will be properly and satisfactorily taken care of.

Intramural Railway at the Exposition.

Those visiting the St. Louis exposition will do well on reaching the exposition grounds to board an electric car of the intramural railway. On foot it will take three or four hours to make as comprehensive a tour as the intramural affords. It is approximately a six-mile trip around the grounds by this line, and there are 16 stations at the various entrances and spaced conveniently along the track. Starting near the main entrance, whence a view of the Grand Basin and Festival Hall may be had, the cars pass between "The Pike" and the Varied Industries and Transportation Buildings. Then they wind about through the buildings at the western end of the grounds, turning the corner of the great Agricultural Building and coming out upon the wooded sections beyond. After a stop at the Fine Arts Building, the cars make their way to the extreme northeastern corner of the grounds, skirt the Government, Liberal

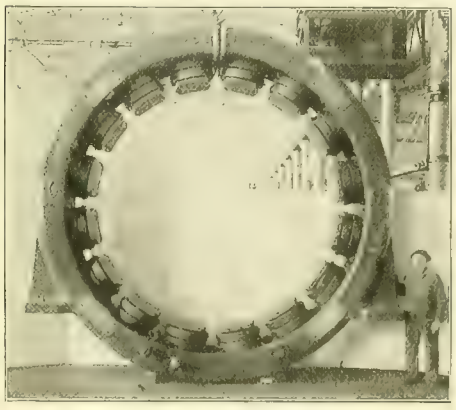


Fig. 1. Field Ring with Coils.

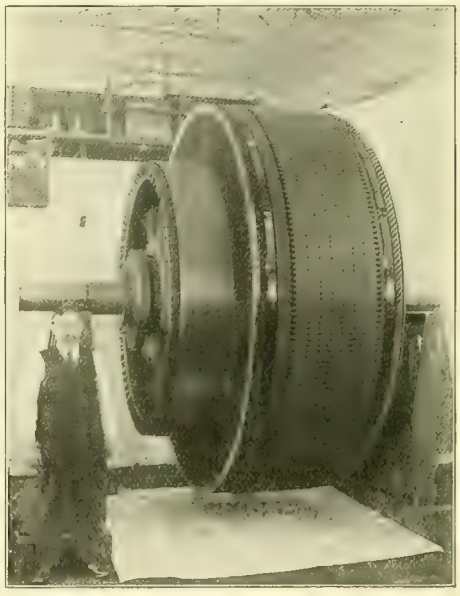


Fig. 2. Armature.

PARTS OF 900-KILOWATT GENERATOR FOR INTRAMURAL RAILWAY.

Arts and Manufactures Buildings, and finally return to within a short distance of the starting point. This railway is owned and operated by the Exposition Company.

The power plant for the intramural occupies a space of about 10,000 square feet in the Machinery Building. It is seen on approaching the main entrance of the building, and is one of the most striking electrical exhibits on the grounds. The electric generating equipment is furnished by the Crocker-Wheeler Company of Ampere, N. J., and consists of seven units, having a combined generating capacity of 3,500 kilowatts. Each unit is a standard Crocker-Wheeler railway-type generator direct connected to the prime mover.

There is one unit of 900 kilowatts capacity, running at 100 revolutions a minute and driven by a Buckeye cross-compound steam engine. A 600-kilowatt generator, running at 85 revolutions a minute, is driven by a Lane & Bodley horizontal cross-compound 20 by 40 by 54-inch engine. Three units are of 500-kilowatts capacity each, one with a speed of 100 revolutions a minute and driven by a 26 by 48-inch single-cylinder rolling-mill type of Corliss engine, manufactured by the Murray Iron Works, the other two being driven by Brown-Corliss vertical cross-compound engines at a speed of 135 revolutions a minute. The sixth unit is of 400-kilowatt capacity, running at 150 revolutions a minute, and uses a Harrisburg horizontal tandem compound 15 by 40½ by 26-inch engine. The last generating unit in the series is driven by a Doble waterwheel, the water pressure being furnished by a Jeansville Iron Works pump. The unit is of 100-kilowatts capacity and runs at 700 revolutions a minute.

With the exception of the differences in size and in details of proportion, the several generators are similar. The cast-iron magnet frame is of the internally-flanged type, which gives a maximum rigidity for a given cross-section, and is parted on its horizontal diameter and bolted together by flanges on the inside. A view of one of the frames is shown in Fig. 1. The poles are of mild steel cast-welded into the frame. The field coils are made up in two or three sections, which are "mummified;" that is, individually wrapped, taped and insulated, and separated from one another by small wooden blocks to improve the heat-radiating qualities. To allow the removal or replacing of the coils the pole shoes are detachable. The armature (Fig. 2) is of the iron-clad type, consisting of a toothed core of laminated mild steel.

The commutators are constructed of high-grade drawn copper, with ample surfaces to carry current without undue heating and to give a large radiating capacity. When desired the brushes may be lifted from the commutator and held away from it by a half turn of an adjusting screw. This is a feature that is especially useful when it is expedient to test individual brush resistances or certain windings for grounds.

The use of both steam and water as prime movers of these generators of virtually uniform type establishes a comparison between the two methods which will be of interest to every technical observer.

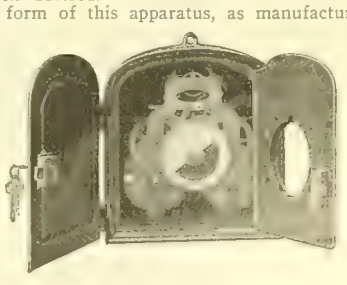
Electric-railway Conditions in Japan.

The Electric Street Car Company of Tokyo has just obtained a charter for 50 years. The conditions of the charter are that out of the net receipts one per cent. goes into a sinking fund to pay up the stock, for there are no bonds. Of the remainder, after seven per cent. has been paid to shareholders, one-third goes to the city and two-thirds is again distributed among the stockholders. The company keeps the right-of-way in repair. The fare is very low—only three sen (one cent and a half)—but this sum has a much greater purchasing power than the same amount of money would have in America. This electric road is used exclusively by the common people. It is curious to note that at a meeting of bankers it was voted not to use the electric cars for another year.

Hartford Time Switch.

Oftentimes it is desirable to have an electric sign burn for certain periods during the evening at times when a certain class of people whose attention it is wished to attract will be the most apt to see it, as, for instance, a theater sign before and after the performance. In order to throw a sign into or out of circuit at intervals without depending upon an attendant to perform the duty, the time switch has been devised.

One form of this apparatus, as manufactured by



HARTFORD TIME SWITCH.

the Hartford Time Switch Company of Hartford, Conn., is shown in the accompanying illustration. This device automatically turns the current on or off at a predetermined time by means of a clock-work mechanism which has an eight-day lever movement. The switch is of the double-contact rotary type, contained in a compact dust and weather-proof case. In addition to the automatic feature, the switch has an auxiliary [illegible] clock to operate without throwing the switch; it has also an auxiliary hand trip by which the switch can be thrown without disturbing the clock.

Telephone News from the Northwest.

The Tri-state Telephone Company will put in an exchange at Red Wing, Minn.

A local exchange will be installed for Withrow, Minn., which will connect with the long-distance service of the Northwestern Telephone Exchange Company.

The council of Northfield, Minn., has refused permission to the Tri-state Telephone Company for a toll station on its long-distance line.

The Cadiz Central Telephone Company has been organized at Browntown, Wis. E. L. Divan is president and C. K. Allen, secretary.

A telephone company has been formed which will build a line from Frost, Minn., to Rome. K. T. Gaard is president and K. Satre, secretary.

A local telephone company has been organized at Cokato, Minn.

The Hinckley and Rural Telephone Company has been formed at Hinckley, Minn. T. O. Donovan is president and P. A. Christianson, secretary. Lines will be built from Hinckley to Turpville, Kroschel and Brookpark.

Fox & Jowett will install a telephone system at Warroad, Minn.

The Yellowstone Park Telephone and Telegraph Company will install an exchange at Gardiner, Mont.

Bill Bros. are installing an exchange in Sioux City, Iowa, and will construct a line from that city to Lincoln, Neb.

The Gilbert and Story City (Iowa) Telephone Company has been organized. G. P. Brown was elected president and T. J. Thompson, secretary.

The Lemars Telephone Company was granted a franchise at Struble, Iowa, recently.

A telephone franchise has been voted at Chariton, Iowa.

The Plymouth (Iowa) Telephone Company has been incorporated with a capital of $10,000. J. F. Holden is president and C. A. Molsberry secretary.

The Wisconsin Telephone Company will install a conduit system for the business section of Green Bay, Wis.

The Dunn County Telephone Company has been granted a franchise at Chetek, Wis.

J. S. A. Schroeder of Camp Douglas, Wis., seeks a franchise at Brillion, Wis., to install a local telephone exchange.

The Winona (Minn.) Telephone Company will build five branch lines in the spring.

The Viking Telephone Company has been formed by farmers of Stony Brook and Pomme de Terre, near Elbow Lake, Minn.

The Western Union Telephone Company has been formed in the town of Irving, near Willmar, Minn., and will build lines at once.

The telephone subscribers of Wheaton and Ortonville, Minn., demand a restoration of the free service between Wheaton, Graceville, Clinton and Ortonville by the Minnesota Central Telephone Company. They threaten to withdraw their patronage and organize new companies if the demand is not granted.

The Dakota Central Telephone Company of Aberdeen, S. D., has secured control of the lines in the central and southern part of the state, formerly owned by the Southern Minnesota Telephone Company and the Southern Dakota Telephone Company, both auxiliaries of the Western Electric Telephone Company. The two systems comprise 1,023 miles of pole lines, giving the Dakota Central Company a total of 4,000 miles, covering the entire state except in the southeastern portion. The company will expend considerable money in extensions and improvements to the lines. Metallic circuits will be built between Aberdeen, Yankton and other points.

The secretary of the Citizens' League of Lake City, Minn., has been investigating the question of municipal ownership of the telephone exchange. He figures that among other things it would be quite likely that the city could secure long-distance connection with both the Northwestern and the Twin City systems, which, he adds, is scarcely possible under private ownership. He thinks that lower rates which the city could establish would induce a larger volume of business without a proportionate increase in the expense. The manager of the local exchange at once wrote to the local paper calling attention to some errors in quoting rates and sizes of exchanges in other towns. R.

Michigan Telephone Matters.

There will be a new rural telephone line from Milford along the Hudson road for the accommodation of the farmers in that vicinity. This is made necessary on account of the increased demand for rural service.

The Michigan State Telephone Company has increased the long-distance rate between Detroit and Pontiac. The result of this increase, it is thought, will be the building up of the Independent toll line business between these towns, which continues at the old rate.

The Co-operative Telephone Company of Detroit has made application to the city for the use of the so-called People's Telephone Company's abandoned poles and conduits. The corporation counsel has given his opinion that this property has reverted to the city for the reason that permission was not given to the Western Reserve Construction Company to lay the conduits and erect the poles on the city's land, although this work was done for the People's Telephone Company, which company had that authority. W.

Ohio Telephone Notes.

Holdings of the Everett-Moore syndicate in the People's Telephone Company of Detroit have been sold to the Michigan State Telephone Company, a Bell interest, by Trustee Arthur Pack for $175,000. Of this $25,000 will be paid in cash and the remainder in approved debentures of the Union Trust Company. The Everett-Moore people at one time owned all but about 10 per cent. of the stock and bonds of the People's Telephone Company, but secured a portion of their money when the plant at Jackson, Mich., was sold. The latter sale, together with the sale of the unfinished building which will soon be made, will let them out with but a small loss. The Federal Telephone Company, through which these plants were built, has no other interests in Michigan.

There has been considerable demand of late for United States Telephone bonds in the Cleveland stock exchange. While they sold freely the last week there was a fraction of a point reduction over former prices. The advance has been rapid the last few weeks, however, and some reaction was looked for. This will be overcome within a short time, it is believed, owing to the rapid strides the company is making in the extension of its business.

The Central Ohio Telephone Company of Centerburg has been incorporated with a capital stock of $10,000 by T. P. Sylvan, Charles E. Bishop, J. E. Litzenberg, G. E. Jackson and E. E. McGuire.

The West Milgrove Telephone Company of West Milgrove will be incorporated in a short time to build and operate a plant at that point. Considerable material has already been secured for the plant. Wilbur Rosedale will be the president and S. L. Ghaster secretary.

The name of the Marshallville Telephone Company of Marshallville has been changed to the Marshallville-Rittman Telephone Company.

The Wellsburg Telephone Company has completed a line to Glenova, where it connects with the National and gives service through to Wheeling. At Wellsburg connections have been made with the Phœnix Telephone Company. The Independent lines thus formed connect with Steubenville, Benwood, Martins Ferry, Cambridge, St. Clairsville, Bellaire, Barnesville and other towns on both sides of the Ohio River as well as with Uniontown, Connellsville and some other Pennsylvania points. To the north connections are made with Cleveland, Canton and other places through the Independent lines.

A company has been formed at Perry to build and operate a telephone plant. W. W. Cook will be the president and F. E. Morrison secretary. Several other prominent citizens are interested in the proposition.

The Preble County Telephone Company has been incorporated with a capital stock of $25,000 by John C. Stover, J. E. Flora, A. M. Fudge, J. S. Steward and others.

A small fire occurred in the switchboard of the Cuyahoga Telephone Company a few days ago. The girls kept at their work, although the room filled with smoke, and they did not know what the extent of the fire would be. About 600 telephones were put out of service temporarily. C.

New England Telephone News.

Work on the construction of conduits for the burying of the New England Telephone and Telegraph Company's wires in Milford will shortly begin. The company has filed a bond for $5,000, giving the local authorities the right to use one duct in the conduit for fire, police and telegraph or telephone wires used for municipal purposes. The expense involved in the changes contemplated by the company amounts to upwards of $15,000.

Telephone connection between the city of Quincy, Mass., and neighboring towns was cut off during the night of April 2d, and investigation showed that a section of the cable at Quincy Point bridge had been stolen. It is also stated that about 250 feet of old cable removed from the poles by the linemen in Weymouth, on the other side of Fore River, was stolen the previous night.

The franchise of the Waterbury Automatic Telephone Company has been acquired by capitalists of Woodbury, Conn., and Arthur D. Warner has been elected president. It is planned to establish an Independent company, the Woodbury Telephone Company owners being active in the proposed construction. The old company, which has sold the franchise, was organized in 1899, but has not carried out its original plans.

Robbery of the New England Telephone and Telegraph slot machines by the process of breaking them open and abstracting their contents is not the only annoyance to which the company has been subjected lately. A systematic use of discs similar in size and weight to the coins required for their operation has been in progress, and the police are now on the watch for perpetrators of this sort of deception. Various pay-station telephone machines have been tampered with, and the company's losses in Boston aggregate a considerable amount. B.

Indiana Telephone Items.

The Harrison County Telephone Company has filed articles of incorporation to operate an exchange in Elizabeth and throughout Harrison County. The capital stock is $10,000. Joshua F. Zenor and T. W. Knight are incorporators.

The Cleveland Telephone Company of Hancock County has been incorporated to build a rural system. E. H. Thomas, I. L. Sample, E. L. Furry and others of Greenfield are incorporators.

The Blue River Telephone Company of Hancock County has increased its capital stock in order to extend its system.

The annual meeting of the stockholders of the Rushville Co-operative Telephone Company was held on April 8th. The secretary's report showed the receipts for the year to be $15,405 and the disbursements $14,665. Rent to stockholders for residences was raised to $1 and for business houses to $1.50. H. E. Barrett, W. D. Root, B. L. McFarlan and T. M. Green were elected directors.

The Indianapolis council at a special meeting passed an ordinance permitting the New Telephone Company to transfer its franchise and holdings to the Indianapolis Telephone Company. The transfer will not affect the franchise rights or obligations. It was suggested in committee that since the company intends to increase its capital it should pay the city more money. The company is now paying the city $6,000 a year and the new ordinance provides that the company shall pay $2 annually on each telephone after 6,000. That number has been reached, and as the company is preparing to take on 2,000 more the city's income will be increased $4,000.

Senator Fairbanks' amendment to the postoffice appropriation bill appropriating $20,000 for experimenting in free-telephone delivery service was ruled out of order. The senators who opposed it based their opposition on the ground that in time it would materially increase the cost of the rural service. Senator Fairbanks says such a service is bound to come ultimately. F.

Evansville Municipal Telephone Company Enjoined.

A permanent injunction against the Evansville (Ind.) Municipal Telephone Company preventing it from doing business under the franchise granted some time ago by the City Council was issued on April 8th by Special Judge W. D. Robinson of the Indiana appellate bench. The injunction suit was brought by ex-Judge R. D. Richardson, and the city demurred to the complaint. Judge Robinson overruled the demurrer, and there being no disposition to appeal he next issued a permanent injunction, holding that the company as constituted violated the Indiana law in admitting preferred stockholders to the directorate and in allowing city councilmen and city employes to become stockholders as such.

The Cumberland Telephone Company at once reopened the negotiations for the arbitration of a scale of rates looking to a new franchise. The Cumberland's proposition is that a committee of arbitration be appointed to determine what would be fair rates for the city, all court proceedings to be withdrawn and a franchise to be given the Cumberland company in accordance with the terms of the arbitration board. A conference was held between Chief Counsel Granberry of the Cumberland Telephone Company, James T. Walker, the company's local attorney, and Mayor Covert and City Attorney Funkhouser. The conferees declined to give out any information relative to the matters discussed, however.

NEW COMPANIES.

C. M. Moore, W. D. Short, H. G. Merritt and others have incorporated the Scotland County (Mo.) Telephone Company with $10,000 capital.

The New York Automatic Telephone Company of Passaic, N. Y., has been incorporated by C. R. Newman, George Roegner and A. C. Gilgen. The capital is $1,000.

A telephone company to be known as the Okaw Township Telephone Company has been organized, with headquarters at Duval, Ill. The incorporators are William Hendricks, G. L. McCullough and A. Roberts.

The Balls Ferry Telephone Company is being organized by L. D. Cheeney, D. L. Gover and others at Red Bluff, Cal., for the purpose of constructing a telephone line to the towns of Anderson and Cottonwood from Balls Ferry.

The Pittsburg and Wheeling Telephone Company has been chartered at Charleston, W. Va., to build and operate a line from Charleston to Wheeling. President J. G. Splane and Director R. C. Hall of the Pittsburg and Allegheny Telephone Company and some of the parties interested in the National Telephone Company are incorporators of the new company, which has a capital stock of $100,000. The lines of the Pittsburg company will be extended south to connect with the National.

Application is being made to the government of New Brunswick for incorporation by a company seeking the right to conduct a general telephone business in the counties of St. John and Charlotte, N. B. The title of the new company is the Citizens' Telephone Company, and it will be connected with the present Forest Telephone Company at Calais, Maine, with a main central office at Calais for both the New Brunswick counties.

The Home Telephone Company, which will soon construct a $250,000 system in San Diego, Cal., having already secured the franchise, has filed articles of incorporation. It is capitalized at $500,000 and includes in the directorate F. F. Graves, F. F. Boyce and others.

TELEPHONE MEN.

William Brueske has resigned as local manager for the telephone system at New Rockford, N. D.

Hon. James A. Tawney, of Winona, Minn., has been elected president of the Interstate Telephone Company. Otto Troost, Jr., was elected secretary.

I. Chute has been elected president and C. D. Chute secretary of the Aitkin-Grand Rapids (Minn.) Telephone Company, which proposes to build a line between those two cities.

T. P. Sylvan has been appointed state sub-license agent of the Central Union Telephone Company in Ohio, with headquarters at Columbus. Mr. Sylvan is a former mayor of Upper Sandusky, Ohio.

R. E. Hamblin, who has been made vice-president and secretary of the Home Telephone Company of Toledo, Ohio, will also retain the general managership. C. E. Stinson has been placed in charge of the construction work, maintenance and operating departments.

GENERAL TELEPHONE NEWS.

A. Monson of Motley, Minn., has devised a new automatic-telephone system.

The Home Telephone Company of Los Angeles will be given a franchise at Oxnard, Cal., and will proceed to install a plant there.

The White Bear (Minn.) Telephone Company announces a 10-cent extra charge on local and long-distance calls betwen 11 p. m. and 7 a. m., the sum to go to the operator, in addition to his salary, as a means of both inducing fewer calls at night and of getting the operator to be more attentive.

The financial exhibit of the New England Telephone and Telegraph Company recently published places the total assets of the company on December 31st last at $29,053,184, as compared with $28,287,823 the preceding year. The item, "plant and franchise" represents $23,430,319 and the real estate is valued at $74,453.

The St. Louis City Hall Commission proposes to establish a branch telephone exchange in the city hall instead of having a special telephone for each office. It is estimated that the change will save the city $1,500 annually. Bids for installing the exchange have been received from both the Bell and the Kinloch companies.

The Kinloch and Bell Telephone companies each have an exchange at the World's Fair. The Bell has 10 trunk lines from the grounds to the city and the Kinloch eight. There are 68 telephones on the Bell exchange and 87 on the Kinloch, all the telephones being located in the Administration Building and on the grounds. Communication between different offices of the Fair is without the use of trunk lines.

The Bell Telephone Company's response to the offer of the City Council of Ottawa, Ont., of a five-year exclusive franchise upon condition of supplying $20 residential telephones, states that it will supply these services for $20, but only in case of four parties using a single wire for four instruments, or $25 for a one-wire service. The company also agrees to pay the city $1,500 a year.

The Board of Control for the city of Toronto, Ont., has decided that a competitive franchise should be granted to a telephone company to do business in the city, the company offering the best terms to receive the contract. The city will demand the right to purchase the system at the expiration of the franchise; also that a percentage of the receipts be paid to the city for street rights.

It is reported that a conference of officers of the Interstate Independent Telephone Association was quietly held in Chicago recently, at which plans for the formation of a telephone supply house were discussed. Leading Chicago manufacturers were not aware of the meeting and do not look with favor upon the plan, asserting that such a move is unnecessary. The plan is said to be to merge two small concerns and use these as a nucleus around which to build a big plant that can supply material to the Independent telephone companies throughout the country.

The state board of telephone assessors of Kansas has decided to assess only such companies as have property interests in more than one county. The attorney-general in a recent decision held that if a local company transacted business over connecting lines extending into other counties it was technically assessable by the state board. The board decided, however, to allow companies having their property confined to the limits of a single county to be assessed by the local assessor. Of the companies reported to the state board 62 will be assessed by the board.

The committee on arrangements for the Democratic convention, which meets in the Coliseum, St. Louis, on July 6th, has perfected plans whereby telephones will connect each state delegation with all the other delegations and with the chairman and clerk. It is expected in this way much turmoil and confusion due to the chairman's failure to hear a motion or to recognize speakers at exciting moments will be avoided. Each newspaper will have a telephone connected with state delegations, the chairman, the clerk and the newspaper office. Long-distance telephones will be in the vestibules.

New Electric Railway for Kansas.

A charter has been granted to the Kansas City and Topeka Railway Company of Topeka, Kan., with capital stock of $2,500,000. John R. Mulvane, J. C. Devlin and Charles S. Gleed of Topeka; James A. Van Osdol of Anderson, Ind.; Henry L. Turner, E. B. Overshiner, A. B. Nettleton, G. A. Wulkup and Arthur Overshiner of Chicago are the directors. Mr. Van Osdol, the president of the company, is the general attorney of the Indiana Union Traction Company. The company is organized expressly for the purpose of building and equipping a standard electric interurban railway between Topeka and Kansas City by way of Lawrence and Olathe. The new road will enter Kansas City over the rails of the Kansas City and Olathe electric railway, now nearing completion. The new road will traverse the counties of Wyandotte, Johnson, Douglass and Shawnee, and its cars will come in from Rosedale over the Metropolitan street-railway tracks to the center of the city. Entrance to the center of Topeka has been arranged for over the tracks of the Topeka railway system. Three engineering parties are now in the field, making final locations between Olathe and Topeka.

ST. LOUIS EXPOSITION NOTES.

It is announced that E. H. Harriman of New York, president of the New York World's Fair Commission, will deliver the address on behalf of the domestic exhibitors at the opening exercises of the World's Fair.

Hugo Reisinger of New York city says that, after careful and exhaustive tests, he has been given the contract by the World's Fair company for his Electra highest-grade carbons to be used for all the arc lights about the grounds and in the buildings.

L. W. Stanton, consulting telephone engineer of Cleveland, Ohio, is supervising the installation of an all-cable telephone plant of between 200 and 300 telephones for the Controller Company of America, on the World's Fair grounds, St. Louis. All the telephones used will be of the measured-service type, which are manufactured by the Controller company. The plant represents the highest type of modern telephony.

The Holophane Glass Company, in conjunction with its western distributor, the V. R. Lansingh Company of Chicago, has a fine booth in the Electricity Building. This exhibit will occupy nearly 2,500 square feet, and represent an expenditure of about $25,000. Many new and novel features will be shown; among those which will attract special attention will be the new system for foot-lights, border-lights for theaters, the seven-color scheme for sign work, and the new system for window lighting.

Space has been awarded at the St. Louis Exposition for the exhibition of the only "wireless" trolley car to be seen on the grounds. The exhibit will be made by the Wireless Railway Company of Philadelphia and cars will be shown in actual operation. An experimental line of this kind has been operated several months on the Chelsea division of the Pennsylvania railroad at Atlantic City, N. J. L. W. Pullen of Camden, N. J., is the inventor of the system, which makes use of small knob contacts, placed at intervals along the track. These are normally "dead." A long powerful bar magnet underneath the car draws up a contact beneath the surface, whereby the knobs are made "alive" while the car is over them. Chief Goldsborough decided to install the car in the court of the Electricity Building, and Director Skiff formally approved this action on March 30th. The car will have a track about 200 feet long, running the length of the east side of the court. For space economy it will be built in the narrow-gauge type. It will be in operation daily.

A large area between the Palace of Forestry, Fish and Game and the Administration Buildings has been set apart for the outdoor transportation exhibit of the German government. It will include a general train-dispatcher's office, an electric switch tower, a mechanical switch tower, a typical German railway station, a blockhouse and 4,200 feet of track. The exhibit will show the practical operation of the German railways under government control in that country. The buildings will all be of typical German architecture, with high-pitched roofs covered with red and green tiles, with medieval oriel windows and ornate outside stairways. Passing through the station building the visitor will find himself within a German railway yard. A confusing intricate network of switches and tracks, all equipped with targets and appliances in use in Germany, stretches before him. Beyond he sees the switch towers from which this network of switches is controlled by means of compressed air and electricity. The pneumatic switch tower is to the south and controls the southern tier of switches. The electric switch tower is to the north and controls the northern tier of switches. In the distance is the blockhouse, from which the train dispatcher directs the movements of the operators in the switch towers. All these buildings may be entered by the visitor and closely inspected. Beyond the train-dispatcher's office there is to be a section of double-track, main-line railway equipment showing the track system in use.

CORRESPONDENCE.

Great Britain.

London, April 1.—Some important and interesting information was given with regard to the government telephone system in the House of Commons a few days ago. The occasion was the proposal by the government to vote $15,000,000 for the purpose of improving the telephone system, which, by the way, was eventually agreed to. The postmaster-general explained that the funds asked for were in no way connected with any contemplated purchase of the undertaking of the National Telephone Company. Negotiations, however, were in progress for the acquisition of the National company's system and he hoped to be able very soon to come to the House with some definite proposal for the absorption of the company by agreement. With regard to the $15,000,000 now asked, this was for the purpose of increasing the trunk lines, the London exchanges and the provincial exchanges. In London the existing plant was capable of serving 40,000 subscribers, although the actual number connected up was only 15,299. The number, however, was rapidly increasing and two new exchanges were about to be established. In London there were now 110,128 miles of wire in 1,094 miles of conduits.

While on the question of telephony, it will not be out of place to mention some increased facilities which have now been afforded between Great Britain and the Continent of Europe. A new list of 20 English towns is now put into communication with Chartres, Orleans, Rouen and about 250 places in the neighborhood of Paris. The new arrangements come into force on April 11th, and the charge for three minutes conversation is $2. Communication can only be effected from postoffice call offices or by subscribers to the postoffice telephone system. The English towns having the benefit of the new facilities are Liverpool, Lowestoft, Manchester, Newport, Norwich, Nottingham, Southampton, Yarmouth, Leicester, Leeds, Ipswich, Hull, Derby, Cardiff, Cambridge, Bristol, Brighton and Bradford.

Messages now appear to be coming over to the London Times from the Far East fairly regularly by means of space telegraphy from the special dispatch boat of that journal to the nearest port, and thence by the ordinary route.

At last the St. Marylebone Borough Council has been put upon the road toward a disentanglement of the troubles in which it has been involved for so many months. It may possibly be remembered that after Parliament ordered the purchase of the undertaking of the Metropolitan Electric Supply Company, a difficulty was encountered, inasmuch as it was discovered that the Borough Council could not borrow the necessary money without special authority. Consequently a bill had to be promoted in Parliament, necessarily a lengthy procedure, and now this bill has received the sanction of a committee of the House of Commons. Of course, it has yet to be approved by the House of Lords, but little trouble is anticipated in that direction. One or two little matters, however, were modified by the House of Commons committee referred to. For instance, the period for the repayment of the loan was reduced from 42 to 38 years, and a clause in the bill which gave the Borough Council authority to lease the undertaking, when acquired, to a working company, was struck out.

The results of the first complete half-year's working with electrical traction upon the Mersey railway are now available. The number of passengers carried has been nearly doubled, and the receipts have increased by a third.

The Fife Electric Power Company has let a contract for another of its generating stations to a British firm for $150,000.

It has been officially announced that arrangements are being made by the Trinity House authorities for fitting up certain of their lightships with space-telegraphic apparatus as an experiment. The matter is being pushed forward and an agreement for the use of patent rights is now being considered.

The tube railway under the River Thames, between North and South Woolwich, has now been definitely abandoned by the promoters.

Mr. Yerkes has been giving evidence before the London Traffic Commission, and very entertaining he has been. He was specially severe on parliamentary committees, whom he stigmatized as invariably possessing insufficient knowledge of the subject they were asked to investigate. He also objected to the present system of cross-examination by counsel in the committee rooms, on the ground that it very frequently caused a witness to appear to say something which he did not mean. He advocated the establishment of a permanent committee, whose duty it should be to collect information by other means and to place it before the parliamentary committees. G.

New York.

New York, April 9.—On Wednesday morning there was an outbreak of fire in the rapid-transit tunnel south of Fulton Street. The flames spread to the cable conduits, with the result that 11,000 telephone and telegraph connections were put out of service. About 6,000 of these were wires belonging to the New York Telephone Company, and as the heat of the conflagration caused the soft-metal joints to fuse almost simultaneously, the operators at the Cortlandt Street exchange were sud-

denly called upon to attend to what appeared to be simultaneous calls from all the numbers on the switchboards. The remainder of the wires affected were mostly of those belonging to the Western Union. By Thursday afternoon most of the connections had been restored, including the long-distance telephone connections with Boston and Buffalo.

There are quite a number of indications that the work of "electrifying" the Long Island railroad will be commenced in the near future, this step having already been decided upon by the Pennsylvania railroad, which some time ago purchased the property of the Long Island railroad. In the first place, the recent financial report of the Pennsylvania railroad was modestly silent as to the disposition of large sums of money which it has borrowed of late, and it seemed likely that by the time the tunnel that is designed to connect the Jersey City terminus with Long Island is completed (in about two years), the Long Island electrification will be an accomplished fact. The work of excavating the tunnel has been actually commenced from the New Jersey end, and the shaft at the Manhattan end has been completed. The section of the tunnel between these points will be 8,000 feet in length.

The New York State Assembly has today passed the bill of the New York Central Railroad Company authorizing the building of a four-track electric railroad between this city and Croton, a distance of about 30 miles. Changes are also sanctioned in the construction of the New York depot.

The Senate earlier in the week passed three bills affecting electrical traction in New York, these being the Elsberg consolidated bill, to introduce means of adjusting financial matters between the traction companies and the civic authorities, and the two bills for increasing the powers of the rapid-transit commissioners.

Senator McCarren has introduced a bill at Albany designed to authorize the creation of a municipal railway commission for New York city, the function of the proposed new body being to construct a municipal elevated line to cross the Brooklyn and Williamsburg bridges, at a total estimated cost of $15,000,000. It is proposed that the money should be raised by a bond issue, and that the maximum fare for a continuous ride shall be three cents. Any ultimate profits on the working of the lines are to be devoted to a reduction of fares.

Lighting Commissioner Oakley is recommending that the open-flame gas lamps in Manhattan and Brooklyn be replaced by incandescent mantles, and he also states that he doubts the wisdom of readvertising for tenders for the electric lighting of the city, on account of the improbability of obtaining any reduction in the prices quoted.

The award of $25,000 offered in 1899 by the Brooklyn Rapid Transit Company for information regarding the originators of the stock raid of that year has been finally awarded by the Supreme Court to George A. Romer and Joseph A. Briton. There were 17 other claimants for the money, whose claims have been set aside by the court.

Space telegraphy plays a part in a new play produced this week at the Broadway Theater. At another local theater also one of the chief hits is a dance in which the performers appear on a darkened stage attired in what appear to be radioactive costumes. D. W. W.

New England.

Boston, April 9.—Plans for the southerly opening and incline of the proposed new tunnel under the retail-business section of Boston have been completed by the rapid-transit commissioners and contract plans are now in preparation in order that bids may be called for and the work proceeded with at the earliest possible moment.

The Bristol County Street Railway Company's property was sold for taxes at Attleboro, on April 6th, to the Federal Trust Company of Boston, which holds a mortgage on the road and purchased it to protect its rights. The line is 16 miles long, from Attleboro and Hebronville to Taunton, and has been in financial difficulty for some time, neglecting to pay its taxes, which reached the sum of $1,600, at which figure the trust company secured it.

The Ridlon Electric Equipment Company, which is to construct and equip the new street-railway line from Lynn to Nahant, Mass., will own about two-thirds of the stock, under the deal which is contemplated between the incorporators and the company, and steps have been taken looking to the reorganization of the railway company's personnel.

The dividend declared by the Suburban Electric Companies, and payable April 15th, is 50 cents a share. This is a reduction of 50 cents from the previously declared quarterly dividends on the preferred stock, due to decreased earnings of the combination.

The National Construction Company of Boston, which has been awarded the contract to build the new trolley-line connections involved in the establishing of the circuit line along the Connecticut River from Hartford to Springfield, will commence work thereon during the coming week, and it is anticipated that the circuit will be in operation by the middle of summer.

John A. Hall and Charles M. Thayer, receivers of the Worcester and Southbridge Street Railway Company, have filed in the Superior Court a report in the matter of claims. The court approved the report and established the claims. Those against the above-named road aggregated $1,013,078.84, and against the Worcester, Rochdale and Charlton Depot Company aggregated $56,675.04.

The Hartford and Springfield Street Railway Company has voted to purchase the franchisie and rights of the Somers and Enfield Street Railway Company for $165,333.33 and proposes to pay with $124,000 in first-mortgage bonds, $9,500 in cash and $31,833.33 in a demand note of the Hartford and Springfield company at five per cent. interest. B.

Dominion of Canada.

Ottawa, Ont., April 9.—The gross earnings of the Toronto Street Railway Company for the seven months ended March 31st last amounted to $1,319,490. Up to the million mark the city of Toronto received eight per cent., and is now getting 10 per cent. When the receipts reach 1½ millions, the percentage will reach 12 per cent., and this point is expected to be attained by the end of April.

A company has been formed to build a line of electric and steam railway from Ottawa and Hull to Buckingham, and thence up the Lievre River, Que. The company is known as the Du Lievre and Ottawa Railway Company. Power is sought to run as far north as to connect with the proposed Grand Trunk Pacific line.

The town of Orillia, Ont., is now practically without light and power, the big concrete dam of the municipal electric plant at Ragged Rapids on the Severn River having given way on the 7th instant. The plant cost $100,000, of which $30,000 was expended on the dam. The repairs to the dam will probably cost upwards of $10,000, and will occupy at least two or three months. The town's old steam-pumping plant will keep up the supply of water and a limited amount of light in the meantime, while the various industries dependent on the municipal electric plant for their light and power will put in temporary steam plants.

The Dominion government has issued incorporation papers to the Great Lakes and Northwest Transportation Company, which is capitalized at $10,000,000. The amount has already been subscribed. In the near future this company will also apply for incorporation from the Manitoba and Ontario governments. The incorporation permits the construction of canals and improvement of navigation between Lake Superior and the Red River to a point to the south of Winnipeg, to construct transportation lines and generally improve the navigation of the lakes and rivers of the Canadian Northwest. The company, however, was formed for the sole purpose of supplying electric power to the city of Winnipeg and surrounding towns and municipalities. The company now has an offer before the City Council of Winnipeg to furnish power for less than half the figure which is now being paid in the city.

The Montreal Terminal railway intends this summer to spread its lines into the northern counties of the Province of Quebec and unite the scattered towns of those districts. A bill is now before Dominion Parliament to grant power to the railway company to extend its system upon the island of Montreal and through the counties of Terrebonne, Montcalm, Joliette, L'Assomption and Bertier. As soon as this bill is passed, the company intends to at once construct a ramifying electric system on the north side of the St. Lawrence River.

The long-standing action of the city of Montreal against the Montreal Street Railway Company has just been decided by the Supreme Court of Canada at Ottawa in favor of the city. This judgment is of immense importance to Montreal, involving as it does percentages on the street railway's earnings for many years, both past and to come. The immediate amount covered by the decision is only about $15,000, but as the judgment will also affect the earnings of the company during the 20 years of its unexpired franchise, it will probably mean a total gain to the city of a round half million dollars. The action was begun by the city owing to the refusal of the company to pay a percentage of its earnings on all its lines, under the agreement by which the company secured its franchise in 1892. W.

Winnipeg, Man., April 9.—J. H. Coburn of Walkerville is applying for a charter to build an electric railway from Windsor, Ont., via Walkerville to Chatham, with power to operate on Sundays.

The Brantford and Erie railway (electric) is applying for an act of incorporation. It proposes to build a line from Brantford, via Waterford and Simcoe, to Port Dover, with a loop line from Waterford, via Delhi and Lynedoch, to Simcoe.

The agreement with Mr. Trethaway of Montreal, providing for the building of an electric-tramway system for Edmonton, N. W. T., and suburbs, as voted on and carried by the taxpayers, has been passed by the Town Council, and is now binding on both parties. Work will begin as soon as the frost is out of the ground.

The Winnipeg, Selkirk and Lake Winnipeg Electric railway will be opened on May 24th (Queen's Birthday). The line is already tied and ironed, and ballasting will begin as soon as the snow is off. Ex-Mayor Arbuthnot of Winnipeg and Mr. F. B. Warren of the same place are interested.

The British Columbia Electric Railway Company and the Vancouver Power Company are offering the public $311,000 of 4½ per cent. joint-mortgage gold bonds to run for 50 years. The British Columbia Railway Company controls the street-railway systems in Victoria, Vancouver and New Westminster; also the lines connecting New Westminster and Vancouver and Esquimalt. In addition, it owns the lighting systems in Victoria and Vancouver. The total bonded debt of the system amounts to $2,044,972, and is followed by $2,287,330 capital stock.

Louis Boyer, solicitor of Montreal, has made an application to the Parliament of Canada for an act to incorporate the Canadian Traction and Power Company, with power to construct a railway from a point in or near the city of Montreal to a point in or near the city of Ottawa, with branch or circuit lines, and to carry on a general business of light, heat and power in connection therewith.

Messrs. Royce and Henderson of Toronto have given notice of an application to the Legislature for power to extend the Toronto Suburban railway from some point in its present system through the city of Hamilton, passing through the counties of Wentworth, Lincoln and Welland to Niagara Falls, N. Y., or to some point on the Niagara River; also to the village of Vaughan, in the township of Vaughan, and to the town of Brampton in the township of Chinouacousy. Power will also be sought to construct branch lines to change the point of commencement of its present Hamilton extension, and for other purposes. H.

Ohio.

Cleveland, April 9.—Dr. LeFever of Morgan County introduced the state franchise bill in the Legislature a few days ago. As outlined editorially in the Western Electrician last week, the bill provides for the appointment of three men by the governor, who shall exercise supreme authority in regard to granting franchises to street and interurban roads, electric-light, gas and heating plants in municipalities. They may fix prices and all conditions, and to that end must take in cost of construction and estimates of the amount of money required to operate and keep the plants in repair. It is asserted that the commission would have power to grant perpetual franchises and that the people of municipalities would not have a word to say in regard to the grants. Nor would there be any possibility of municipal ownership, as the board could not grant a franchise to a city or village in which the ownership is already vested, but it could grant a franchise to some person or corporation to compete with the municipal plant, if one should be established. It is said that the author asked half a dozen members of the Legislature before he found one who would allow his name to appear on the bill.

Thomas L. Childs has been granted a 25-year franchise to build and operate a street railway in Akron, with the provision that a fare of not more than three cents be charged and that he pay for half the lighting of the streets which the road occupies or furnish the lights. Mr. Childs has planned to build a road from Akron to Canton and Massillon, and this franchise gives him an entrance to Akron.

The annual meeting of stockholders of the Cincinnati Gas and Electric Company will be held on May 2d.

William Ford has been in the East for some time looking after the financing of the Ohio and Michigan Traction Company.

Reports are in circulation to the effect that President H. H. Hoffman of the Cincinnati and Columbus Traction Company has purchased the holdings of Henry Burkhold in that company. The par value of Burkhold's stock is about $100,000.

The Bruce bill, providing that electric railways shall be placed in the same category with steam roads for taxation purposes, has passed the Senate and now goes to the House for concurrence.

Notice was filed with the secretary of state Saturday that the capital stock of the Ohio Union Traction Company has been increased from $10,000 to $700,000. Some comment has been caused by this action, because of the talk in the past that the Appleyard syndicate has been planning to unite Cleveland and Toledo and some other Northern Ohio cities with Columbus, Springfield, Dayton and Cincinnati through the system of trolleys under its control in Ohio.

The Cleveland Electric Railway Company intimates that it has nothing further to offer than six tickets for a quarter, with transfer, where cash fare is paid, in return for the concessions the city offered to make. Some of the members of the City Council now say that nothing but seven tickets for a quarter, with at least half of the concessions at first offered, would induce them to vote for an extension of franchise to the company.

The recent increase of the capital stock of the Steubenville and Wheeling Traction Company from $10,000 to $400,000 is supposed to be for the purpose of securing funds for the completion of the line. Considerable grading and other work has already been done on the road. It is said that the persons owning the Wheeling Traction Company are interested in this road. A. A. McCaslin is secretary of the provisional organization.

Senator Ricketts has prepared a bill for the purpose of doing away with perpetual franchises. Mr. Wertz has already prepared a bill of that kind, but for some reason it has not been very well received.

The Bruce bill, giving street-railway companies the right to appropriate private property in municipalities for the purpose of shortening curves, reducing grades or building power houses, has been passed by the House of Representatives.

Operations have been resumed on the Cleveland

and Southwestern Traction Company's lines, the men going back to work with an understanding of the working conditions that are to prevail on the lines. President W. D. Mahon of the Amalgamated association came to Cleveland and told the men they had no right to demand the dismissal of General Manager Nicholl.

W. Kelsey Schoepf of the Cincinnati Traction Company is agitating a new hotel for that city. He says that a $3,000,000 structure should be erected, and he is willing to put $100,000 into a company that will build a good hotel on the government square.

In place of having a president for the Electric Package Company of Cleveland, it has been decided to invest the executive power in a committee of three officers, chosen from the roads over which the company operates. J. O. Wilson of the Cleveland and Southwestern, Charles Currie of the Northern Ohio Traction and Light Company, and C. W. Wasson of the Cleveland, Painesville and Eastern, compose the first committee, and they will serve four, eight and 12 months, respectively. At the expiration of their terms successors will be elected for a year, so that one will go out every four months, always leaving two experienced men on the committee. E. H. Hyaman, present auditor, will also serve as secretary and treasurer.

Conductors and motormen of the Cincinnati, Lawrenceburg and Aurora have demanded an increase from 17½ cents per hour to 24 cents, and have given the management until April 15th to consider the matter.

President Horace Andrews has been in New York the last few days, and, it is said, is continuing negotiations toward the consolidation of the Syracuse Rapid Transit Company and the Utica and Mohawk Valley Railway Company.

The Rugg Electric Company of Cincinnati has been incorporated with a capital stock of $10,000 by J. M. Walker, Joseph K. Rugg, Ethel T. Rugg, M. Y. Cooper and J. F. Kinney.

The Columbus Railway and Light Company has agreed to allow the city to use its poles for carrying the wires of the municipal light plant, at a certain rental, providing it does not make a similar arrangement with any other company, and with the agreement that the company may also use city poles. The Board of Public Service regards this proposition as impossible, and may purchase poles for its own use entirely.

The Marion Electric Light and Power Company has been dissolved.

The Holles bill, giving police powers to conductors of interurban lines, has been passed by the House of Representatives.

Watch-inspection service is being adopted on most of the electric roads in Northern Ohio. Only a few weeks ago the Webb C. Ball Watch Company of Cleveland was appointed inspector on the Cleveland and Southwestern lines and the Pomeroy system, and a few days ago the same company installed the system on the Cleveland, Painesville and Eastern. Local inspectors have been appointed at various points on the lines, and the work is conducted just as it is with steam railways. O. M. C.

Michigan.

Detroit, April 9.—The Northern Electric Manufacturing Company has secured a verdict against the Detroit United Railway for motors which were furnished to the Detroit Construction Company, the concern which built the Detroit, Rochester, Romeo and Lake Orion railway. The amount of the verdict is $11,001.70. The case will be appealed.

Three new cars have been received for the Detroit-Toledo interurban line and will be stored until the line is completed into Detroit. The cars are 60 feet in length, with seating capacity for 58 passengers. They are claimed to be the finest electric cars in the country.

The Indiana railway (electric) is arranging for an extension of the South Bend-Niles line to Buchanan, a distance of six miles. The abandoned Michigan Central roadbed between Niles and Buchanan has been purchased for the use of this extension.

The entire stock and accounts of the Michigan Electric Company of Detroit have been sold by the Union Trust Company to John A. Roebling's Sons Company of Trenton, N. J., for $14,000. The latter firm will place a local electric man in charge of the property until it is satisfactorily disposed of. It is possible that a branch of the New Jersey house may be established in Detroit.

All the electric railways of Western Michigan will combine with the boat lines running into Chicago from ports on the east shore of the lake in a rate war against the Pere Marquette railroad. The electric lines, in conjunction with the boats, will endeavor to take away the fruit shipments, which formerly went all-rail or by rail and boat. This fight is being brought about by the action of the Pere Marquette in withdrawing arrangements for through business with the boats. As the railroad now has a through local line of its own to Chicago, it wishes the entire haul. The new electric line which is being built north from Muskegon to Shelby and Hart will be able to do a fine business as soon as completed as a result of this fight. The road is called the West Michigan Interurban, and is financed by Grand Rapids capital. The line is also to be extended from Muskegon to Grand Rapids.

The Detroit United Railway is equipping its cars with air brakes as fast as it can. All the new double-truck cars are so equipped. The old single-truck cars will receive attention next. The three-cent lines still have to get along with small cars and hand brakes, although they are always crowded.

C. G. W.

Indiana.

Indianapolis, April 11.—The Evansville and Eastern Electric Railway Company has been incorporated for the purpose of building an electric line from Evansville to Rockport by way of Newberry and Yankeetown. The officers are: President, J. C. Harris; vice-president, J. W. Farquay; treasurer, M. S. Sontag; secretary, L. C. Frick; directors, W. I. Rudd, F. W. Reitz and W. L. Sontag. The length of the line will be 32 miles. It will open up a rich country and connect prosperous towns that are now accessible only by roundabout routes.

Arrangement is being made for the adoption of an interchangeable mileage-book system by the nine interurban lines entering Indianapolis. Under the interchangeable plan but one book will be necessary in traveling over the several lines. To the man who does considerable traveling the plan means cheaper fares, for the reduction made as an inducement to buy mileage books is quite pronounced.

The Indiana Central Traction Company has filed a certificate with the secretary of state showing an increase in its capital stock from $50,000 to $200,000.

The attempt of the City Council of Mooresville to extend the city limits to bring the power house of the Indianapolis and Martinsville Rapid Transit Company within the city, so as to procure the taxes, is being resisted by the company. Besides the large car barns, there is machinery in the power house valued at $100,000. The town tax for the company would be considerable in excess of the present county tax. The officials of the company say if the plant is taken into the city it will be dismantled within two years and removed to the junction of White and Eel Rivers, where a tract of land has already been offered the company for the erection of the proposed additional power house for the extension of the company's line into the coal fields. The business men of Mooresville are opposing the council in the belief that the moving of the power house would be a blow to the town.

Albert Barr, an electric lineman with the Ft. Wayne and Southwestern Traction Company, has enlisted in the United States navy as an electrician and has been assigned to the Kearsarge.

Ex-Congressman C. G. Conn has purchased Governor Durbin's interest in the Elkhart Power Company. Mr. Conn is now in control of the entire project, and he proposes to invest $1,000,000 in an electric plant.

The Town Board of Cicero has granted a franchise to John Plain for an electric-light plant.

A test suit has been filed by a farmer in Johnson County against the Indianapolis, Columbus and Southern Traction Company to enforce an agreement regarding stops. The plaintiff sold the company a strip of ground for a right-of-way, and an agreement was recited in the deed that all cars should stop at such point as the plaintiff might designate. Recently the company began making fewer stops, and the suit was begun. F.

Northwestern States.

Minneapolis, April 9.—The Faribault (Minn.) Gas and Electric Company will greatly improve its plant, including the installation of a steam turbine.

The State Electric Street Railway Company has secured a franchise at Clinton, Iowa. The company will spend $150,000 in rebuilding and equipping its line.

A municipal electric-light plant will be built at Alton, Iowa.

The Cass Water, Light and Power Company will treble its lighting capacity at Cass Lake, Minn., and has advertised for bids on material.

The Minneapolis Retailers' Association has won its fight over rates with the General Electric Company and a reduction of 20 per cent. has been made. As a consequence the association will not put in a power plant to generate its own electricity.

The Nevada (Iowa) Electric Company has let the contract for the equipment for its new extension to its power house to the Westinghouse Electric and Manufacturing Company.

The Illinois and Iowa Interurban Company has let the contract for the motors for its new electric railway from Davenport to Clinton, Iowa, to the General Electric Company and for the machinery and equipment for the power house and sub-stations to the Westinghouse company.

The Sioux City (Iowa) Traction Company has installed three new boilers in its power house to furnish power for some of the interurban extensions which will be made shortly.

South Stillwater, Minn., has sold its $15,000 electric-light bonds to the First National Bank of Stillwater at $460 premium.

The Ladysmith (Wis.) Light and Power Company will begin at once the erection of its new power house.

The new council of Duluth, Minn., is in favor of building a municipal lighting plant instead of renewing the present contract with the General Electric Company. R.

Rocky Mountain States.

Salt Lake City, Utah, April 7.—A project is being pushed at Victor, Colo., for the building of an electric-light plant to be owned and controlled by citizens on a co-operative plan. Dissatisfaction over the rate charged by the two electric-light companies operating there has brought this about. A committee was appointed at a mass meeting held recently to report upon the feasibility of the plan.

The prospective construction of an electric road connecting Boise, Emmett and Payette, Idaho, is being vigorously opposed by Emmett citizens. Their opposition is based on the fear that with the completion of the line the branch road at Nampa would fall into disuse and that Emmett merchants would ship practically all their freight by way of Payette.

A certified copy of its articles of incorporation have been filed at Boise, Idaho, by the City Trust, Safe Deposit and Surety Company of Philadelphia, which will handle the bonds of the Boise Traction Company. Attorney W. E. Borah has been appointed Idaho agent for the company.

The Colorado Telephone Company is now occupying its handsome new building in Trinidad, Colo., and underground cables have replaced the overhead wires. The improvements are of the latest design and the changes in the system were made at a cost of about $100,000. G.

Pacific Slope.

San Francisco, April 7.—C. F. Cunningham of the National Electric Company of San Francisco has been in Rio Vista looking over the field there, with the object of installing an electric-light and power plant.

W. E. Hampton, an electrical engineer of this city, has been inspecting the Alamo Electric Power and Milling Company plant in Lower California. This company intends to install a large power plant at Ensenada for operating mining machinery. About $150,000 is to be expended.

The Century Electric Corporation of San Francisco has been incorporated with a capital stock of $250,000. The directors are all well-known electrical men, and include C. M. Wood, F. M. Greenwood, E. F. Weihe, L. D. Hitzeroth and H. S. Tittle.

Rumors are current of a consolidation of the San Jose-Los Gatos Interurban electric railway, the San Jose and Santa Clara electric railway and the San Jose Railroad Company of San Jose, Cal.

The Cow Creek plant of the Northern California Power Company at Kilarc will be completed in about two weeks and 4,000 horsepower added to the company's mains. This plant is already connected with the main system at De La Mar, and it is the intention to construct another line to a point a few miles farther down, so as to be able to give an uninterrupted service. This company has established a supply business, and will handle electrical goods of all kinds, there being no other stores of this kind in Redding.

The Tuolumne Electric Company has been incorporated by R. W. Hussey, C. W. Quilty and others with a capital stock of $40,000. The place of business is at San Jose.

The city trustees of Fullerton, Cal., have advised City Attorney Marks to prepare advertisements offering for sale a franchise privilege for furnishing electricity for light and power purposes.

The government has granted a right-of-way for the construction of the Clark electrical power plant on Upper Salt River and a transmission line to Globe, Troy and Kelvin, Ariz.

E. D. Hibbs, who has just arrived from New Jersey to accept the position of assistant to the general manager of the United Railroads of San Francisco, will at once begin his work relieving G. F. Chapman of a portion of his responsibilities. A.

PERSONAL.

Superintendent George G. Mulhern of the Cleveland Electric Railway Company will be a candidate for sheriff before the next Republican convention in Cuyahoga County, Ohio.

F. D. Phillips, formerly with the Electric Appliance Company of Chicago, is now identified with the Crescent Company of the same city, of which he has recently been elected vice-president.

Martin D. Wood, for a number of years manager of the Western Union Telegraph Company at Kansas City, died on April 5th. The funeral was attended by many out-of-town employes of the Western Union.

Dr. F. W. Gunsaulus, president of the Armour Institute of Technology of Chicago, has accepted the invitation of the Louisiana Purchase Exposition Company to deliver the invocation at the opening ceremonies of the fair on April 30th.

James P. Felton, who for the last 10 years has been located at Schenectady, N. Y., was recently appointed manager of the supply department at the Boston office of the General Electric Company. Mr. Felton is a Lynn man, having been a resident of that city previous to 1894.

Carl Schwartz, formerly of the Berlin Allgemeine Company, has been appointed on the staff of the New York Central railroad engineering department as assistant engineer, and will be connected with the designing and erection of the elec-

trical part of the traction power stations. Mr. Schwartz was at one time chief engineer for the Siemens & Halske company at St. Petersburg, Russia, where he designed and erected a number of important power stations and power-distributing systems.

C. A. Denman has resigned the superintendency of the Richmond (Ind.) Street and Interurban Railway Company and will engage in the telephone business in the South. Mr. Denman is succeeded by Albert Gordon, formerly connected with the Lafayette street-railway system.

Frank J. Stafford, manager for the Buckeye Electric Company in the Pittsburg district, died at his home in Lakewood, a suburb of Cleveland, last week in his 51st year. At one time Mr. Stafford was manager of the Cleveland Electric Light Company, now the Cleveland Electric Illuminating Company. A wife and one son survive.

Oliver D. Colvin, Seattle manager of the American Steel and Wire Company, will become the manager of the Snoqualmie Falls and White River (Wash.) Power Company on May 1st. President Baker will devote himself entirely to the financial end of the business and to questions of policy and promotion, while Mr. Colvin will have direct management of the extensive electric power plant of the company.

ELECTRIC LIGHTING.

Mayor Wilson of Farmington, Mo., is endeavoring to secure an electric-light plant for that city.

Plans are being considered at Homer, La., for the construction of an electric-light plant by the city.

The City Council of Lawrenceburg, Tenn., is negotiating for the establishment of an electric-light plant.

The Princeton Electric Light Company of Caldwell County, Ky., has been incorporated with a capital stock of $20,000.

The city of Cadiz, Ky., has decided on the establishment of an electric-light plant and will let the franchise to the highest bidder.

An electric-light and power plant is to be built this summer at Seward, Alaska. G. W. Dickinson and George Sohns are interested in the project.

Amended articles of incorporation have been filed by the Indianapolis Light and Power Company, by which the company's franchises are enlarged and broadened, allowing it to mine coal, equip other cities with apparatus for electric light and power, and sell any surplus product from its mine.

The Junction City (Kan.) Electric Railway Company will furnish the current to light the quarters, barracks and streets of Fort Riley with electric lamps. The company has built a new and large addition and will add one of the largest and best-equipped plants in the country for the work. It is putting in new machinery, costing about $100,000. The work will be completed by May 15th.

It is reported that the interests behind the merger of the Rochester (N. Y.) Gas and Electric Company and the Rochester Railway Company have also obtained a controlling interest in the Rochester Light and Power Company, formerly the Central Light and Power Company. The third-named company has a perpetual franchise, covering the entire city, and broader in all of the more important provisions than the franchise of the Gas and Electric Company.

ELECTRIC RAILWAYS.

The Jersey Central Traction Company opened its electric railway between Red Bank and Keyport, N. J., recently.

At a special meeting of stockholders of the South Side Elevated company, Chicago, the proposition to increase the capital stock by $7,226,700, making the total issue $17,550,500, was approved without a dissenting vote.

It is stated that the farmers along the valley road between Boulder and Louisville, Colo., will give a 15-foot right-of-way across their farms to the proposed Denver-Boulder electric railway, if it can be induced to adopt that route.

German capitalists propose to build about 90 miles of electric railway, radiating from Cienfuegos, Cuba, with lighting plants for eight towns and a 10,000-horsepower generating plant. Plans for contractors, it is said, will be ready in about three months.

The City Council of Akron, Ohio, has granted to Thomas L. Childe a franchise to operate a street railroad upon certain streets in that city, the rate of fare to be three cents. The road will be part of a line between Canton, Massillon, Akron and Cleveland.

The electric plants in River Forest, Maywood, Melrose Park and Elmhurst, Ill., are to be taken over by the North Shore Electric Company of Evanston. For this purpose the capital stock of the company has been increased from $750,000 to $1,250,000. This makes 16 villages now included in the operation of the North Shore Electric Company. It has the plants from Evanston to Waukegan along the North Shore. The last four to be acquired are near the Desplaines River, and bring the chain of electric lighting plants south along the western limits of Chicago. Samuel Insull is president of the company, and he and his friends have acquired the various properties.

The franchise and good will of the East Lynn (Mass.) Street Railway Company have been taken over by the New York syndicate of Morgan & Phelps. The purchasers will take immediate steps to perfect organization of the company. The capital stock will be fixed at $150,000.

Since the interurban electric railway between Wichita and Hutchinson, Kan., is assured, the Commercial Club of Wichita is now endeavoring to induce the Arkansas Valley Transit Company to extend the line to Wellington, Arkansas City, Winfield and other points southwest of the city.

The Missouri Land and Investment Company, chartered several months ago, will begin at once the construction of the proposed interurban electric railway between Jackson, Miss., and Vicksburg, Tenn. W. Q. Cole of Jackson is secretary of the company and Mr. Paige of Terre Haute, Ind., is the engineer in charge.

At the annual meeting of the stockholders of the Chicago and Milwaukee Electric Railroad Company in Chicago, Vice-president J. W. Manck was succeeded as a director by H. F. Osborne. The other retiring directors were re-elected. The company reported a very prosperous year. Work has commenced on the construction of an addition to the power house at Highwood. The improvements will cost $250,000.

POWER TRANSMISSION.

A bill has passed the Senate granting permission to the Davenport Water Power Company to build a dam and power plant in the Mississippi River near Davenport, Iowa.

J. D. Price is among those interested in the formation of the Wycomic Electric Power Company, which proposes the establishing of a power plant near Salisbury, Md.

The Hercules, Mining, Milling and Power Company has been incorporated with a capital stock of $1,000,000 at Virginia City, Nev. It is the intention of the company to erect power plants and sell power in Alpine, California and Douglas counties, Nev. The incorporators include P. Curtz and M. Mack.

The Ox Bow Power Company will construct its power plant at Ox Bow, on the Missouri River, about 25 miles north of Helena, Mont., if the necessary concessions can be obtained. The Ox Bow is a loop in the river about 12 miles long, and at the neck the distance between the two points of the diverging current is about a quarter of a mile. It is proposed to dam the river and to establish a power plant, after tunnels and canals have been constructed. The company expects to supply Butte, Anaconda, Helena and numerous small cities with electrical power. The cost of the undertaking is estimated at about $750,000.

Preliminary tests have been made by the Columbia River Improvement Company, whose power plant at Electron, Wash., near the headwaters of the Puyallup River, is now nearing completion, and the company expects that the actual delivery of power in Seattle can be made at once. The whole supply generated will be used by the Seattle Electric Company, in conjunction with that already being received from the Snoqualmie Falls company. The tests made were conducted with power transmitted from the Seattle Electric Company's Post Street station. Sixty thousand volts were turned into the transformers in the power station at Electron, under the direction of Superintendent Lukes of the Seattle Electric Company. The machines stood the test satisfactorily.

AUTOMOBILES.

Two-story automobile cars have made their appearance in Washington, D. C., and sightseers are patronizing them liberally. They have a spiral stairway leading to the upper deck from the rear platform, and will hold about 50 people. The cars are designed chiefly for the transient sightseeing business, which is very large in the national capital, but regular lines to run in competition with the street railways are also to be installed.

One of the handsomest garages in America is now in the course of erection in New York for Andrew Carnegie. The house will cost $20,000. It will be of fireproof construction, with a front of white marble and Harvard brick. The large storage room on the lower floor will be entirely of white enamel brick and paved with red acid-proof brick. The charging room will be in the rear and the two stories over the storage room will be occupied by the men who operate and care for the vehicles.

SOCIETIES AND SCHOOLS.

A special meeting of the Pittsfield (Mass.) members of the American Institute of Electrical Engineers was held recently in the office of Dr. F. A. C. Perrine at the Stanley works, and it was decided to organize a local branch of the Institute. There are some 23 members of the Institute in Pittsfield.

The names mentioned in the incorporation of the society for carrying out the plans for the construction of the Union Engineering Building in New York are Charles F. Scott, Albert R. Ledoux, Theodore Dwight, Charles Kirchhoff, Charles Wallace Hunt, Frederick R. Hutton, Schuyler Skaats-Wheeler, Bion J. Arnold and James M. Dodge.

In consideration of the prominence which the engineering department of the University of Illinois has attained, the engineering alumni association of that institution is urging the nomination of an engineer for university trustee on each of the party tickets. Candidates who have the indorsement of the alumni have been agreed upon and will be recommended to the Republican and Democratic conventions. There are nine members on the board, and it is thought that at least one of them should be in direct sympathy with the engineering department.

At a meeting of the executive committee of the International Association of Municipal Electricians, held at Brooklyn, N. Y., on April 2d, the following papers were selected and assigned to be read at the ninth annual convention, to be held at St. Louis, September 13, and 14, 1904: "Street Lighting, Principles Involved and Systems Used," by A. S. Hatch, Detroit, Mich.; "The Limitations of the Telephone for Fire-alarm Purposes," by Adam Bosch, Newark, N. J.; "The Inspection of Theaters from an Electrical Standpoint," by William H. Thompson, Richmond, Va.; "Methods of Testing," by Walter M. Petty, Rutherford, N. J.

PUBLICATIONS.

"Little Gem" rosettes made by Pass & Seymour of Solvay, N. Y., are brought to the notice of the trade through a small booklet illustrating different styles.

A small circular descriptive of electric fans is being sent out by the Sprague Electric Company of New York city. Numerous fans of the wall, desk and ceiling styles are illustrated and described, all of which are neat and compact, and are highly recommended by the maker for efficiency, durability, quiet running, safety and appearance.

The Central Electric Company, Chicago, Ill., announces that it is sending out a handsome little catalogue, illustrating and listing 1904 Diehl direct-current fan motors. This catalogue is an exceedingly attractive little book, and the company especially requests that all dealers who are interested, and who have not received a copy, should write to it for one.

"Some Facts Relating to Wireless Telegraph" are contained in a pamphlet issued by the Thos. E. Clark Wireless Telegraph-telephone Company of Pontiac, Mich. Some of the possibilities of the space-telegraph business are set forth in the pamphlet, together with the history and scope of the Clark company. The principal styles of apparatus manufactured by the company are pictured and described, consisting of long-distance sets, experimental, sets for schools and colleges and railroad signaling sets.

The Simplex Electric Heating Company of Cambridge, Mass., has just issued a complete catalogue of its electric-heating specialties. The catalogue comprises over 80 pages, fully illustrated and listing almost every form of a cooking utensil; also a large variety of other appliances, such as glue pots, soldering irons, curling-iron heaters, heating pads, instrument sterilizers, radiators, foot warmers, laundry and tailors' irons, etc. The catalogue is sent upon request.

The Hunter Fan and Motor Company of Fulton, N. Y., presents to the trade a tasteful booklet, describing the Tuerk alternating-current ceiling fan. These fans are made with both two and four blades and are hung from artistic fixtures, two of the types also acting as electroliers. In the latter the starting switch is at the bottom of the fan and the lights are turned on from the lamp sockets. The electrolier fans are furnished for any alternating-current circuit from 60 to 125 cycles and 50 to 250 volts.

MISCELLANEOUS.

The Chicago and Eastern Illinois and the Big Four railroads will install at once an electric interlocking plant at the crossing of the two roads in Terre Haute, Ind. The machine will be erected at an expenditure of $11,000. The interlocker will be of the Taylor patent and will be operated entirely by electricity which will be made in the plant and used through a storage battery.

The Chicago and Alton Railway Company has put into operation a new signal system, which includes three specific safeguards against accidents—the usual telegraphic train orders, automatic electric block signals and station block signals. The station blocks are formed by a continuous service of telegraph operators, day and night shifts, at each station, providing a system of signals which must corroborate the safety testimony of the automatic signals before a train can proceed.

The sanitary trustees of the Chicago Drainage Canal at their recent meeting again avoided a declaration as to the disposition of the waterpower to be developed at the proposed plant to be erected

below Lockport. President Carter proposed that the power be disposed of at a reasonable rate to cities, villages and towns in the district, but, although the Chicago City Council empowered its finance committee some time ago to negotiate for the purchase of the power for municipal use, the sanitary trustees have repeatedly postponed consideration of the proposition.

Among the public works at Panama which are likely to be opened to contractors, it is stated that there will necessarily have to be extensions made to the electric-light plant. It is old and not equal to the demand. It is contemplated also to start a street-car system, to be operated by electric power from this plant. The government contemplates connecting the capital of Panama with the other parts of the republic by telegraph lines, and the question of roads and public bridges will be considered.

A Baltimore boy while nosing among the ruins of the recent fire, came across what the fire had left of a small Crocker-Wheeler motor. He gathered up the castings and wrote a letter to the manufacturers describing his find and closing thus: "Can I wind the armature so as to use it as a direct-current series-wound dynamo? If so, what size and how much wire must I use on the field magnet and armature? How many coils must I divide the armature into? . . . Thanking you very much for the information you can give me," etc. Such enterprise is commendable.

TRADE NEWS.

Mason Dingley and Edward Detzel have formed the firm of Dingley & Co. at Painesville, Ohio, where they will do a general electric and plumbing business.

The Crescent Company, Chicago, manufacturer and manufacturers' agent for electrical specialties, has removed to 216-222 Omaha Building, where it has ample facilities for its increasing business.

The Allis-Chalmers Company has taken over the Bullman-Wilson Foundry Company of Cincinnati and will lease it to the Bullock Electric Manufacturing Company. The Bullock company is a stockholder of the Bullman-Wilson company.

A shipment of 200,000 feet of various sizes of rubber-covered electric-light wires was reported made on April 6th to Japan by the Indiana Rubber and Insulated Wire Company of Jonesboro, Ind. The company also exports on an average 3,000 pounds of friction tape to Paris, France, every month.

The Swan Manufacturing Company of Hartford, Conn., incorporated with a capital of $5,000, will manufacture and deal in engines, automobiles, machinery, electrical apparatus and supplies. The incorporators are W. J. Swan of Middletown, F. H. Howard of Hartford and J. E. Dowd of Meriden, Conn.

J. P. Hornaday & Co. of No. 1108 Traction Building, Cincinnati, Ohio, have associated with them prominent financial and construction interests, and will in the future make a specialty of financing, constructing and reorganizing street-railway, electric-light, waterworks and steam-railroad properties. They have recently completed the reorganization of the Paducah (Ky.) city railway.

The B.-R. Electric Company of Atlanta, Ga., has been sold by President James G. Rossman to the Georgia Railway and Electric Company. Mr. Rossman will in the future give his entire time to electrical consulting engineering, and will open offices in Atlanta for that purpose. The demands upon him in this line led to the sale of the B.-R. company. Mr. Rossman will have a number of expert electrical men with him.

George Clymer and W. E. Towns have formed a partnership under the name of Clymer & Towns, and will engage in the electrical business, doing wiring and like work, and will open a store and office in Fond du Lac, Wis. Mr. Clymer is at present construction foreman for the Wisconsin Telephone Company. Mr. Towns was formerly in the employment of the Fond du Lac Street Railway and Light Company, but for about two years he has been in Minnesota and the Dakotas.

A number of prominent representatives of well-known electrical manufacturing concerns consisting of Charles L. Jenny, A. A. Thresher, F. B. Duncan, C. E. Searles and Hugh A. Brown recently visited the plant of the Foos Gas Engine Company of Springfield, Ohio, to inspect the gas engine which will be sent by that company to the World's Fair. The engine is of 22 horsepower and is suitable for 200 16-candlepower incandescent lights when belted to a generator of standard make.

The plant of the Standard Vitrified Conduit Company, New York city, which is located at South River, N. J., has been running continuously since it commenced operations in 1902, so great has been the demand for the product of this company. The plant is of unusual size and completeness of equipment, and has a capacity of 40,000,000 feet of conduit annually. Both single and multiple-duct conduit are manufactured and a patent mandrel for laying the former is furnished free to customers. A catalogue of the product may be had on application.

The Crocker-Wheeler Company announces an increase of capital from $1,000,000 to $2,000,000. The company was organized in 1892 by Dr. Schuyler Skaats Wheeler and Professor Francis B. Crocker on a relatively modest basis. It now has 15 branch offices from Boston to San Francisco, and is one of the foremost producers of electrical apparatus. Since the beginning the capitalization has been increased several times, until in 1899 it was made $1,000,000. In view of the rapidly expanding business, the stockholders have now decided to double the amount.

The Westinghouse Electric and Manufacturing Company is introducing a new portable power-factor meter which operates equally as well on leading currents as on lagging currents. There are two sets of coils, one containing a separate series winding for each phase of the circuit and the other a potential winding across one phase of the circuit. The series coils produce a resultant rotating field. Passing through the potential winding is a small iron vane which takes up a position in the rotating field depending on the phase relation of the currents and the voltage impressed on the potential winding. A pointer on a shaft carried by the vane indicates the angle between the current and voltage, the scale reading directly in power factors. The Westinghouse company is reported to have secured the contract for the generating equipment to be installed by the municipalities of Kalk and Muizenberg, Cape Colony, South Africa, for electric-lighting purposes.

The Chipman Electric Purifying Company of New York has appointed Col. W. S. Rogers as manager of its western office, located in Cleveland, Ohio. Colonel Rogers is one of the pioneers in the electrical business, having been with the Brush Electric Company for 15 years before it quit business. He has been watching the work of purifying water by electricity and is convinced that it is far in advance of sand filtration. Being thoroughly satisfied with a great future in this work, Mr. Rogers consented to accept the position offered him as manager of the western department, which includes all the territory west of Pennsylvania. The Chipman process contemplates not only the purification of water under pressure for steam boilers, but has a thoroughly developed system for municipal work, not only clarifying but purifying water for towns and cities. Plans are being drawn up now for a plant to furnish 30,000,000 gallons a day for the city of Montreal, and from the great number of inquiries being made, it will in a short time require a large force to keep up with the work.

BUSINESS.

The Chicago Fuse Wire and Manufacturing Company announces that it has secured a very desirable space in the Electricity Building at St. Louis and will make an attractive display of its various products.

The Kuhlman Electric Company of Elkhart, Ind., is sending out a neat aluminum card, on one side of which is given, "in a nutshell," the weights, area and safe current capacity of the various sizes of insulated wire. A brisk demand for the company's three-phase transformers is reported.

The Gould Storage Battery Company of New York city reports a number of new installations of batteries containing from 60 to 244 cells. These batteries are used for various purposes, such as floating batteries upon railway lines, isolated and residential plants and for telephone exchanges.

The Electric Appliance Company, Chicago, reports that notwithstanding the numerous cheaper grades of lamps now on the market its sales on Packard lamps during the winter just past have far and away exceeded all previous records. This, the comapny says, is no phenomenon, but merely the result of the maintained efficiency of the high-class Packard product.

Charles R. Pratt and Edward Van Winkle, consulting engineers, at 160 Fifth Avenue, New York, announce that they are prepared to examine and determine the value of any patent, and, being consulting engineers as well as patent attorneys, are in a position to advise patentees as to the best methods of obtaining results from their patents.

The Bullock Electric Manufacturing Company of Cincinnati especially recommends its oil-insulated shell-type transformers. These transformers are built with the coils mounted in a vertical position and are either water or self-cooled. Those that are water-cooled range in size from 100 to 2,000 kilowatts, the self-cooled from 37½ to 250 kilowatts. The designs cover transformers up to 80,000 volts. They are described in bulletin No. 1025, just issued by the company.

The Electric Storage Battery Company of Philadelphia states that it is continually adding to its list of Exide battery depots, the list now including 12 cities. These stations instituted for the purpose of the prompt delivery and care of Exide batteries have proved to be of great convenience to the public, and the rapidly increasing demand for Exide batteries has necessitated the opening of new depots at central points. These stations are located in New York city, Philadelphia, Pittsburg, Buffalo, Chicago, Denver, Boston, St. Louis, Rochester, Toledo, Detroit and Columbus.

Roth Brothers & Co., Chicago, builders of the well-known Roth dynamos and motors, have recently issued several new bulletins showing their latest products. This company makes a specialty of small motors and dynamos. The motors range in size from one-eighth horsepower to 20 horsepower and the dynamos from eight lights capacity (16-candlepower) up to 300 lights capacity. The motors are adapted for any power purpose. The company will be pleased to mail to those interested a hanger showing some of the many uses to which Roth motors can be put, as well as other literature on its product. Roth motors are in use not only in the United States but in almost every foreign country. The Roth Brothers' business has grown steadily year after year, and they are today one of the largest makers of small dynamos and motors.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) April 5, 1904.

756,219. Wireless-telegraph Receiving System. Eugéne Ducretet, Paris, France. Application filed August 14, 1903.

An oscillation transformer whose primary and secondary windings consist of flat spirals, superposed one on the other, is provided with means for making electrical connection with various parts of each spiral, whereby the number of effective turns is varied.

756,223. Process of Treating Low-grade Ores and Tailings by Electrolysis. Ernst Fahrig, Philadelphia, Pa. Application filed May 9, 1903.

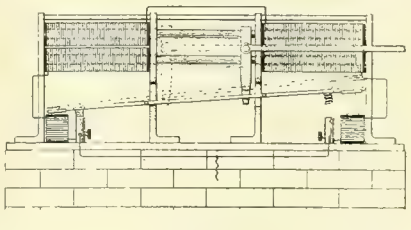
The ore or tailings are first ground and mixed with a suitable quantity of water and a suitable electrolyte so as to form a pulp; the pulp is passed by gravity between a series of pairs of inclined anode and cathode plates arranged tower fashion one below the other. From time to time the precious metal deposited on the cathode plates is removed.

756,242. Electric Heater. Robert Kuhn, Detroit, Mich., assignor to the United Electric Heating Company, Detroit, Mich. Application filed October 7, 1902.

Wrapped about the receptacle for the material to be heated is a heating coil. An outer closed casing surrounds, but is spaced from the coil.

756,275. Electric Signaling Device for Elevators. Fred S. Payne, Boston, Mass. Application filed August 11, 1903.

Several electric switches are operated by a movable brush; signals upon each floor of the building are operated by certain of the switches and indicate at all times the direction in which the elevator car is moving, or will next move, and push buttons are located upon each floor. Magnets electrically connect with the push buttons.



NO. 756,316.—ELECTROMAGNETIC RAILWAY SWITCH.

756,296. Selective Signaling for Poly-station Telephone Circuits. Burdett Stryker, Washington, D. C., assignor to the American Telephone and Telegraph Company. Application filed April 30, 1903.

Conductors of the main circuit contain a normally incomplete or open bridge and an earth branch from one of them. A polarized bell in the bridge is constructed or adjusted to respond to current pulsations of definite sign only, when the bridge is closed, and a relay controls the continuity of the bridge connected in the earth branch.

756,316. Electromagnetic Railway Switch. Rollin A. Baldwin, South Norwalk, Conn., assignor to the Baldwin & Rowland Switch Company. Application filed December 18, 1902. Renewed July 24, 1903.

Two electromagnets throw the switch in opposite directions. An armature is common to both magnets and a tilting bar has a movable pivot located on the armature and electric contacts in circuit with each magnet. The bar is adapted to be closed and opened alternately by the tilting of the bar. (See cut.)

756,328. Recovery of Gold and Silver from Cyanide Solutions. Samuel B. Christy, Berkeley, Cal. Application filed May 20, 1901.

The process of removing gold and silver from dilute cyanide solutions consists in forcing the solution to circulate from a storage tank through a suitable electrochemical cell and back again repeatedly, so that the solution is brought into intimate contact with anodes and cathodes in rapid alternation and at such a speed that fresh gold and silver-bearing solution is brought into intimate contact with the cathodes.

756,331. Spring-jack for Telephone Switchboards. Merritt S. Conner, Chicago, Ill. Application filed January 5, 1903.

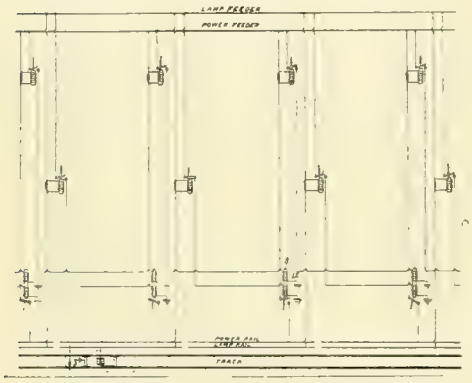
A strip of spring jacks comprises the front supporting strip having plug holes, test thimbles held in the holes and having rearwardly extending tongues, an angular stiffening web carried by and forming a part of each tongue, switch springs with suitable insulating parts supported by the stiffening webs and means for binding the parts together.

756,344. Circuit Breaker. Leonard L. Elden, Boston, Mass., assignor of one-half to Sears B. Condit, Jr., Somerville, Mass. Application filed June 20, 1901.

Make-and-break contacts co-operate with an operating member. Armatures are actuated by coils in each circuit of the circuit-breaker. Tripping mechanism is automatically operated respectively by the respective armatures.

756,408. Call or Alarm Device for Hotels or Other Buildings. Harvey Reed, Minneapolis, Minn., assignor of one-third to William M. Stone, Minneapolis, Minn. Application filed September 4, 1902.

A solenoid is operated by a controlling circuit involving one or more switches, an armature or needle being subject to the solenoid. A number of contact fingers and a contact bar engageable with all of the fingers are under the direct action of the solenoid and armature. Electric bells are located in different rooms, and circuit connections including the bells, whereby all of the bells may be simultaneously thrown into action.



NO. 756,523.—AUTOMATIC POWER CUT-OUT.

756,412. Support for Incandescent Electric Lamps. Adolphe Romain and Jean D'Ayguesvives, Paris, France. Application filed October 10, 1902.

A support for incandescent electric lamps comprises a casing, an upper portion of insulating material, contact plates on the upper portion, screw-threaded rods engaging with the plates and extending through the portion and a lower portion of insulating material.

756,424. Secrecy System for Telephone Switchboards. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed December 14, 1901.

A telephone switch at each station controls the line circuit, a third telephone is adapted to be brought into the circuit to communicate with the telephone at one of the stations and electromagnetic switch mechanism controls the connection of the third telephone with the circuit. Means controlled through the joint agency of the telephone switches at the other stations operate the electromagnetic switch mechanism.

756,436. Telephony. John Trowbridge, Cambridge, Mass. Application filed May 18, 1903.

Electrical undulations are transformed into qualitatively corresponding magnetic undulations within a supplemental magnetic field, producing qualitatively corresponding resultant magnetic-product undulations and producing by means of the product undulations rectilinear mechanical vibrations quantitatively proportionate to the resultant magnetic products and qualitatively corresponding to the original electrical undulations.

756,437. Telephone. John Trowbridge, Cambridge, Mass. Application filed May 18, 1903.

An instrument for repeating electrical undulations consists of a magnetic field, an armature coil in a neutral location in the field, a telephonic transmitter, and connections arranged with relation to the reciprocal effects of the coil and magnetic field to impart mechanical vibrations perpendicularly to the receiving member of the transmitter.

756,445. Rheostat. Henry J. Wiegand, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Application filed June 1, 1903.

A suitable base having a depression formed in the face carries contact plates arranged in the depression and held in position by lugs or projections formed on the plates and entering holes in the base.

756,460. Electric Arc Lamp. André Blondel, Paris, France. Application filed November 10, 1902.

Means for ventilating the interior of the globe are described.

756,502. Mechanism for Removing Ice from Electric Conductors. Benjamin J. Jewett, Brooklyn, N. Y., assignor of one-half to Frederick H. Bartlett, Brooklyn, N. Y. Application filed October 29, 1903.

A frame supports a rotary cutter and a driving wheel. A brush attached to the frame and trailing behind the cutter sweeps up the particles.

756,508. Telephone Attachment. Gabor Königstein, San Francisco, Cal., assignor of one-half to Joseph Silverman, San Francisco, Cal. Application filed September 8, 1903.

A support for the telephone receiver is described.

756,511. Electric Railway. Thomas D. Lovell, Beverly, Mass., assignor of one-half to Joseph F. Flanagan, Boston, Mass. Application filed November 3, 1903.

A sectional conductor supplies current to the cars or trains, normally closed branch conductors supplying current to the sections of the sectional conductor. Two electromagnets are placed in the branch conductors, one adapted when energized to open the circuit of a different branch and the other adapted to lock the circuit open.

756,516. Automatic Electric Cut-out. Guy Milburn, Baltimore, Md. Application filed March 31, 1903.

A normal circuit through the lamp includes two electromagnets, a rocking shunt bar being arranged to be held by one of the magnets in an inoperative position. A shunt circuit is placed around the lamp with means for rocking the bar to establish the shunt circuit when the magnet is de-energized. An oscillating arm is arranged to be actuated by the other magnet and provided with means whereby it will also hold the shunt bar in an inoperative position.

756,523. Automatic Power Cut-out for Electric Railways. Harry F. Pieper, New York, N. Y. Application filed January 5, 1904.

A series of electric power rails and a series of electric lamp rails divides the track into blocks, and devices controlled by the completion of the lamp circuit in one block automatically cut out the power in a preceding block. (See cut.)

756,534. Circuit Controller. Jacob L. Schureman, Jr., Chicago, Ill. Application filed January 11, 1904.

Combined with a switch-controlling magnet are a rheostat connected with an electric circuit, a switch coacting with the rheostat and actuated by the magnet, and a switch-restraining device.

756,541. Electric Switch. Peter Sorensen, Brooklyn, N. Y. Application filed November 23, 1900.

Rotary contact arms have a spring for rotating them. A disk rotates with the arms and is provided with projections arranged in concentric circles. A detent lever carries a pin for engagement with the projections, a catch for holding the pin in engagement, tripping levers for releasing the catch, and a time mechanism for operating the levers.

756,547. Trolley Pole. Edwin A. Wakefield and George W. Morse, Mechanic Falls, Me. Application filed December 18, 1903.

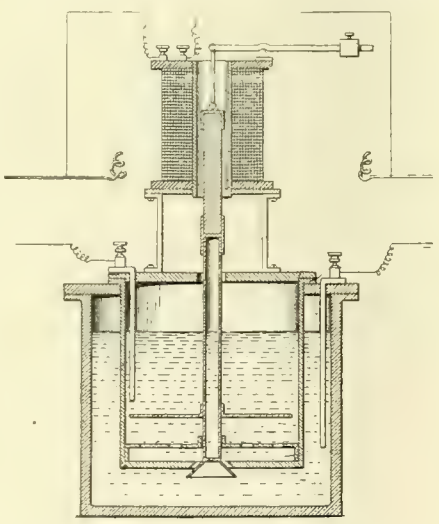
The trolley pole is mounted on a sliding carriage and is held in a raised position by a spring.

756,550. Trolley. Charles M. Wilson, St. Louis, Mo. Application filed February 18, 1904.

The trolley wheel is made with a wide rim, grooves on the rim are directed spirally toward a central groove which normally follows the trolley wire.

756,605. Current Regulator. Emil Dysterud, Monterey, Mexico. Application filed June 9, 1903.

An outer vessel contains a smaller vessel mounted within, provided with an opening. A movable valve closes the opening. Magnetic mechanism actuates the movable valve, electrodes are mounted within the inner and outer vessels respectively, and electric connections are made between the electrodes and the field of the machine to be regulated. (See cut.)



NO. 756,605.—CURRENT REGULATOR.

756,608. Annunciator. Franklin H. Elwell, Chicago, Ill. Application filed July 9, 1902.

A detent which regulates the movement of a pointer over a dial is operated by an electromagnet.

756,627. Insulator. John A. Hanson and Albert F. Lambert, Davenport, Wash. Application filed June 14, 1902.

Two dielectic bodies arranged in halves inclose the wire and are held in place by a staple.

756,665. Apparatus for Testing the Insulation of the Coils of Electromagnets. James Livesey, Fall River, Mass., assignor to himself and Robert Healy, Fall River, Mass. Application filed February 1, 1904.

Apparatus for testing the insulation of magnet coils consists of means for generating electricity, electric buzzer arranged in the circuit with a standard sounding coil, a telephone receiver and means for making electric connection at will with the coil to be tested and with the standard sounding coil.

756,711. Electric Controller for Alternating Currents. Robert P. Rukenbrod, Turtlecreek, Pa. Application filed January 26, 1903.

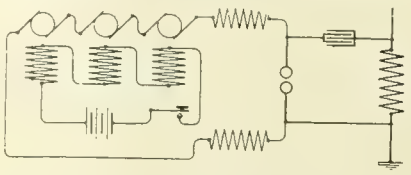
The essential features are resistance terminals and conductors, an arm having contacts for the terminals and conductors, a reversing switch comprising arms and contacts, pivoted ends for some of the arms, the ends being alternately in line with and at right angles to the arms and means engaging the ends for moving the arms.

756,718. Wireless Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to the International Wireless Telegraph Company and Marie V. Gehring, Philadelphia, Pa. Application filed August 9, 1902.

Combined with a receiving circuit is a Wheatstone bridge containing in one arm a conductor adapted to be heated by the received energy, choking coils in the arms of the bridge adjacent to the first-mentioned arm and a recording instrument controlled by the conductor.

756,719. Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to the International Wireless Telegraph Company and Marie V. Gehring, Philadelphia, Pa. Application filed August 19, 1902.

Radiant energy is diverted through one arm of a Wheatstone bridge. The passage of the currents through the other arms of the bridge is impeded. The energy of electric currents is converted into the energy of heat, thereby unbalancing the bridge and controlling a translating device.



NO. 756,720.—WIRELESS SIGNALING SYSTEM.

756,720. Wireless Signaling System. Harry Shoemaker, Philadelphia, Pa., assignor to Marie V. Gehring, Philadelphia, Pa. Application filed June 25, 1903.

In the transmitter of a space-telegraph system is a direct-current circuit, a number of banks of storage batteries, means for charging the banks of batteries in parallel and for discharging them in series, means for impressing the energy of the batteries upon a freely oscillating circuit and means for impressing the energy of the freely oscillating circuit upon a radiating circuit. (See cut.)

756,724. Insulator. John C. Snodgrass, Steubenville, Ohio. Application filed August 26, 1903.

The electric conductor is clamped between two insulating blocks, one of which is V-shaped and fits into a V-shaped recess in the other, holding the wire in place.

756,757. Third-rail Electric-railway System. John D. Wilkens, Chicago, Ill. Application filed July 24, 1903.

Supporting standards carry an overhanging casing or conduit made of two companion sections or halves. The conductor is suspended within the casing.

756,777. Electrical Annunciator. Albert Carliss, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed October 5, 1901.

A swinging armature is mounted in front of the annunciator magnet, which releases a disk when the magnet is energized, displaying a signal.

756,782. Circuit Breaker. Leonard L. Elden, Dorchester, Mass., assignor of one-half to Sears B. Condit, Jr., Somerville, Mass. Original application filed June 20, 1901. Divided and this application filed December 10, 1903.

Solenoids are operated by each circuit, the solenoids cooperating with an actuator to throw the circuit-breaker.

756,793. Electrical Induction Machine. Hans Lippelt, New York, N. Y. Application filed January 13, 1903.

Collectors are disposed relative to the ends of the armature conductors and constructed to vary the length and place of contact of one or more of the conductors.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on April 12, 1904:

360,842. Electrical Apparatus for Separating Metallic Articles from Paper Pulp. Charles H. Atkins, Boston, Mass.

360,844. Telegraphy. William T. Barnard, Baltimore, Md.

360,862. System of Indicating Time by Electric Lights. Patrick B. Delany, New York, N. Y.

360,903. Electric Pendulum Clock. Albert L. Parcelle, New York, N. Y.

360,925. Electric-wire Coupling. Renaldo Solano, Brooklyn, N. Y.

360,934. Cabinet Battery. Henry E. Waite, New York, N. Y.

360,968. Automatic Fire Telegraph. Morris Martin, Malden, Mass.

360,980. Hydrometer Alarm. Thomas P. Whittier, East Saginaw, Mich.

360,986. Telegraphy. Alfred M. A. Beale, New York, N. Y.

360,987. Telegraphy. Alfred M. A. Beale, New York, N. Y.

360,988. Multiple Telegraph System. Alfred M. A. Beale, New York, N. Y.

360,994. Automatic Printing Telegraph. Charles G. Burke, Richmond Hill, N. Y.

360,995. Automatic Printing Telegraph. Charles G. Burke, Richmond Hill, N. Y.

361,020. Telegraph Alarm Signal. Samuel E. Mosher, Chillicothe, Ohio.

361,047. Telephone Transmitter. William Burnley, North East, Pa.

361,089. Automatic Electric Car Brake. Charles Selden, St. Louis, Mo.

361,090. Electric Railroad Brake. Charles Selden, Baltimore, Md.

361,115. Electric Motor. William Baxter, Jr., Baltimore County, Maryland.

361,116. Horizontal Governor for Electric Motors. William Baxter, Jr., Baltimore County, Maryland.

361,117. Journal Bearing for Electric Motors. William Baxter, Jr., Baltimore County, Maryland.

361,124. Telephoning. James W. Bonta, Philadelphia, Pa.

361,217. System of Supporting and Repairing Electric Conducting Wires, etc. Henry Flad, St. Louis, Mo.

361,249. Process of and Apparatus for Tanning by Electricity. Eugene Worms and Jean Bale, Paris, France.

WESTERN ELECTRICIAN

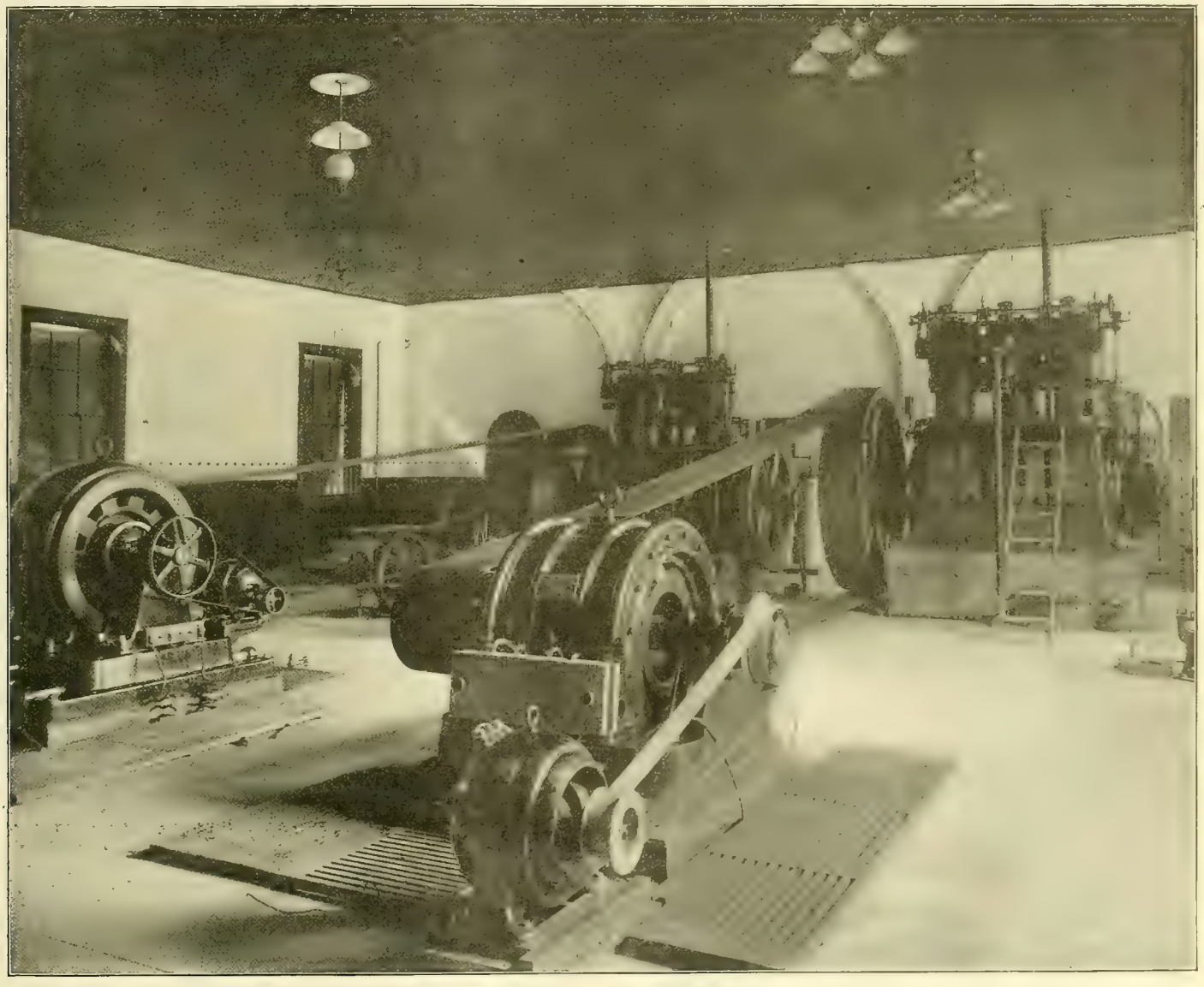
EVERY SATURDAY

Vol. XXXIV. CHICAGO, APRIL 23, 1904 No. 17

A New Canadian Gas and Electric Station.

By Frank C. Perkins.

During the last decade a large number of gas companies, both in the United States and in Europe, have found it advantageous to install an electric plant in connection with the gas works, supplying both gas and electricity to their customers. The first electric central station to be installed by a gas company in Canada, using the fuel manufactured at the gas works for driving internal-combustion engines which operate electrical generators, has been recently constructed by the Chatham (Ont.) Gas Company. As the city of Chatham is operating the municipal electric-lighting plant, supplying its own current for its street lights, the gas company supplies current only for commercial arc and incandescent lamps. The company's gas is very largely used for cooking and heating.



A NEW CANADIAN GAS AND ELECTRIC STATION.

The electric-light plant installed by the Chatham Gas Company is shown in the accompanying illustration, the principal source of power being the gas engines, which are started by compressed air. An auxiliary steam plant, however, has been provided which includes a 50-horsepower high-speed steam engine driving a dynamo of 30 kilowatts capacity and an automatic high-speed engine of 150-horsepower capacity, operating an 80-kilowatt dynamo of the Royal Electric type. The steam engines are of the Armington & Sims make.

The gas-engine electric plant includes two Westinghouse vertical three-cylinder gas engines, one having a capacity of 85 horsepower and the other 125 horsepower. They operate by belt transmission two single-phase alternating-current generators. The small gas engine operates a 60-kilowatt single-phase alternator of the Warren type at a speed of 800 revolutions per minute, while the larger engine drives an 80-kilowatt single-phase alternator of the S. K. C. type at a speed of 1,000 revolutions per minute.

The station is constructed of pressed brick and stone, the engine room measuring 60 feet long and 45 feet wide. The switchboard includes four panels with the usual ammeters, voltmeters and ground detectors. These measuring instruments are of the Whitney type, while the lightning arresters were supplied by the Westinghouse company.

Another gas engine and generator will shortly be installed to increase the capacity of the station. The engines are connected with air tanks, which are supplied with a pressure of 200 pounds per square inch by an air pump of the Westinghouse type, the engines operating as air motors in starting. Both the electric plant and the gas works have been so arranged that the capacities may be doubled or tripled when found necessary.

By turning the coal into a gaseous fuel and using it in internal-combustion engines it is said that no greater amount of material is used than by steam engines for an equal supply of power, while the by-products of the coal greatly reduce the cost. The tar, ammonia liquor and coke obtained as by-products after the gas is produced give a large return, and by using the gas engine one engineer can operate a large number of units, while no fireman is found necessary. It is also stated that the maintenance is very much less, as there are no repairs for boilers, condensers, pumps and other auxiliary machinery. It is also possible to start one or more engines at any time by the compressed-air outfit, and no energy is being consumed when not in operation as with a boiler plant where steam is kept up continually.

At this gas works and electric station the buildings were so constructed that the coal enters at one end of the station, passing from the coal sheds to the retort room, where it is made into gas and conducted to the gas tanks which supply the engines with the gaseous fuel, and by means of these engines and alternators the power is transformed into electric current for use on the arc and incandescent-lighting circuits. It will thus be noted that the change from coal into gas and electric power is arranged in one continuous operation with the greatest economy.

A steam coal-hoisting plant has been provided at the wharves on the river bank at the rear. The coal is conveyed into the sheds of the retort house from the boats, being freighted by water from Toledo, Cleveland, and other ports along the lakes. A 10-horsepower gas engine is utilized for elevating the coal a height of seven feet to the charging floor of the retort house. There are four benches of six retorts each located in this building, having a capacity for from 90,000 cubic feet to 220,000 cubic feet a day, the former figure representing the present output of the gas works. The gas engine

in the coal-hoisting plant was constructed at Galt by the Coldie & McCulloch Company.

The condensing, scrubbing, tar and ammonia-extracting apparatus has a capacity of about one-third of a million cubic feet a day. Next to the condensing plant is a room containing the station meter and governor for the works as well as the purifier. A small gas holder has also been installed for the gas engines, its capacity being about 15,000 cubic feet. It is so arranged that it may be supplied with gas from the large gas holder or direct from the retorts. There is reason to believe that before long a large number of gas companies in Canada as well as in the United States will install electric central stations operated by internal-combustion engines, as this means of generating electric power is seemingly very economical.

Electrolytic Processes Discussed by Faraday Society.

At the meeting of the Faraday Society in London on March 21st, Dr. O. J. Steinhart presided. A paper by Dr. F. M. Perkin and Mr. W. C. Prebble on the "Electrolytic Analysis of Gold" was read in abstract by Dr. Perkin. The object of the researches described was to arrive at an electrolytic method of estimating gold which should be perfectly accurate and yet far more rapid than the ordinary double-cyanide method, which the authors, differing from Classen, consider inordinately long, even in hot solutions. Solutions of sodium, thiosulphate, cyanide, sodium sulphide, potassium thiocyanate and ammonium thiocyanate were all tried, and the results compared. The first-named was useless; of the others—which are all accurate—the thiocyanates gave the best results and the ammonium salt was better than the potassium. With currents of 0.2 ampere per square decimeter, the deposition of 0.05 to 0.08 gramme of gold was complete in five or six hours. With a current of 0.4 to 0.5 ampere, 1½ to two hours sufficed. The presence of a little persulphate considerably reduced the voltage required. Experiments were also made to determine the best method of removing the deposited gold. Chlorine or bromine water were satisfactory, but slow; aqua regia was risky; the authors recommended a two per cent. solution of potassium cyanide containing a little hydrogen peroxide or a persulphate. One or two minutes then sufficed to remove the gold. An improved form of basin electrode for working with hot solutions was described. A lamp-wick syphon, from a small reservoir, supplies water to compensate for evaporation.

Charles R. Darling then read a paper on "Thin-film Electrolysis, and a Proposed Application to Printing," which was illustrated by experiments. While investigating a process for letter-press printing by electrolysis, without the use of ink—an extension of Bain's well-known telegraphic printing—the author found that the final results of electrolysis, when the electrolyte forms only a thin film, often differ materially from those observed in an ordinary cell. In these experiments a carbon or metal plate (it was immaterial which) formed the anode; on this was placed an impression pad, consisting of some sheets of moist blotting-paper. Upon this was the trial sheet, carrying the electrolyte film, and on this the cathode type or coin.

Voltages from six to 200 were employed. To obtain a clear image of the type, a certain minimum strength of solution is requisite. The first experiments were made with saline solutions; silver nitrate gave a clear, permanent black image of the type, but the paper, of course, darkens on exposure; copper sulphate and nitrate yielded images that faded after a time; the same unexpected result occurred with lead, mercury salts and bismuth. The best images were obtained with manganese salts. These, consisting, as they did of the oxides or hydrates, were quite permanent; all purely metallic deposits excepting silver disappeared after a time. In the case of non-saline solutions, the paper, which might consist of asbestos or pure Swedish filter-paper soaked in distilled water, acquired the properties of an exposed photographic plate, and, on treating with a silver salt and developer, a perfect image of the cathode was obtained, even after a long interval. The latent images are not due to hydrogen peroxide nor to metallic compounds, as they occur with carbon electrodes; but they reside in the surface of the paper in contact with or toward the cathode. The author ascribes them to a class of phenomena that have been investigated by Bose and termed "the response of inert matter to electrical stimuli," and thinks they are probably the result of some state of strain set up in the film by the current.

As regards the fading of the metallic images, this may be simply due to recombination, although that explanation is not entirely satisfactory.

Those taking part in the ensuing discussion were Dr. H. Borns, N. J. Bluman, Mr. Fontana, Dr. Perkin, Mr. Bawtree, Mr. Prideaux and Dr. Steinhart.

ALTERNATING-CURRRENT WORKING.

By W. B. Gump, Asso. Mem. A. I. E. E.

Part II.

Inductance and Capacity.

The general character of inductance and of capacity was described in the previous article. With regard to inductance it was stated that its effect upon a circuit is a lagging current; with regard to capacity, a leading current. It is the purpose of this article to take up these matters in detail, analyzing an electric circuit by introducing, first, inductance, and portraying its phase relation to the exciting

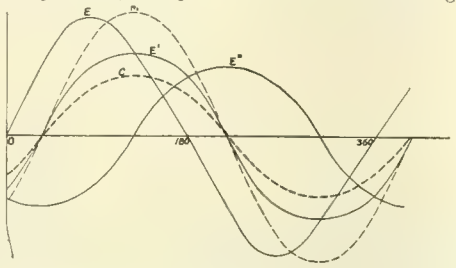


FIG. 9. CURVES OF PHASE RELATION BETWEEN CURRENT AND ELECTROMOTIVE FORCE.

current and impressed electromotive force; then taking up the effects of capacity in a similar manner.

It is well to call attention to the fact that inductance and reactance have been considered as synonomous. It will probably be better in all of the following descriptions and analyses to regard "inductance" as the "coefficient of self-induction" L and to regard the expression $2\pi f L$ as "reactance." This is generally found to be the case in text books on alternating currents.

In order to understand the phase relations of current and electromotive force, let us observe Fig. 9. Let the current (C) rise and fall according to the sine law, and since an electromotive force is necessary to overcome the resistance and send this current through the circuit, draw an electromotive-force curve (E′) in phase with it as shown. This curve may rise above or may fall below the current curve, since E′ at any instant equals $C \times R$; R remains constant, and any suitable length representing it may be used to construct the curve. When R is less than unity the electromotive-force curve will of course fall below the curve (C). Next, construct the curve (M), which represents the magnetism. This may be any convenient size. The diagram does not take into account the effects of hysteresis, as it will be considered later.

It is now necessary to turn our attention to the electromotive-force curve of self-induction (E″).

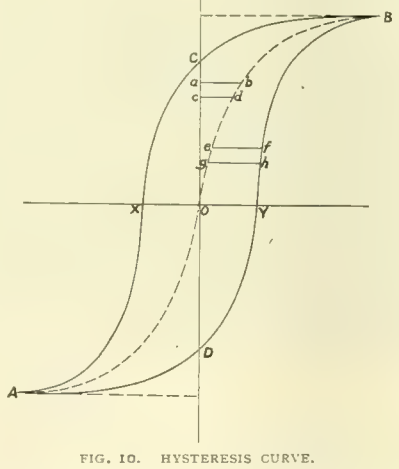


FIG. 10. HYSTERESIS CURVE.

If the fact be kept in mind that an electromotive force of self-induction is one which tends to keep the current, and hence the magnetic field, constant, it is apparent that while the current is increasing in value the electromotive force of self-induction will be decreasing, and while the current is decreasing the inductive electromotive force will be increasing. At the point of maximum value of (C)—and of (M)—it will be seen that the counter electromotive force is zero. The field at that instant is not changing, therefore no counter electromotive force will be manifest. Thus the counter electromotive force is found to be 90° ahead of the current. The current which causes the magnetic field to be established can only flow in consequence of an electromotive force being impressed upon the circuit, which will overcome both the ohmic resistance and the counter electromotive force of self-induction. An electromotive force causing this current to flow is called the "impressed electromotive force." It is evident from a study of the diagram that the "impressed electromotive force" is the resultant electromotive force arising from the electromotive force overcoming resistance (E′), and an electromotive force which opposes the counter electromotive force (E″). Therefore, if to the ordinates of a curve exactly opposite and similar to (E″) we add the ordinates of (E′) the electromotive-force curve (E) will result, which is the impressed electromotive force overcoming the impedance of the circuit.

Hysteresis.

The phenomenon relating to the reversal of magnetism in iron, known as "hysteresis," should be understood by those who have had the elements of electrical engineering, and time and space could not give place to it here were it not for the facts that its influence on the wave form of the exciting current and its magnitude as a loss warrant its consideration.

Let Fig. 10 represent a curve of hysteresis. Instead of considering the co-ordinates (X Y) and (C D) as representing the "coercive force" and "retentivity," respectively, let us assume that (C D)

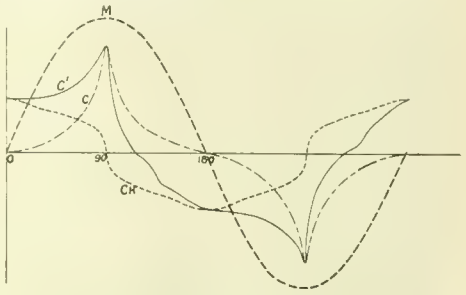


FIG. 11. CURVE (C′) OF TRUE EXCITING CURRENT.

denotes time and (X Y) exciting current. If the dotted line (A O B) be drawn as shown it will represent the relation of current to magnetism when there is no hysteresis (an impossible condition with iron in the circuit) and the abscissæ (a b) and (c d) will be the magnitude of exciting current to produce a certain flux change corresponding to that particular instant of time. Since the exciting current is not directly proportional to the magnetism, it will be seen that plotting the ordinate lines (a b) and (c d) on the base line of Fig. 11 will give a theoretical curve (C), the exciting current with no hysteresis. It will be noticed that this curve is pointed at the peak, and the curve of magnetism (M) is a sine wave. The reason for this peak is due to the fact that the magnetism does not vary at the same rate as the current producing it. Now, if we plot a curve, using the ordinate lines (abscissæ) (e f) and (g h), on the other side of the dotted line (O B), Fig. 10, we shall obtain a curve (C H), Fig. 11, which represents the portion of current absorbed in overcoming hysteresis. In other words, it is the "hysteresis component" of the exciting current. If, now a curve is plotted, as the resultant of (C) and (C H), the curve (C′) is obtained, which is the curve of the true exciting current caused to flow in the circuit. Thus hysteresis is seen to have a marked effect upon the current curve. The eddy-current component is still another feature, but cannot be considered here. The characteristics thus far shown point out plainly that a great deal of study is required in order to arrive at definite conclusions relating to alternating-current phenomena.

The phase relations of electromotive force and current in an alternating-current circuit are generally represented by vector diagrams. To most students it is necessary at the beginning to plot the curves in order to fix them well in mind, and it has been with this idea in view that the current and electromotive-force curves have all been plotted. It is obvious that while vector diagrams can account for phase relations they cannot of course take into account wave form. When the latter is required therefor graphical methods are resorted to.

Let us now consider a problem involving a circuit containing reactance and analyze it vectorially. Observing Fig. 12, let the horizontal line (O B) represent the electromotive force in phase with the

NOTE.—By the breaking of a type the denominator of the second member of the second equation in the last paragraph of the second column of the first installment of Mr. Gump's series, on page 286, was omitted. This denominator is π.

current, overcoming the ohmic resistance. Since the electromotive force of self-induction (counter electromotive force) is 90° ahead of the resistance electromotive force, we may at once draw (O Y). The impressed electromotive force is evidently the resultant of the reactance electromotive force and the resistance electromotive force. Keeping in mind the fact that reactance electromotive force is that

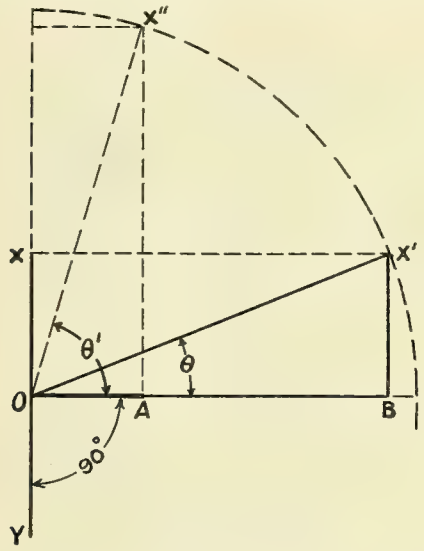


FIG. 12. VECTOR DIAGRAM OF CIRCUIT CONTAINING REACTANCE.

which overcomes the counter electromotive force due to reactance (O Y), it is evident that the impressed electromotive force must be the resultant of (OX) and (O B). (O X') is therefore the impressed electromotive force. The angle of lag is denoted by θ.

Suppose in the same circuit which the diagram represents we should increase the reactance and

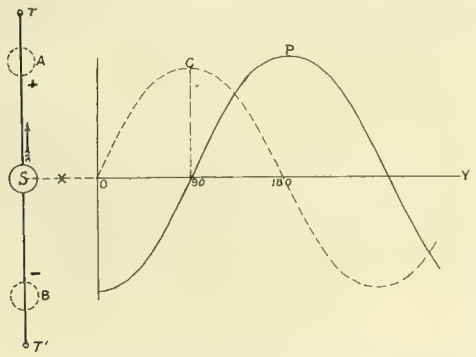


FIG. 13 DIAGRAM ILLUSTRATING THEORY OF CAPACITY.

at the same time decrease the ohmic resistance; then the electromotive force necessary to send a current through this ohmic resistance would evidently be small. Let (O A) represent this resistance electromotive force. Then (A X'') will correspond to the reactance electromotive force and (O X'') will be the resultant or impressed electromotive force. It is readily seen that the angle of lag θ' can closely approach 90° but it can never exceed it, because the ohmic resistance, however small, is always appreciable. Let us demonstrate the case by assigning

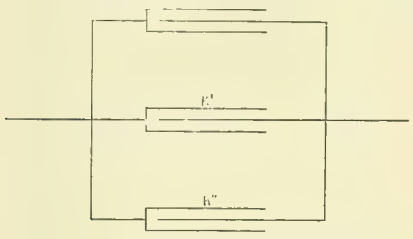


FIG. 14. CONDENSERS IN PARALLEL.

definite values to the vector diagram. Suppose it is desired to ascertain the current flowing and the angle θ' when the resistance, impressed electromotive force and reactance are known. The reactance has been shown to be equal to $2\pi f L$. The coefficient L may be found from the formula $L = \frac{F \times t}{10^8 \times C}$ when the current is known. In this formula F is flux, t is number of turns of wire, and C is current. Since it is the current we are seeking, the equation $C = \frac{E}{J}$, which corresponds to Ohm's law, must be used.

In this equation

$$J = \sqrt{R^2 + (2\pi f L)^2}$$

Therefore

$$C = \frac{E}{\sqrt{R^2 + (2\pi f L)^2}}$$

Let

(O X'') (Imp. e. m. f.) = 10,000 volts.
(O A) (Resistance) = 10 ohms.
L (Inductance) = 25 henrys.
f (Frequency) = 60 cycles.

Then

$$C = \frac{10{,}000}{\sqrt{100 + (2\pi f \times 25)^2}} = \frac{10{,}000}{\sqrt{88{,}740}} = 162 \text{ amp}$$

$$\text{Now, } \tan \theta' = \frac{2\pi f L}{R} = \frac{942}{10} = 94.2$$

This current is practically "wattless," for tan. 94.2 is 89.5° = angle of lag θ'', being nearly a right angle.

By multiplying the current by the resistance (10 ohms) the ohmic drop (O A) is obtained, and in this way a proportional scale which is convenient in size may be had. As the current is quite large in the example given, it is obvious that it would have to be multiplied by a very small constant. Problems of this kind are best handled by laying them off on a drawing board, using as large a scale as is practicable. The figure drawn is not intended to be accurate, and must not be considered as made to scale. As it was intended only to show the relative phase relations, no pains were taken to make it to scale.

It will be seen that the true power utilized in the circuit we have considered is proportional to the horizontal line (OA), since the useful power is E × C, where E represents volts overcoming ohmic resistance, and C represents current in amperes. The line (OX''), on the other hand, represents the apparent watts, or is the impressed electromotive force times the current which overcomes both resistance and reactance. Since the latter quantity is wattless, the power is expressed by the formula.

$P = E \times C$ [corresponding to (OB)]
or $P = E' \times C \times \cos. \theta$.

Where P = power.
E = electromotive force overcoming resistance.
C = current in phase with E.
E' = impressed electromotive force, overcoming impedance.

Cos. θ' (or θ) is called the "power factor."

In the above problem Cos. $\theta' = \frac{10}{10{,}000} = .001$.

Capacity.

Capacity has been defined as the ratio of the quantity of charge to the difference of potential produced in a condenser. Let us now consider the nature of capacity, and its phase relation to the current. It will be well to apply a mechanical analogy which is as nearly like the electrical characteristics as can be devised. Looking at Fig. 13, suppose (S) to be a sphere (metallic or otherwise), which is suspended at the middle of a rubber cord fastened at each end (T) and (T'), thus holding the cord taut, and in a vertical position. Assume the portion above the

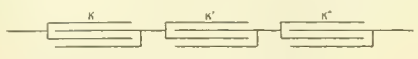


FIG. 15. CONDENSERS IN SERIES.

(X) axis to be positive, and that below to be negative, as indicated. Now let a stress be applied to the sphere in the direction indicated by the arrow, moving the sphere upward from its zero position. This force will correspond to the current which charges a condenser. Suppose this stress to reach its maximum at the point shown at (A). This will correspond to a complete charge, and at this point the energy stored up is ready to be expended. In the figure, curve (C) corresponds to the charging current, and (P) the condenser discharge pressure. When the current is at maximum the condenser pressure is at zero, and when the current is at zero the condenser is charged to its maximum. Thus the current will be seen to lead the condenser electromotive force by 90°. While there is no mechanical movement which will strictly portray these phase relations, the one given, it is thought, will go a long way in helping to fix the fundamental principle in mind.

It is evident from the foregoing that the effect of capacity is to create a negative angle of lag, and is directly opposed to that of reactance. The effect due to capacity is called "capacity reactance" or "condensance" and is expressed by the fraction $\frac{1}{2\pi f C}$; where C is the capacity of the condenser in farads. Nearly all circuits traversed by alternating currents have some capacity, due to the fact that the insulation material on the alternator and line conductors forms a dielectric which alternately receives and gives forth charges of electricity. The following equation will give the impedance involving angles of both lag and lead between current and electromotive force.

$$J = \sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi f C}\right)^2}$$

Therefore

$$C = \frac{E}{\sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi f C}\right)^2}}$$

where C is current and E' is impressed electromotive force.

The capacity of a condenser can be determined from the formula

$$C = \frac{.000225 \text{ A} \times \text{N} \times \text{K}}{\text{t}}$$

when C = capacity in microfarads.
N = number of sheets of dielectric material.
T = thickness of dielectric in mils.
A = area in square inches of dielectric between two plates.
K = specific inductive capacity of dielectric.

Values of K.
- for glass, 3 to 7.
- for paraffin, 2 to 2.3.
- for shellac, 2.75.
- for mica, 6.6.

When C is expressed in farads, the formula obviously becomes

$$C = \frac{225 \text{ A. N. K}}{\text{t}}$$

The capacity of a combination of condensers depends upon the way in which they are connected. When they are connected in parallel, the capacity is the sum of the several capacities. Thus, in Fig. 14,

$$C = K + K' + K''$$

when C = capacity in microfarads of the combination. Arranged as in Fig. 15, the reciprocal of the combined capacity becomes the sum of the reciprocals of the individual capacities. Or

$$C = \frac{K \times K' \times K''}{K'K'' + KK'' + KK'}$$

The last expression may not be readily understood from inspection. The following algebraic proof, however, will render it clear:

Let E be the difference of potential of the charge on condenser (K) (Fig. 15), E' the potential difference on (K') and E'' the potential difference on (K'') and Q the charge on each. Then

$$E = \frac{Q}{K};\ E' = \frac{Q}{K'};\ E'' = \frac{Q}{K''};\ \text{also } P = \frac{Q}{C}$$

when P = potential difference of combination and C = capacity of combination, Q being induced in each condenser. Therefore,

$$\frac{Q}{C} = \frac{Q}{K} + \frac{Q}{K'} + \frac{Q}{K''}$$

from which

$$C = \frac{K.K'.K''}{K'K'' + KK'' + KK'}$$

Observation of the last expression shows that it is the reverse of the expression for electrical resistance.

Power in Alternating-current Circuits.

It has been pointed out that the power in an alternating-current circuit is the product of the effective electromotive force by the effective current, times the cosine of the angle of lag. It is evident, then, that a circuit involving any appreciable amount of reactance (which is generally the case), will give a power curve which is not entirely above the zero axis. In order to have a clear conception of this, a curve (Fig. 16) has been drawn in which the angle θ

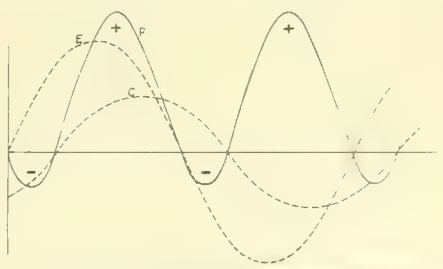


FIG. 16. POWER CURVE OF INDUCTIVE CIRCUIT.

is about 50°. Since the power at any instant supplied to the circuit is the product of the instantaneous electromotive force by the instantaneous current, the curve (P) shows that power is both given to and received from the line periodically. In the case of a transformer having an open-circuited secondary, the current is "wattless," since no work is done by it.

A study of the curve will show that as the angle of lag decreases, the negative lobe decreases; that is, a greater percentage of power supplied is utilized. A similar curve may be drawn for capacity reactance

(Fig. 17), in which the angle is leading instead of lagging. The effect of increasing this angle is to decrease the positive lobe and increase the negative lobe. Increasing this angle to 180° would mean that all of the work done is negative and is returned to

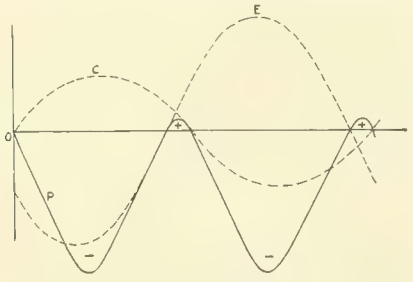


FIG. 17. POWER CURVE OF CIRCUIT CONTAINING CAPACITY.

the generator operating it as a motor. This condition is impossible in practice, since it cannot be kept continuous without the expenditure of work from the alternator.

[*To be continued.*]

Prof. Trowbridge's Magnetic Telephone Repeater.

Professor John Trowbridge of Harvard University is the inventor of a unique telephone repeater, which is illustrated herewith. By the aid of a supplemental magnetic field the inventor amplifies the nearly-exhausted undulations in a telephone line and sends them on with renewed energy, at the same time preserving unimpaired, he says, the modulations in the wave form which produce articulate sounds in the receiver.

Fig. 1 is a plan view, partly diagrammatic and conventional, of a telephonic repeating instrument or relay embodying the invention. Upon a suitable base are mounted a pair of horseshoe magnets (M) (M). These may be permanent magnets or electromagnets. In the latter case they should be energized by a continuous and steady current, as from a primary or storage battery. Likewise mounted on the base is a telephone transmitter (T), which is here shown as a "solid-back" carbon-button transmitter. Firmly and rigidly mounted on the impulse-receiving member of the transmitter there is an armature (A), which is preferably composed of soft-iron rods or short wires. At the ends of the armature are secured transverse pole pieces (a a), likewise of soft iron. The magnets are arranged with their north and south poles mutually opposite each other, or, in other words, the north poles of the magnets are diagonally opposite, as also are the south poles. The resulting-induced polarity of the armature pole pieces is as shown by the letters (n) (s). Adjusting screws enable the operator to adjust the magnet poles as close as desired to the armature pole pieces.

The mode of mounting the magnets in polar opposition, as shown, establishes a field which may be described as quadrilateral and symmetrical or balanced, and the armature is normally in a state of equilibrium, the balanced forces of the magnetic field exerting no stress upon the impulse-receiving member of the transmitter. This condition is regarded as important, because the transmitter, whatever be its specific character, is thus maintained in precisely the same delicately responsive state that characterizes a transmitter which is prepared in the usual and proper way for the reception of sound-waves. It has been found by careful experiment that with an armature in an unbalanced magnetic field connected directly to a transmitter—say to a diaphragm—the constant pull of the magnetic field causes a distortion of the impulse-receiving member of the diaphragm, and consequently produces disturbing effects, which obscure the proper articulation of the instrument.

The incoming telephone line (L) will be supposed to be at such a distance from the transmitting devices at its remote end that the electrical undulations are feeble, so that reproduction of audible speech thereby in the usual manner is impracticable. In circuit with the line is wound an armature coil (1') on the armature (A), preferably bunching the coil in two parts near the ends of the armature, leaving the middle portion bare of coil, and thus obtaining practically all the electromagnetic effect of the coils (1'), while saving weight.

The transmitter is wired in the usual manner, having a battery of proper strength in its immediate circuit. In this circuit is also located the primary of an induction coil (I), the secondary of which is in the outgoing or relay line (R).

When the incoming line is quiet and no electrical undulations are passing on it, the relay instrument is in equilibrium; but when electrical undulations are set up in this line the polarity of the armature is varied in exact correspondence and consonance with the electrical undulations in the line, and an undulating or vibrating magnetic field is generated in the supplemental field of the magnets. The resulting effect is the product of the armature-coil effects and the supplemental-field effects, and the magnetic, and consequently the mechanical, results are enhanced and amplified. Within quite generous limits the strength of the supplemental magnetic field may be raised and the consequent product effects increased. Moreover, by means of the polar relationship of the field and armature coil all torsional moments are in equilibrium, and the resultant mechanical vibrations are in a straight line and are exerted in this straight line perpendicularly to the impulse-receiving member of the transmitter and perpendicularly to the planes of contact between the resistance-varying members of the transmitter. The same rectilinear transmission of mechanical effects and perpendicular impact may readily be secured, whatever be the structural character of the

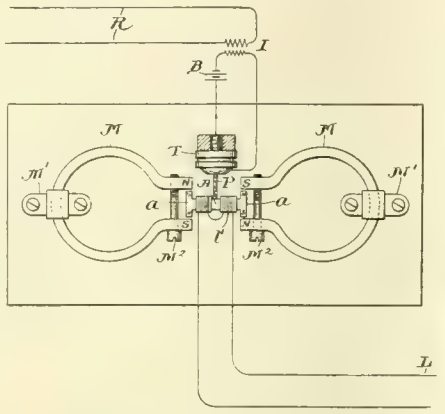


FIG. 1 TROWBRIDGE TELEPHONE REPEATER.—REPEATING MECHANISM.

transmitter. By preserving these conditions the relay or repeating instrument sends to the outgoing or relay line (R) undulations precisely corresponding to the incoming undulations of the line (L), which excite the armature coil (1') and bring into action the vibration-amplifying forces of the supplemental field of the magnets. Thus the transmitter is impressed with undulating impulses which are essentially the same in articulate character as the sound-waves which excited the sending instrument at the remote end of the line (L), and consequently transmits to the line (R) unimpaired articulate quality undulations essential to the production of intelligible articulate speech, which may then be made manifest by a proper telephonic receiver at the remote end of the line (R).

In Fig. 2 there is illustrated by a diagram an arrangement for obtaining reciprocal relay effects between two distant stations. At one station is located the usual transmitter, with battery and the primary of the induction coil in its circuit. The line, including the secondary of the induction coil, and the receiver, leads to the relay station. At this relay station two instruments similar to that shown in Fig. 1 are set up, one instrument in adjustment to receive and repeat impulses from the first transmitter and the other instrument to receive and repeat impulses from the transmitter which is at the other end of the line.

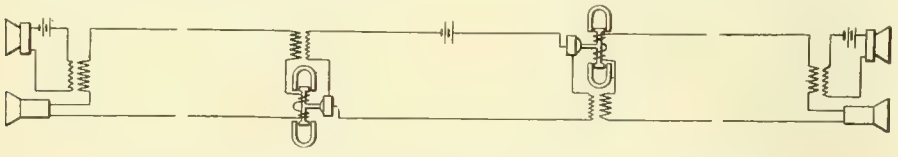


FIG. 2. TROWBRIDGE TELEPHONE REPEATER.—CONNECTION OF REPEATER TO LINE.

Speech vibrations stimulate current undulations in the primary coil of the first transmitter and generate corresponding undulations in the line. These electrical undulations are converted into magnetic undulations at the first armature coil and these again are supplemented by reciprocal magnetic effects of the field of the magnets. These magnetic undulations are reconverted into electrical undulations precisely corresponding to the original speech vibrations at the transmitter, and these undulations set up corresponding undulations in the circuit, which are in the usual manner finally reconverted into sound-waves at the receiver at the other end of the line.

Duty on Carbons Adjusted.

The United States Circuit Court of Appeals has rendered a decision whereby the duty on nearly all carbons imported into this country for lighting purposes will be reduced. R. F. Downing & Co., importers, contended that a quantity of carbons assessed 90 cents a hundred by the collector of the port should have been assessed at 35 per cent. ad valorem as carbons not specifically provided for, they not being prepared for lighting purposes. The Board of United States General Appraisers affirmed the position of the collector and the case went to the Circuit Court, where Judge Wheeler reversed the previous rulings. The Circuit Court of Appeals sustained Judge Wheeler.

Expeditious Cable Repairing in New York Subway.

One not familiar with the methods by which repairs to telephone systems are made can hardly realize how these repairs are made so quickly. A freakish fire in the subway at Fulton Street, New York city recently shows how remarkable are the recuperative powers of a well-managed telephone system and gives also a typical example of what the fire departments have to contend with.

The Scientific American gives an account of the fire and the methods of repairing the damage.

The subway at the point where the fire occurred is being excavated by what is known as the "covered-excavation" process, that is, the street paving is replaced by heavy planks which are supported on columns, and excavation is carried on underneath this planking. The iron pipes which cover the telephone and telegraph wires are carried along the top of this tunnel ceiling. The wires, it will be understood, are wrapped into cables and covered with a soft lead sheathing. A brick and concrete manhole which was formerly located at Fulton Street had to be torn away to permit building of the subway, and the cables, which at this point were not protected by iron pipes, were supported on a wooden platform hung from the beams of the ceiling (see Fig. 1), and were for some mysterious reason wrapped with burlap. The fire was caused by some telephone-repair men who, while driving out the moisture from some of the wires by pouring heated paraffin over them, incidentally set fire to the

FIG. 1 EXPEDITIOUS CABLE REPAIRING.—POSITION OF CABLES BEFORE FIRE.

paraffin. A dense smoke was emitted by the fire which drove the men out of the subway. The blaze quickly communicated to the burlap covering, and developed sufficient heat to melt the lead sheathing of the cables and attack the insulation of the wires within.

The fire was quickly extinguished by the firemen, who arrived promptly on the scene; but the havoc wrought in the mean time was tremendous. Fig. 2 shows what an intricate tangle the telegraph and telephone companies had to unravel. Over 5,000 telephone wires, 1,400 telegraph wires, a large number of private wires, and some of the fire-alarm wires were broken, bent, twisted, snarled and fused together in a seemingly inextricable mass. Thousands of circuits were broken or short-circuited. The New York Telephone Company suffered the worst damage. At the Cortlandt Street exchange, every signal on the switchboard flashed forth at once, creating the wildest confusion. The station was obliged to suspend business, thus seriously inconveniencing a large part of the lower New York business and financial district.

Repairs were begun immediately, and 34 hours after the fire the tangle had been all cleared and the circuits restored to their normal condition—a wonderful achievement when the difficulties of the situation are considered. The iron tubing had to be cut away at each side of the damaged section in order to expose uninjured lengths of the cable on which the repairmen could operate. Each wire of the cable had to be sorted out and its number ascertained from the central exchange before the wires could be spliced together. This was done in the following manner: A wire of a certain number was grounded at the central. At the break a telegraph relay and battery were provided. One of the relay terminals was grounded and by connecting different wires to the other terminal one was finally reached which completed the circuit through the relay, as indicated by a "click" of the sounder. That wire was then secured in an index board in a slot labeled with the number of the wire, as telephoned from the central station. This operation was greatly expedited by connecting a large number of wires at a time with the relay and then, if a click was heard

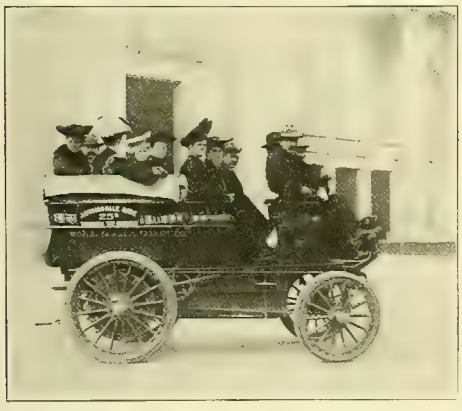
indicating that the sought-for wire was to be found in that bunch of wires, they would be separated into two groups. The group that next produced a click would then be further divided, until it was narrowed down to the desired wire. Owing to the large number of cables which had thus to be operated on, and the limited amount of space available for the repairmen, it was decided to splice together the wires of certain of the cables without attempting to sort them out and then breaking the cables in the vaults at the central to sort out and connect the proper wires with

FIG. 2. EXPEDITIOUS CABLE REPAIRING.—TANGLE OF WIRES AFTER FIRE.

each other. This, of course, necessitated more splicing of wires, but it resulted in a considerable saving of time, owing to the fact that the cables could all be operated upon simultaneously. It is estimated that 25,000 splicings were made. The repairs were necessarily temporary, because in their haste to bring the system back to its normal state the telephone company made connections without running the cables through the iron tubing.

Electric Omnibus Service at the Exposition.

Among the various means of transportation within the grounds of the Louisiana Purchase Exposition the electric omnibus service promises one of the most popular means of seeing the exposition. A company has been operating electric vehicles seating from 12 to 20 persons for some time, but as the time for



ELECTRIC BUS AT ST. LOUIS EXPOSITION.

opening the fair approaches it has added to its equipment and expects to operate 75 vehicles during the fair. This number will include 18 hansoms and broughams.

The accompanying illustration shows one of the older vehicles, accommodating 12 persons, on a regular trip through the grounds. Some of the vehicles recently put into service, however, are much larger. Large tally-hos seating 40 persons will make regular runs from the heart of the city, whence, after stopping at the more important hotels, they terest. The company has two generating plants, one will proceed to the grounds. The fare of $1 includes admission to the grounds, and the passenger, without changing cars at the gate, is taken over the regular route within the grounds, which affords a view of all the important buildings and main points of in- downtown and the other just outside the main entrance to the grounds. The latter plant is of 150-horsepower capacity, with three gas-driven units. Each vehicle is provided with two batteries, each sufficient for a 25-mile run, it is said.

Flood Damage in Indiana and Ohio.

Electric-light and power plants and interurban railways in the Middle West have suffered considerably from high water this spring, particular damage being done in Ohio and Indiana. It will be remembered that last year, a little later in the season, the floods along the western tributaries of the Mississippi wrought destruction not only to electrical plants but to property in general. Especially in Kansas City was the situation severe. The manufacturing district was flooded, bridges were carried away, electrical and other machinery was damaged, and nearly the entire wiring system of the district for telegraph, telephone, light and power purposes had to be rebuilt.

To record the full extent of this spring's damage would require much space. A few instances may be cited.

The accompanying picture is a reproduction of a photograph of the Harrison electric-light and waterworks plant at Harrison, Ohio, as it appeared at the time of the recent high water. Owing to the giving way of the Big Four railroad embankment on the west fork of the White Water River, three miles above Harrison, on March 26th, the entire region between that point and the town, including the grounds of the Harrison light and water plant, was flooded. The water rose so rapidly that the two employes at the plant, Joseph Binder and Holt Walker, had to be taken out in skiffs. As there was an abundance of water in the standpipe, there was no interruption to the supply for fire protection, and, within 24 hours the lighting plant had resumed operation, as the dynamos occupy elevated positions that placed them almost beyond the reach of the water. The loss to the proprietor, Mr. James A. Graft, was but nominal, as about the only expense incurred was for the removal of the accumulated mud and debris.

WATERWORKS AND ELECTRIC PLANT AT HARRISON, OHIO, DURING FLOOD.

Many other plants, however, have not been so fortunate as regards financial loss. In some instances machinery has been practically ruined. The inconvenience and financial loss to interurban electric railways have likewise been considerable in some localities, where fills have been washed away and traffic completely suspended.

Central-station and street-railway men in parts of Indiana feel that the destructive floods in the White and Wabash River Valleys have demonstrated the inadequacy of interurban fills and bridges, and teach a valuable lesson concerning the locating of power houses on low ground in the vicinity of the rivers. The waters reached the highest mark since 1875, effectually proving that grades must be raised in many localities and that heavy fills will, of necessity, have to give way to steel trestlework. Power houses at Indianapolis, Anderson, Wabash, Mooresville, Philadelphia and elsewhere on the interurban lines were flooded, putting out the fires and putting the systems out of service. The Union Traction Company lost a new four-span steel bridge over the Wabash River near Logansport, and considerable interurban property was destroyed and damaged. It is said the flood has cast a damper on the construction of the interurban line between Logansport and Lafayette, along the old towpath route, by the Murdock syndicate, because the route for at least half the distance was submerged from four to 10 feet. This company recently filed a mortgage to cover the issue of bonds, but the flood may have a disastrous effect upon the entire enterprise.

The waters at this time have subsided. An estimate of the losses sustained is impossible, but it is sure to be large. The damage in Marion County, Ind., to all kinds of property, is estimated at $2,000,000. The destruction to property has not been without some loss of life, as fatalities are reported from many quarters. A sad story comes from Portland, Ind., where Charles Bailey, superintendent of the City Electric Light and Waterworks Company, after rescuing 70 people when the flood was at its height, was picked up unconscious at the waterworks plant. He is now said to be in a critical condition.

Papers for International Electrical Congress.

Section A of the International Electrical Congress on "Theory," of which Professor E. L. Nichols is chairman and Professor H. T. Barnes secretary, promises to present many subjects of interest judging by the list of papers so far promised. Following is a list of papers promised to date:

Foreign.—"Metallic Conduction," by Professor Paul Drude; "Electrical Standards," by Professor W. Jaeger; "Ions," by Sir Oliver Lodge, F. R. S.; "Magneto-striction," by Professor H. Nagaoka; "The Theory of Ionization, by Collision," by Professor J. S. Townsend, F. R. S.; "Secondary Standards of Light," by Mr. J. Voille; "Condensation Neuclei," by Mr. C. T. R. Wilson, F. R. S.; "Magneto-optics," by Professor P. Zeemann; Professor J. J. Thomson, F. R. S. (subject to be announced).

American.—"The Mechanical Equivalent of Heat as Measured by Electrical Means," by Professor H. T. Barnes; "Atmospheric Neuclei," by Dr. Carl Barus; "The State of Our Knowledge Regarding the Earth's Magnetism," by Dr. Louis A. Bauer; "Magneto-optics," by Professor D. B. Brace; "The Absolute Value of the Electromotive Force of the Clark and Weston Cells," by Professor H. S. Carhart and G. W. Patterson, Jr., Ph. D.; "The Electric Arc," by Professor C. D. Child; "Coherer Action," by Dr. K. E. Guthe; "Electrical Discharges in Gases," by Professor E. P. Lewis; "Electrostriction," by Professor L. T. More; "The Unobtained Wave-lengths Between the Longest Thermal and the Shortest Electric Waves Yet Measured," by Professor E. Fox Nichols; "Standards of Light," by Professor E. L. Nichols; "Magnetic Effect of Moving Charges," by Harold Pender, Ph. D.; "Electrical Theory," by Dr. M. I. Pupin; "Alternating-current Measurements," by Dr. Edward B. Rosa; "Radioactive Change," by Professor E. Rutherford; "Radioactivity of the Atmosphere," by Professor J. C. McLennan; "Electrical Discharge in Gases," by Professor J. Trowbridge; "Electrical Theory," by Professor A. G. Webster.

A meeting of the Congress committee of organization is scheduled for April 23d in New York. All Congress officers have been invited to attend. The meeting will be at 95 Liberty Street, New York, and by kind permission of the American Institute of Electrical Engineers at its offices.

The Floating Static Electricity of Pikes Peak.

One of those "important-if-true" items so often found in the columns of American newspapers is published by the Salida (Colo.) Record. Here it is:

"How to harness the static electricity floating about the summit of Pikes Peak and to divert the now wasted energy to the operation of the cog road up the mountain, is the problem upon which engineers are now at work. From recent experiments, it is believed that the electricity can be transferred to the base of the peak and there stored in such quantities that the road can do away with steam power. If this problem is solved successfully and the change made, one of the greatest electrical engineering feats in history will have been accomplished, and Colorado will be its birthplace."

The last sentence, it may be remarked, fairly bristles with truth.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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DATES AHEAD.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

ONE of the most interesting announcements at the recent convention of the American Electrochemical Society in Washington was that of Professor Charles F. Burgess of the University of Wisconsin to the effect that he has so far developed a process for the making of electrolytic iron that the product can now be had in sufficient quantities to make it commercially available. This is an important development and shows the direct benefit of scientific research to industrial advancement. The use of electrolytic iron is now limited to the facing of dies and electrotypes, but as the metal is very hard, due to the occluded hydrogen, it has apparently a valuable field of application, if commercially available. To produce chemically pure iron the hydrogen is freed by heat. Professor Burgess made the interesting statement that not a pound of pure iron had ever been produced commercially except by his process, which he considers, and no doubt with good reason, of much importance. The iron is produced at the rate of 2.2 pounds per kilowatt-hour, or at a cost of half a cent a pound. The purity of this product is 99.9 per cent., hydrogen constituting the only impurity. The iron has many of the properties of the best Swedish and can be readily welded but cannot be rolled satisfactorily. In the discussion Carl Hering pointed out the difficulties of the process, owing to large size of the tanks and the great quantity of electrolytic solution required. However, these objections would not be insuperable, it would appear, if the method figures out as worth while in industrial application.

MUCH truth is contained in the reports of the members of the Moseley educational commission, which have just been printed in book form. This commission, it will be remembered, was sent from the United Kingdom to the United States to compare methods of education, particularly technical education, in the two countries. Being broad-minded men, the commissioners find much to praise and some things to censure. A majority of the commissioners are impressed by the superiority of American methods of training boys for business, although some are nowise convinced by these methods. There is a virtual consensus of opinion that willingness to learn characterizes pupils in the United States, while the teachers seem to be universally possessed with a desire to help pupils in every way possible.

Prof. W. E. Ayrton makes the following instructive comparison: "The American student usually is not as scholarly nor as well read as the English student of the same age, but he has his knowledge in better form to apply. The British system turns out a man full of knowledge of principles, while the American product is a business man with scientific training. The characteristics of each nation have their advantages. To America we look for that rapid, bold and successful application of science to industry which brought about the commercial invasion of the world, while to Europe we look for these scientific imaginings and creations which apparently are so unimportant today, but which tomorrow may revolutionize old industries or give birth to new ones." Professor Blair of the Irish department of technical instruction writes that the best ability in the United States is not to be found in the professions and in politics, as in Great Britain, but in industries and commerce.

These deductions are correctly drawn, so far as any generalization can be accurate. We have evolved methods of education which seemed to be best adapted to the nation's needs. These methods may be only partially advantageous when applied to other countries, and indeed may be considerably modified as life in this country is developed and broadened after the more pressing material problems have been solved.

SPACE TELEGRAPHY has been in existence for seven years at least, and it seems strange that, without previous warning, the Russian government should suddenly conclude that correspondents using the wireless system at the seat of war are spies and announce that their dispatch boats are liable to seizure as prizes of war. The official notice was communicated to the State Department at Washington on April 15th and reads as follows: "In a case in which neutral steamers having on board correspondents who might communicate war news to the enemy by means of perfected apparatus not being yet foreseen by existing conventions would be arrested near the coast of Kuantong or in the zone of operations of the Russian fleet the correspondents will be looked on as spies and the steamers furnished with wireless telegraphy seized as prizes of war."

So far as is known the only installation of space telegraphy for the purpose of newspaper correspondence in the present war is that on the London Times' steamer Haimun. The special correspondent of that paper for some time has been cruising in the Yellow Sea, communicating from a British ship with British territory at Wei-Hai-Wei by means of instruments of which the ownership is British and the patent American. It is the De Forest apparatus that is used, as shown in the account published in the Western Electrician last week; and it is no wonder that both the company owning the patents and the London Times have vigorously protested against the arbitrary order of the Russian government. So far as the American company is concerned, the State Department has taken the protest under consideration, but following the almost unbroken practice it probably will decline to take any action on a hypothetical case. If an American citizen is arrested by the Russian officials the State Department will lay down a line of policy to meet this novel departure in international law. It is realized that newspaper correspondents using space telegraphy from the neighborhood of naval operations might unwittingly give information of great value to the enemy, whose vessels being also equipped with space-telegraph instruments might readily take up messages sent to a shore station. But of course there is nothing to prevent the Russians from sending out wireless messages of their own, if they are enterprising enough, which, being intercepted by the Japanese, would lead the latter to false conclusions. There is no witchcraft about space telegraphy, and in singling it out for such severe and special penalties the Russians appear to exceed the bounds of reason. However, the Russians may have some particular cause of complaint which does not yet appear, and the future development of the onslaught on wireless enterprise will be awaited with interest.

PERHAPS it is not too much to hope that the present Congress, or some Congress, will do justice to the military telegraphers of the Civil War. The bill to provide for the taking into the regular army and the granting of pensions to the telegraph operators who stood so faithfully by their service in the war of the rebellion has been favorably reported by one of the pension committees. Previous to the Civil War the use of the telegraph upon the battlefield had never been accomplished in the United States. There was at that time a mystery about the art of telegraphy that surrounded it with a peculiar charm. The men who controlled the telegraph keys manipulated an agency under the conditions of the war powerful for good or evil. Great care was necessary in the selection of the men for that service, not alone because they were familiar with this new art but it was also necessary to choose men in whom special confidence could be reposed. Their posts were at places of extreme danger; their duties were almost continuous, and were unrelieved by the excitement and relaxation which at some time or other always attends ordinary camp life. They were also required to swear to a special oath of allegiance to the government. The entire work of railways and telegraphs was under the control of Colonel Thomas A. Scott, with Captain Anson Stager as general manager of the government telegraph lines. By the end of 1861 857 miles of telegraph line had been put in active operation. By 1863 2,124½ miles had been completed, of which 1,266 were abandoned, leaving at the end of 1863 858½ miles in active operation; this was accomplished at a cost of $74,173.42. This referred only to the Department of the Ohio, Cumberland and Tennessee. The total length of lines in operation at the end of the fiscal year of 1863 was 5,326. The report for the year 1864 shows that the estimated number of mesages sent over the military telegraph lines was 1,800,000. The total number of miles in operation that year was 6,661 land wires and 553½ submarine. In all 15,389 miles were constructed during the entire time of the war. The number of men who performed this work is yearly growing less, and it is hoped that the pending measure will be carried to a successful issue.

A Contribution to the Study of the Electric Arc.[1]

By William S. Weedon.

Arcs may be roughly classified into
1. Crater arcs.
2. Flame arcs.

To the former class belong the plain carbon arc and arcs between certain conductors of the second class, such as zirconium oxide (Rasch arc). To the latter class belong the so-called flame carbon arcs (e. g., Bremer arc), which are drawn from carbons containing certain metallic salts; we also have in this class the arcs from most metals. In the first class the light obtained is derived principally from the two spots or craters, while in the second the arc stream itself furnishes the greater part of the light—generally all. This second class offers by far more interesting study, since we are able to follow the changes in the character of the light as we alter our conditions.

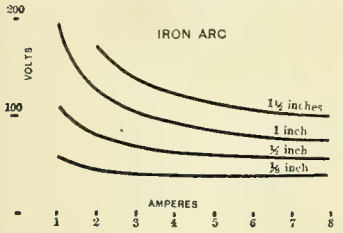

Fig. 1.

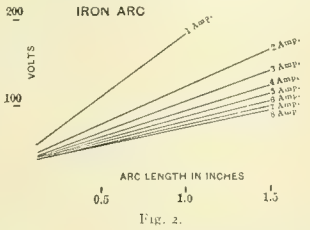

Fig. 2.

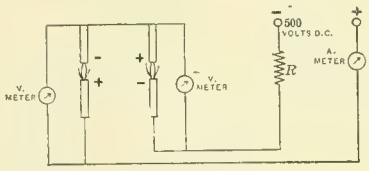

Fig. 3.

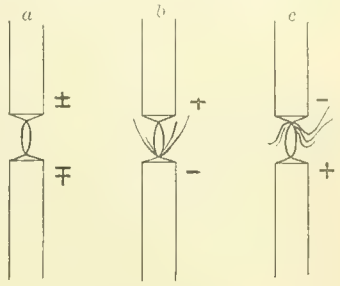

Fig. 4.

Only direct current arcs are considered in this paper, the source of current being a 500-volt generator, and in some cases the Edison three-wire circuit for 125 and 250 volts.

The relation between voltage, current and arc length are fairly well known, but for the sake of illustration, I have given two sets of curves for the iron arc (Figs. 1 and 2), and in general form these cruves apply to both classes of arcs. The measurements are across the arc terminals.

One of the most important problems in connection with the arc is with reference to the amount of material which is transported during the running of the arc. In the air, for most materials, this is quite large. The rate of waste of carbon is diminished by running "enclosed," or in an atmosphere of carbon monoxide. The question is, how much material is necessarily transported at given current density, voltage and arc length? Is there any law for arcs corresponding to Faraday's law for solution?

First of all, it is evident that the heat conductivity of the electrode is an important consideration, as it is plain to one who is at all familiar with the arc that there is much more material voltalized by heat than is necessary to furnish material for the active part of the arc.

Copper Arc in Air.—The following experiments will give a good idea of the relation between the number of amperes used and the rate of waste, and also shows the tendency for the anode to gain in weight rather than lose.

Two arcs were run in series (Fig. 3), both being vertical in order to obtain conditions as uniform as possible. Only the lower electrodes were weighed. In both arcs the electrodes were one-fourth inch in diameter; arc length, one-eighth inch; time of running, two hours, at two amperes, 45 volts.

	Cathode. Grams.	Anode. Grams.
Weight before running	20.610	20.821
Weight after running	20.288	20.833
Loss	0.322	.....
Gain	.....	0.012

Upon increasing the current to five amperes at 35 volts (same arc length) and running for two hours, the result was as follows:

	Cathode. Grams.	Anode. Grams.
Weight before running	20.247	20.764
Weight after running	18.462	20.833
Loss	1.785	.....
Gain	.....	0.069

In the latter experiment, the current used is 2.5 times as large as in the first experiment, but the loss in weight of the cathode is more than five times as great.

A fact to be noted here is the tendency for the heavy, outer mantle of the copper arc to appear only occasionally when the current is low. This is undoubtedly connected with oxidation, and the same phonemenon is to be seen in iron arcs. In Fig. 4 (a), the arc is shown with the outer mantle invisible; when the outer mantle flashes it appears to come from the cathode, as is represented in (b) and (c).

Cooling the electrodes was then tried, the arrangement being as before. The lower electrodes, however, which were weighed, had the form of a copper shell, three-fourths inch in diameter, 1¼ inches long and one sixty-fourth inch thick. The upper electrodes were the same as before. Water was sent in a jet against the tip, as is shown in the sketch (Fig. 5).

While the arc was running, the lower electrodes could be touched very close to the arc without any sensation of warmth being experienced. The result of several experiments is as follows:

Time, 1½ hours; current, two amperes; volts, 50. The arc length was somewhat more than one-eighth inch, as it was found that with one-eighth-inch arc an arc of rather different color—purplish—was obtained in the case where the cathode was cooled. Under these conditions neither electrode lost in weight, and the gain was apparently due to oxidation.

	Cathode. Grams.	Anode. Grams.
Weight before running	13.014	12.649
Weight after running	13.018	12.672
Gain	0.004	0.023

In order to determine the actual loss of the cathode it was reduced in hydrogen, and the real loss found to be 0.013 gram. It is to be seen from this that the Faraday equivalent, if one exists, does not apply to arcs as it does to solution, since by this amount of current, 450 times the amount of copper should have been transferred.

In order to overcome the influence due to oxidation, it was determined to run an arc in nitrogen between copper electrodes. The general results, however, were exactly the same as when the arc was run in air, and it appears that the copper and nitrogen undergo combination under these conditions. The arrangement used is shown in the sketch (Fig. 6).

The gas was generated in the usual way from sodium nitrite and ammonium chloride, and purified by passing through aqueous potash and concentrated sulphuric acid.

Copper Arc in Hydrogen.—In some preliminary experiments, the vertical arc was used with cathode below, the electrodes being solid one-fourth-inch copper rods. With the 500-volt circuit only a short arc could be drawn, and the cathode was found to lose in weight, while the positive electrode gained. By varying the arc length and current three distinct kinds of arcs were obtained.

1. When the electrodes are cold, at the starting of the arc, with about 1,300 ohms in series, there occurs momentarily a discharge giving a pink glow,

Fig. 5. Method of Cooling Electrode

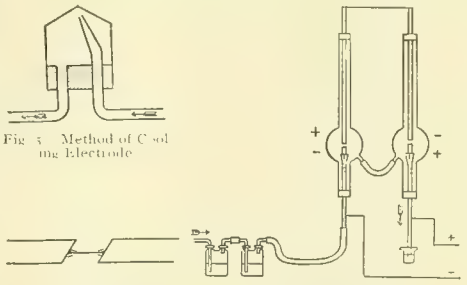
Fig. 6. Arc in Nitrogen

Fig. 8. Non-luminous Arc.

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which soon changes to one of the arcs described below. The spectroscope shows strong hydrogen lines.

2. An arc about one-eighth inch in length, current 0.5 ampere, voltage about 300, is non-luminous, and shows both copper and hydrogen lines to a slight extent. There is a faint glow around the positive electrode, arranged in transverse striations. The negative electrode is hotter than the positive, and the discharge is irregular, seeming to come from a small point on the positive to a much larger and brighter spot on the negative electrode.

3. While arc No. 2 is being run, if the series resistance is decreased by about 100 ohms, at a critical point, a green copper arc suddenly appears. Hydrogen lines, as well as copper lines, may be seen, but frequently only the copper can be detected. The voltage has dropped from 300 to about 70 during this change, and the current rises to four amperes. The discharge is quite irregular.

A single bulb was used for these arcs, the arc being arranged as was shown in the case of the copper arc in nitrogen, Fig. 6.

A curious phenomenon was observed here, and in order better to study it the arc was placed horizontally. The two electrodes were of the same size, held by adapters. The negative was seen to be much hotter than the positive electrode, and soon became molten over the tip. While the arc was running, nothing peculiar was observed, but as soon as the circuit was broken, or when the arc went out of its own accord, the molten copper swelled suddenly to two or three times its normal size. It often happened that, when the arc went out of its own accord the space between the electrodes was bridged over and the arc started anew, the phenomenon occurring many times. It appears that this is due to absorption of hydrogen, which is given off at the temperature of the arc.

Water-cooled electrodes were now tried, a single horizontal arc being used and arranged as shown in Fig. 7.

The bulb was about eight inches long by six inches in diameter, with the main tubes one inch in diameter. The arc was drawn by pushing the stoppers in the tubes and then withdrawing them. In this experiment, the current used was only .35 ampere; the arc length was quite short, one thirty-second inch or less, and the character of the arc was not allowed to change from the non-luminous arc above described as arc No. 2. The time of running was 1½ hours.

	Cathode. Grams.	Anode. Grams.
Weight before running	12.657	12.185
Weight after running	12.653	12.189
Loss	0.004	.....
Gain	.....	0.004

Although the loss or gain in weight is very small, and the experimental error possibly large, it is certain that we have obtained a smaller loss than ever before, and if the figures are within any degree accurate there is transferred only about 1/1500 of the Faraday equivalent for solution. The spot upon the cathode was in this case also larger and brighter than upon the anode.

Arons[1] attempted to obtain the copper arc in hydrogen with electrodes separated 0.1 millimeter. He used only 106 volts, however, and consequently was unable to obtain an arc. He also states that at 75 millimeters pressure he had considerable difficulty in obtaining a discharge between iron electrodes in hydrogen. This was therefore tried with the 500-volt circuit, and under the same conditions previously given for the copper arc.

Iron Arc in Hydrogen.—When solid iron rods are used, the same pink light, described under copper arcs, was obtained. This changed almost immediately to a high voltage, non-luminous arc discharge, but it was impossible to obtain a true iron arc before the electrodes were completely melted down.

Water-cooled shells were employed, as described for the copper arc. The arc was run three hours, with current 0.35 ampere, voltage about 300. The spot upon the cathode was larger than that on the anode. Apparently the running of the arc under these conditions is not perfectly simple, and it seems probable that some combination with hydrogen takes place; the iron blackened around the large spot on the cathode, and bevond this, and also on the anode, there appeared curious bronzelike colorations. In several experiments, run under the above conditions, the anode lost in weight and the cathode gained. This amount varried from 0.003 to 0.005 gram, according to the circulation of the water. Low as these changes in weight are, I feel sure that the experimental error is not large enough to allow the possibility of the change in weight being in the other direction.

Carbon Arc in Hydrogen.—Carbons one-fourth inch in diameter were used, the arc being placed horizontally, and the electrodes being held by adapters. At two amperes an arc three-sixteenths inch in length registered 180 volts. The light was not brilliant, the arc stream itself being non-luminous and appearing as a fine line connecting the two electrodes, see Fig. 8.

The temperature of the two electrodes seemed to be about the same, nor could it be said with certainty that any difference in size of the two craters was noticeable. The presence of acetylene or hydrocarbons of the acetylene series was shown by passing the exhaust hydrogen through an ammoniacal solution of cuprous chloride. A very slight brown precipitate was formed. The [illegible] hours, and the result was as follows:

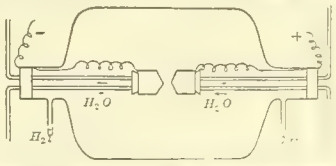

FIG. 7 HORIZONTAL WATER [illegible]

	Grams.	Grams.
Weight before running	[illegible]	[illegible]
Weight after running	[illegible]	[illegible]
Loss	[illegible]	[illegible]

Under the microscope, the negative after running

1. Paper read at the general meeting of the American Electrochemical Society, at Washington, D. C., on April 9, 1904.

1. Annalen der Physik [illegible]

showed its surface to be covered with small pits, which were distributed with fair regularity, while the positive showed larger depressions distributed with less regularity. The spectrum observed was a combination of the enclosed arc spectrum and the hydrogen spectrum.

It seems that oxidation, or combination with the surrounding gas, is not absolutely necessary for the production of a luminous arc, but such combination facilitates its formation. This was further confirmed by some experiments made with metallic chromium at one millimeter air pressure. At low current a Geissler discharge was obtained, but at higher current the true chromium arc appeared.

With regard to the amount of material fed to the arc it may be said that there is apparently a tendency for the arc to ionize the surrounding atmosphere if there is not enough material vaporized from the electrode. If much heat is developed, more is vaporized than is employed in transporting the current. Between these two extremes both the atmosphere and the electrode vapor are ionized. We can therefore hardly make measurements which will give us figures comparable to Faraday equivalents. It would appear from this that there is a slow gradation from the spark discharge to the true arc, passing through the intermediate stage where both kinds of discharge are present. The main distinction, therefore, between the arc and the spark discharge is that in the former vaporized material from the electrode or electrodes undergoes most of the ionization which takes place, while in the latter the surrounding atmosphere suffers most of the ionization. Undoubtedly, as Prof. J. J. Thomson observes, in the arc discharge the terminals are incandescent, while such is not the case in a spark discharge. But it appears to the writer to be more a question of securing sufficient material vaporized from the electrodes (by heat or by current direction) which vapor can be ionized, for there is undoubtedly an extremely small quantity of the material transferred by the current itself.

In this we assume that when the copper spectrum appears, copper is undergoing ionization, and that

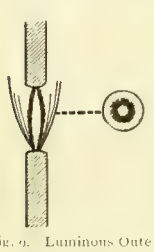

Fig. 9. Luminous Outer Mantle of Arc

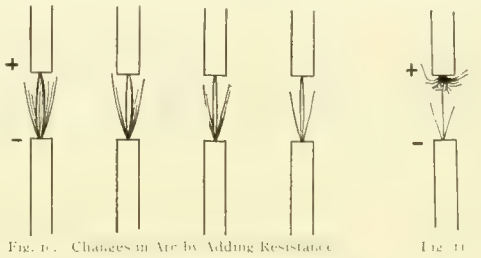

Fig. 10. Changes in Arc by Adding Resistance

Fig. 11

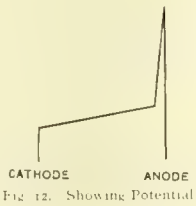

Fig. 12. Showing Potential Gradient of Arc.

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when the hydrogen spectrum appears, hydrogen is undergoing ionization. This will be discussed later.

Structure of Arcs.—The structure of metallic arcs in air is, in general, as follows:

The very middle path is not luminous, but the light is derived from the outer mantle, and most frequently from that portion of the outer mantle next the inner path, as represented in Fig. 9. In the carbon arc the outer mantle is not well defined, owing to the fact that the product of combustion is gaseous.

It seems probable that the inner non-luminous path above mentioned is in a way comparable to the Crookes' dark space. The explanation given for the presence of the latter is that the large number of negative ions present have too great a velocity to ionize the atoms with which they collide, but that farther along the tube, when their force has been diminished by collision, ionization may take place. Where this occurs light is given off.

In the arc, the inner path may be caused by the fact that the negative ions in very great number are moving rapidly toward the anode, and producing ionization only where their force has been sufficiently diminished by collision, viz., on the sides of the inner path.

There are many changes in the character of an arc during running which are very subtle and of rather obscure origin. In many instances the material depositing on one or both electrodes causes difficulty, and in many instances irregularity in the composition of the material used causes unexpected alterations in the structure of the arc.

Does the Cathode Determine the Character of the Arc?—In studying the characteristics of the arc, the first fact which one is apt to discover is that the light given off by an arc is not produced by simple heating of particles present in the arc. The opinion was held by the writer for some time, and arrived at after a number of experiments on metallic arcs, that the cathode determines the character of the arc. But here (as in a number of other experiences in the study of the arc) some incorrigible facts appeared just as the opinion was well established, and made the generalization impossible.

There are cases in which the cathode does not appear to be the determining feature. For instance, two very clear and conflicting cases are as follows:

Copper cathode and magnetite anode give copper arc.

Magnetite cathode and copper anode give iron arc.

Here the cathode undoubtedly determines the nature of the arc.

Copper cathode and thorium carbide anode give thorium arc.

Thorium carbide cathode and copper anode give copper arc.

Here we have the anode giving character to the arc.

Besides these contradictory cases we have such substances as tungsten, calcium carbide and zirconium carbide, acting almost as well in one direction as in the other when copper is used as the second electrode. The conditions for the above experiments were in each case as follows: Diameter of electrode, one-half inch; arc length, one inch; current, three amperes; voltage, about 100. It is well to give exact conditions in these experiments, as some arcs do not behave the same under conditions which are varied only slightly. This may be illustrated by the magnetite-copper arc above described. A vertical arc is used with the magnetite as cathode below. Under the conditions above given with regard to current and arc length, no copper appears in the arc at all. This is true, apparently, at all current strengths tried, from one ampere to 15 amperes. It does not seem to hold, however, below 0.5 ampere. If we start with three amperes for a one-inch arc and gradually reduce the current by throwing in external resistance, the arc changes, as is shown in Fig. 10.

When the current reaches 0.5 ampere, however, the character of the arc suddenly changes, and instead of a pure iron arc we have one in which the copper is shown clearly around the anode, Fig. 11.

Whether we are bordering upon the phenomena of spark discharge here or not, the arc characteristics certainly seem to be changed. Reduction in the supply of cathode material seems to be the most important factor. The copper appears to take a part in the ionization when the iron fails to be produced in quantity sufficient to feed the arc. The same phenomena above described may be seen if the copper as cathode is placed below, with the magnetite above. At low current the iron flashes out, and the spectrum of the upper portion is that of iron, while the lower portion is purely copper.

The position of the electrode materially alters the character of the arc. If an arc is drawn between two terminals of different composition, and the arc belongs to the class in which the cathode, rather than the anode, determines the arc characteristics, the arc flame is naturally fed more uniformly if the cathode is below. We then obtain an arc of clean-cut characteristics, showing generally the spectrum of the cathode only, and possessing a well-defined structure, composed of an inner path, the intermediate luminous path and the outer mantle, which may possess more or less luminosity. If the cathode be placed above, we have the material composing the cathode fed to the arc rather badly, for it does not extend, as a rule, completely across this space to the anode (one-inch arc being used). As a result, the upper portion of the arc possesses strongly one set of characteristics, while the lower portion partakes, to a greater or less extent, of the properties of the anode.

It certainly cannot be said that the cathode always determines the nature of the arc. There seems rather to be a kind of selective action taking place, some substances being ionized in preference to others. This is strongly brought out by a study which is at present being made in this laboratory of electrode mixtures. It is certainly true that metallic salts are ionized very readily in the arc, and the presence of carbon also has a peculiar effect. It is to be especially noted here that this ease of ionization does not depend altogether upon the volatility, nor even upon the mere presence of the vapor of the substance in the arc. The direction of the current may determine it in a given instance. If we take the example already used of copper-magnetite with magnetite as anode below, the copper is certainly at a lower temperature than then when the current is reversed, yet the arc is entirely a copper arc. No iron appears in the arc or its spectrum, even though the current is raised to 15 amperes, and the magnetite is boiling so strongly that the arc must be filled with its vapor. Why is not the vapor ionized, giving the iron arc? Why do not even the heated particles give off light?

In trying to gain some conception of what takes place in the arc, we must go back to the study of the distribution of potential in the arc stream. The potential gradient is about as shown in Fig. 12.

We ought also to have some conception of the process of ionization in the arc, and for this purpose I quote the views of Prof. J. J. Thomson, which were given in his lectures at the Johns Hopkins University last June:[1]

"On this view the cathode is bombarded by the positive ions which maintain its temperature at such a high value that negative corpuscles come out of the cathode; these, which carry by far the larger part of the arc discharge, bombard the anode and keep it at incandescence; they also ionize, either directly by collision or indirectly by heating the anode, the gas or vapor of the metal of which the anode is made, producing in this way the supply of positive ions which keep the cathode hot. It will be seen that the essential feature in the discharge is the hot cathode, as this has to supply the carriers of the greater part of the current in the arc; the anode has in general to be hot, otherwise it could not supply the positive ions which keep the cathode hot."

Prof. Thomson also gave as his opinion that the positive ions would ordinarily act as the principal current carriers, were the distribution of potential more regular; for there is generally more heat developed at the anode than at the cathode. The sharp drop of potential at the anode, however, acts as a barrier in the path of the positive ion.

It would appear from this that if this sharp drop of potential could be eliminated that the positive ions would lend character to the arc, as well as the negative ions. We should then have the character of the anode influencing the nature of the arc to a great extent. In order to test this, a large number of experiments were made, and the general results will be given.

Under certain conditions arcs have a tendency to hiss, and this is accompanied by several phenomena which are very interesting. In the first case, there is a diminution in voltage across the arc, and this generally amounts to about 10 volts, whatever the character of the arc. It has been shown that these 10 volts are lost principally by that portion of the arc next to the anode.[1]

From this it would seem that a hissing arc might offer a chance to test the idea advanced by Prof. Thomson, and some of our experiments seem to confirm the supposition, although it is difficult to obtain a case which is clearly defined.

The magnetite-copper arc is one of the clearest cases known. The copper, as cathode, is placed below. As has been frequently stated, the arc is distinctively a copper arc—under normal conditions. Hissing occasionally takes place, however (the noise is not a prominent feature except in carbon arcs), and a bright jet of flame appears at the anode. This flame is due to iron, as is shown by the spectroscope and by the color. The arc voltage was decreased by 10 volts during hissing, and an exploring rod of iron showed that these 10 volts were lost, for the most part at least, at the surface of the anode.

In this case, at least, it would appear that during hissing the positive ions may carry a large part of the current, due to the lack of the potential barrier, which is present in normal arcs. The electrodes in the above experiment had a diameter of from one-fourth inch to three-fourths inch, while the current varied from three to seven amperes; arc length, one-fourth inch to one inch.

Here, again, however, we are thrown somewhat in doubt, as this bright jet of flame from the anode often occurs when there is no drop of potential at all. This frequently occurs with such substances as ferromanganese, which are capable of ready oxidation. Nevertheless, whenever this drop of 10 volts occurs the characteristics of the anode appear. We are forced to the conclusion that if the assumptions we have made are correct, there are times when the potential barrier, mentioned by Prof. Thomson, is not sufficient to hold the positive ions in check. This may be assumed also for those arcs in which the characteristics of the anode appear when running under normal conditions.

At any rate, it may be seen that the character of the light is not determined simply by the heated particles present in the arc. There certainly may be heated particles present which are not active in giving off light. It does not appear altogether out of the question to associate the light derived from the cathode with negatively electrified particles and that derived from the anode with positively electrified particles. There seems no necessity for making a more complicated assumption, although we must admit that one may be possible. It is perfectly conceivable, for instance, that under certain circumstances the vapor from the anode may be ionized by negative ions, and, consequently, should be associated with the latter.[2] The experiments above recorded with reference to the magnetite-copper arc do not seem to be in accord with this view, however.

1. See "Conduction of Electricity Through Gases," by Prof. J. J. Thomson, p. 424.

1. Luggin, Wied. Ann. 53, 1162. Ayrton, "The Electric Arc," p. 310.

2. Townsend, Phil. Mag. (6)-1-p. 198 (1901), 3 p. 559 (1902). Townsend, Nature, 62-Aug. 1900 p. 340. Townsend and Kirkby, Phil. Mag. (6) 1 p. 630 (1901).

Street-railway Statistics.

According to Poor's Manual for 1904, the total mileage of city, suburban and interurban railway tracks in the United States on January 1st last was 24,561. Of this 281.4 miles was operated by horse cars, 142.2 by dummy engines, 267.8 miles by the cable, while 23,869.6 miles was operated electrically. For the operation of the horse-car lines 7,923 horses and mules are employed; for the dummy lines there are 475 dummies and locomotives; for the electric lines 52,119 motor cars are required; while for all lines there are needed for operation 13,301 passenger and freight cars. The value of these properties may be judged from the fact that the capital stock amounts to the sum of $1,685,840,206; while the

bonded debt is $1,180,313,809. The electrically operated roads have increased from 10,239 miles in 1894 to 23,869.6 in 1903. At the same time the lines operated by dummies and locomotives have decreased from 409 to 142.2; those operated by cable from 578 to 267.8, and those operated by horses from 1,950 to 281.4 miles. While the total mileage has not quite doubled in this period, the capital stock has increased over 150 per cent., while the bonded indebtedness has increased by even a larger ratio.

High-tension Transmission Discussed.

Abstracts were given in the Western Electrician of April 2d of four introductory papers read at the recent Institute meeting in New York and of the discussion which followed. Many of the members, of course, were unable to be present, but not a few sent in written discussions on the various subjects. Some of these, together with a few of the points brought out in the Chicago meeting held on March 29th, follow:

The Relative Fire Risk of Oil and Air-blast Transformers.

E. P. Roberts, Cleveland: In the matter of oil transformers, the practice with which the writer is connected has been for some time to place the transformers in a fireproof room, believing that the fire risk justified the slight additional expense. Our practice in this matter has been somewhat of an evolution. The Dayton and Northern power house, designed in 1900, had a separate room built on the outside of the building and to one side of the generator room. This additional room was fireproof construction with fire door between it and the engine room, and with the floor on the same level as the engine floor. The one sub-station of this road had a fireproof room built into the balance of the building, which building consisted of a rotary room, the fireproof static transformer room, a storage-battery room, freight and passenger offices, and, above the latter, living rooms for the attendant. The floor of the static room was on the same level as the floor of the rotary transformer room. In each static transformer room the high-voltage lightning arresters and switches were placed.

Since that time we have modified the above, and for the Dayton and Muncie Traction Company, now under construction, the design is as follows: For the power house there is an addition to the building immediately in the rear of the switchboard. This addition has two floors and the entire addition is fireproof construction, steel, brick and concrete. The upper floor is on a level with the engine floor level, and in this room are placed the high-tension lightning arresters and switches, and there is a fireproof door from same into the engine room. The lower floor is below the level of the engine-room basement and has a fireproof door from the basement. In this room are placed the static transformers. The floor is of concrete, with drains, and in case the transformer should catch fire and the oil escape it will run into the drains and be smothered. But even if the drain should not take it off with sufficient rapidity, it could not run into any other room.

The additional cost of the building is slight, as, in any case, room must be provided for the transformers and high-voltage switches and arresters and does not necessitate complication in wiring or in mechanism for controlling the switches.

Howard Bayne, New York: Proper arrangements should be carefully planned and must be permanently installed. The transformers should be placed in a separate vault, and in case of a large number they might be divided between several vaults. Suppose each vault to be equipped with one or more permanent two-inch steam lines, according to the amount of space in the vault. In case of fire all outlets, such as doors and ventilators, should be closed and the steam turned on. Both or either of these operations could be arranged to work automatically. The fire would be smothered in a very few minutes or possibly in less than a minute. The prime requisite is to have a large volume of steam turned into the vault quickly. If the fire is confined to the surface of the oil and the core and windings remain covered with oil, the transformers could be used again with very little delay, if any.

The efficiency of steam in fighting oil fires is surprising. To illustrate: The company which I represent owned an enormous earthen storage tank at Gladys, Texas. It covered five acres and contained 200,000 barrels of crude oil, which was most inflammable, since it gave off naphtha vapors and hydrogen sulphide. On August 11th lightning struck the point of the conical roof. The small hatch at the apex was blown off and a tremendous blaze started. After several minutes the men got the hatch on again and turned steam into the tank. The blaze grew perceptibly less almost immediately and diminished rapidly, and finally went out.

W. L. Waters, Milwaukee, Wis.: Considering first fires due to internal causes: It is almost impossible to start a fire in an oil-cooled transformer, due to a short-circuit or a burnout in the transformer itself, unless there is an almost unlimited power back of the short-circuit. The oil will smother the fire so effectually that usually the mains will go before the transformer catches fire.

In an air-blast transformer on the other hand, a short-circuit will turn the interior of the transformer into blazing furnace, and even though the air supply is automatically cut off the transformer will certainly be totally destroyed unless it is cut out in the circuit. Whether the burning of the transformer itself starts a general fire depends of course on the general arrangement of the building. Of course if there are attendants present they can take care of the burn-out and can generally cut out the transformers before the situation gets serious.

Considering fires due to external causes: In the case of an ordinary fire the oil-cooled transformer will be completely protected from damage by the oil, as the oil will not be heated to ignition point and will prevent the heat from reaching the transformer itself. An air-blast transformer in a similar case would probably be totally ruined, though it might not add much fuel to the conflagration. In the case of a large fire the oil in an oil-cooled transformer would be ignited, and on account of the large quantity of inflammable material the results would be disastrous. This could possibly be prevented if attendants were present to draw off the oil, or if automatic arrangements were employed for draining the oil in case of fire. But in any case an oil-cooled transformer is a very serious risk in a large fire.

The Use of Group Switches in Large Power Plants.

Dugald C. Jackson, Madison, Wis.: No single arrangement of switching devices can be laid down as the perfect one for all plants. In general, however, the most reliable service is attained by bringing directly to the main bus bars all of the generator and feeder circuits. Each circuit in this case should be supplied with a master switch by which it can be disconnected independently of its two selector switches. With such an arrangement of circuits no local accident which may occur beyond the main bus bars and their connections can interfere with more than one circuit. Also, no switch need be of greater capacity than that of its circuit. As the quantity of energy which must be handled by a switch has much to do with the reliability of its operation this latter consideration is of importance.

In a group-switch arrangement, as described by Mr. Stillwell, the reliability of service is not so great as in the arrangement above described, since it introduces auxiliary bus bars and associated connections, an accident to which will disturb the operation of all of the circuits in the group; also by the addition of currents of several circuits at the group switch a troublesome switching problem is engendered.

By carrying each of the circuits directly to the bus bars a more convenient and flexible system of switching can be arranged. The individual circuit, which is the natural unit of distribution, is recognized in this arrangement. By this system each circuit, whether it be a generator circuit or feeder circuit, has its own individual group of switches, the operation of which will effect its connections alone, and it may be connected to either or both sets of bus bars or disconnected therefrom with complete independence.

Irving A. Taylor, Brooklyn, N. Y.: There are few plants, even of great magnitude, where a complete shutdown for five minutes (sufficient to clear a defective switch) once a year or two, is of sufficient importance to warrant the expenditure of several thousand dollars to prevent it. Probably large lighting companies having a low-tension network are an exception to this on account of the difficulty of starting up after a shutdown. With this exception it looks very difficult to decide in favor of group switching.

Another point that has to be considered in arranging feeder or generator switches is that few men of sound judgment would allow a man to touch lines or even the coils of a generator if an open oil switch were the only thing between the man and death. The risk is not much; but life is too important to assume it. An oil-switch handle may be open, but one line may be short-circuited in the switch, or the latter may be broken. Therefore some kind of an air switch should be provided in series with each feeder or generator oil switch for use on such occasions. An ordinary air switch having short break, but provided with barriers, seems to be very proper for the generator circuit. On feeders it seems as though a fuse block could be used to advantage, as it will not cost materially more than the air switches and will give additional means of automatically disconnecting the circuit as well as fulfilling the above functions. In any case such switches or fuses should be installed between the bus bars and the oil switch.

Gilbert Wright, Pittsfield, Mass.: I would suggest in place of the arrangement of group switches, selector switches and bus bars shown on the plan submitted by Mr. Stillwell [see Western Electrician of April 2d, page 271] that one set of main buses be used instead of two, and that the feeders be tapped directly from this one set of buses, the feeders to be controlled electrically, singly and in groups. This method of control, that is, single and group, is readily accomplished by installing one control switch for each feeder and one master switch for each group. This reduces the total number of switches by 32, eliminates one set of main buses, eight sets of group buses, with the necessary wiring between the switches and buses.

The writer looks upon group switches, duplicate buses and the necessarily complicated wiring for connecting them in the power house as so much insurance on the continuous operation of the plant. This insurance is placed in small amounts, in a great many places, and at a cost much too large in proportion to the results obtained. It will be seen that a possible saving of $30,000 could be made on this plant by the method described above.

Terminals and Bushings for High-pressure Transformers.

Irving A. Taylor: Instances have been noticed in air transformers where an uninsulated or lightly insulated tap is brought out through the external coil insulation and a lead soldered on and the joint insulated. This leaves a weak spot on the lead insulation just where it enters the coil insulation. Leads should be heavily insulated to a point well within the coil jacket and should pass through the latter in a slanting rather than a straight direction so as not to leave a vulnerable point in it at the point of entrance.

In some cases internal leads are brought up through the top layers. This is a grave source of weakness, as it gives a creeping surface through the inter-layer insulation. It also makes it necessary to wind the upper layers around it, and these are therefore liable to be crushed together. Taps from inner layers should always be brought out from the end of the layer and in such a manner as not to cut the interlayer insulation.

Leads from oil transformers give a great deal of trouble by syphoning oil, and it is not at all easy to suggest a certain way of stopping it. Mr. Moody's remark that a solid section in the lead is necessary is correct; but it is difficult to insulate this section in practice so that the oil will not creep between the layers of insulation and on to the stranded cable. After a good deal of experimenting I used a porcelain tube (filled with sulphur) over this solid section and found this to be about the only successful method of stopping creepage. Bushings through the case should be extended well above the iron and the cable should be sealed in with non-solvent insulating compound (sulphur may be used), so arranged as not to pocket any oil, but to drain it off. It is best not to have the braided covering of the lead extend inside the case as it is liable to carry oil out.

All transformer cases should be grounded to prevent fire and make them safe to handle. Attention should be given to the fact that the ground wire should be heavy in proportion to the circuit-protecting devices used. Thus, a No. 8 wire should not be used on transformers protected by 300-ampere fuses on the secondary side. The ground connection should be electrically sufficient and its resistance should be tested to determine this, a moderate voltage being used. Where rubber-covered leads are used the rubber should be heavy (not less than one-quarter-inch wall per 10,000 volts) and of high quality, and a fireproof covering should be used. Extra flexible cable is usually preferable.

Chicago Discussion.

James Lyman of Chicago read the introduction to the discussion upon the relative merits of air-blast and oil-cooled transformers, giving also his own views on the subject. He was more in favor of the air-blast transformer for moderate voltages. For high voltages, for which the air-cooled transformer as built to-day is not adapted, he was in favor of the water-cooled type as presenting less fire risk than the oil-cooled type.

W. A. Blanck of Chicago, in discussing the two types of transformers, spoke in favor of the air-cooled type when it is necessary to install the transformer in the building with the rest of the machinery, since the attendant who is watching the other machinery can also watch the transformer. In cases where a separate building is provided a water-cooled, oil-immersed type is to be preferred, since no attendance is necessary.

The question was then brought up as to whether any one present had ever actually seen the oil in a transformer take fire so as to determine whether the fire took place from causes within the transformer itself. Two cases were mentioned in which the oil burned, but the transformer was not destroyed.

In relation to the subject of switches, W. G. Carlton of Chicago pointed out the fact that if an overload device is provided along with the rest of the switching apparatus it should have a time limit in proportion to the load. But in connection with the time-limit device should be another device which will enable the circuit to be opened instantly in the case of a dead short-circuit on the line. Speaking of the air circuit-breaker, Mr. Blanck said that this much-abused type is really the only one to be installed in some instances, notably in mining districts, where the consumers as a rule are widely scattered and each transformer capacity is small. The air circuit-breaker in these cases, on account of its low cost, is the only one to be adopted.

The question of the proper type of door for oil-switch cells was brought up and freely discussed by G. N. Eastman, W. A. Blanck, E. O. Sessions, W. G. Carlton and P. Junkersfeld. Two forms of door were recommended. One is the wooden door with glass window, which allows of frequent inspection. The one drawback, however, being that the construction is not absolutely fireproof, which should be the aim in all construction of this nature. The iron door had also its advocates, it being fireproof, with the disadvantage, however, that a possible ground might take place from the switch to the door, and also that inspection is difficult, and the switch might be opened and the attendant never know.

Evansville Telephone Situation.

It is given out that the directors and some of the stockholders of the Evansville Municipal Telephone Company are making an effort to form a local Independent company, and propose to eliminate entirely the municipal feature by putting the company on the basis of other Independent companies. The decision of Judge Robinson decreed that the ordinances of the City Council granting the alleged franchise to the Evansville Municipal Telephone Company be null and void. The city has the right to appeal, and by statute has a year's limit, because it does not contest or seek to suspend judgment while the appeal is pending. The decree has the effect of enjoining the Evansville Municipal Telephone Company from exercising the franchise granted it by the City Council. It does not, however, prevent the city from constructing and maintaining a telephone system under other and legal arrangements. Neither does it prevent the enjoined company from reorganizing and rearranging the holding of the preferred stock. But if the company is still to exist, the decree points out the necessity of a reorganization along statutory lines.

Self-restoring-drop Patent.

The decision of Judges Jenkins, Grosscup and Baker in the United States Circuit of Appeals concerning self-restoring drops, given on April 12th and referred to in the Western Electrician of last week, is the outcome of a long fight on the part of the Western Telephone Manufacturing Company, formerly the Western Telephone Construction Company. The Western Telephone Construction Company in the early days of Independent telephony was perhaps the most formidable opponent of the Bell company in patent litigation. It obtained what is said to be the first victory over the Bell company on patent claims.

Having obtained the right to make, sell and use telephones, the Independents were still confronted by the serious obstacle of important patents on switchboard construction, none of which was available. James E. Keelyn, president of the Western Telephone Construction Company, therefore sought out new methods, which resulted in the Fisk invention of the self-restoring or express type of switchboard, which he developed. It is the patent based on the invention of the self-restoring drop which caused the long litigation leading up to the recent decision. The patent is numbered 521,461, granted June 19, 1894, and therefore has seven years more to run.

Telephones in Nova Scotia.

A new long-distance telephone line, with 292 miles of copper wire, has been opened between Halifax and Sydney in Nova Scotia. The reports of the company show that in the province of Nova Scotia there is one telephone in use for every 88 inhabitants. In the city of Halifax there is one to every 27 persons, while in other towns the proportion is between 20 and 30. The report of the general manager of the Nova Scotia Telephone Company shows 790 miles of poles for long-distance lines and 2,246 miles of copper wire. The total mileage of telephone wires in the province is 7,136, and the total miles of posts is 791. The number of telephones in the province is 3,260, of which 1,801 are in the city of Halifax. Last year the company transmitted 14,000,000 messages. The long-distance lines unite Truro, Amherst, Bridgewater, New Glasgow and Windsor-Sydney. The average number of calls a day per telephone in Halifax is 11, compared with 7½ under the old system. Halifax answers daily 18,000 calls; the average per telephone is only 10, although some instruments go as high as 150 calls a day. The rates for conversations of three minutes between Halifax and Points in Cape Breton country are each $1.25 in the daytime and 65 cents at night between 6 p. m. and 8 a. m.

Telephone News from the Northwest

The Dakota Central Telephone Company will change the line from Pierre, S. D., to Huron to a metallic-circuit copper line. The company will also build a copper line to Pipestone, Minn.

The Potato Belt Telephone Company of Bethel, Minn., has been incorporated with $20,000 capital stock.

The Northwestern Telephone Exchange Company's long-distance lines north from Fargo, N. D., suffered in the recent snowstorm, wires and poles being broken badly. The aerial service in the city was also in bad order.

The Iron Range Electric Telephone Company is installing a selective long-distance service. Bemidji, Minn., is the central point for the business from Fosston to Blackduck, Minn.

The Farmers' Telephone Company of Fairmount, N. D., is to be incorporated with $6,000 capital.

The Roberts (Wis.) Telephone Company has been incorporated with $5,000 capital.

The city of Wheaton, Minn., has decided to install a municipal telephone exchange, as the Minnesota Central Telephone Company refused to restore free service with Graceville. The Minnesota Central declares that it will not permit the municipality to put in a telephone plant, and a legal battle is in sight.

The mayor of Brainerd, Minn., has vetoed an ordinance to permit an increase of rates by the telephone company.

Vernon W. Eaton of Wadena, Minn., has been engaged by the Rothsay (Minn.) Telephone Company as manager of construction.

The Eastern Iowa Telephone Company of Oxford has been incorporated with a capital of $100,000 by Edwin Hummer and others.

P. J. Korth will put in a telephone exchange at Earling, Iowa.

The Farragut (Iowa) Telephone Company has been incorporated with a capital stock of $5,000.

The Farmers' Co-operative Telephone Company has been organized at Amund, Iowa. George A. Faber is president and E. M. Awe secretary.

The Hamilton County Telephone Company has been incorporated at Webster City, Iowa, with capital of $24,000. D. C. Chase is president and J. W. Lee, secretary. R.

Ohio Telephone Notes.

Creditors of the Everett-Moore syndicate and the Federal Telephone Company have agreed to an extension of time of 18 months from October 13, 1903, and the affairs have been placed in the hands of a committee consisting of Frederick S. Dickson, Calvary Morris and H. R. Newcomb, the latter being chairman. R. W. Judd has been named as secretary and treasurer. It is believed that all the securities will be in such a shape at the end of that time that the syndicate will be entirely relieved of any indebtedness.

An increase of 567 telephones was made by the Cuyahoga Telephone Company in March, and it is believed that the company will have 15,000 or more telephones in use before the end of the year. The increase for March represents an increase in the annual earnings of $16,746. At this rate the company will in a short time be in excellent shape and will meet all expectations of investors. The stock has been in demand on the stock market in Cleveland for the last few weeks.

A new ordinance was submitted to the Village Council of Norwood last Monday, giving a franchise to the Independent interests. Mayor Mills, who vetoed the first ordinance, will leave in a short time on an extended trip through the South, and the president of the council will be the acting mayor. He seems to be favorable to the Independent movement and will probably sign the ordinance, if it is passed. All weak points in the first ordinance have been amended and strengthened.

The Central Ohio Telephone Company of Centerburg, which was incorporated recently, is planning to build lines in Knox, Morrow, Licking and Delaware counties. Charles L. Bishop and others are interested in the company.

It is said that a number of prominent citizens of Springfield are at the head of a movement to discard the service of one of the telephone companies, contending that one is enough. General J. Warren Keifer, candidate for Congress and at one time interested in the Independent movement himself, is said to be one of the men interested, and Judge A. N. Summers of the Supreme Court is another.

The Automatic Monitor Company of Toledo has been incorporated to manufacture a device that will show the length of time a telephone receiver has been off the hook. The device is an invention of D. A. Yoder. H. R. Ashbrook and others are also interested in the new company.

Officers of the West Milgrove Telephone Company of West Milgrove, incorporated some time ago, are: President, Wilbur Rosendale; vice-president, J. P. DeWolfe; treasurer, C. D. Stearns; secretary, S. L. Gaster. The company will build an exchange at West Milgrove and lines radiating for a mile in all directions, giving a complete farmers' service.

It is said the Central Union Telephone Company will spend about $5,000 in improvements about Springfield this year. About 100 additional terminals will be made on farmers' lines and 500 additional lines will be installed. The lines will radiate from North Hampton, Tremont, Harmony and other towns near Springfield.

President F. S. Dickson of the United States Telephone Company has secured $150,000, to be used in extensions and improvements of the system. The greater part of it will be expended in connecting up lines of the present system with those of other Independent long-distance companies, under the arrangements agreed upon a few weeks ago. C.

Indiana Telephone Items.

The Farmers' Rural Telephone Company has filed articles of incorporation. The company's purpose is to operate a telephone exchange in Summitville and throughout Madison County. John F. Thurston is one of the incorporators.

The Northwestern Long-distance Telephone Company has been incorporated to build an exchange and construct telephone lines in Mohawk and in Hancock County. The capital stock is $2,000. J. W. Murphy, Sr., is among the incorporators.

The Citizens' Telephone Company of Napoleon has been organized on the joint-stock plan to build a telephone exchange and system in Napoleon and extend the lines to Batesville. John Bullman is president and Granville Thackery, secretary.

The Lawrence Telephone Company of Lawrence has increased its capital stock $10,000 for the purpose of extending its lines, installing a new switchboard and making other necessary improvements.

The Bicknell Telephone Company of Bicknell has increased its capital stock, with the view of extending its lines and improving the plant by increasing the switchboard capacity.

The Town Council of Chesterton has granted a franchise to the Portage Home Telephone Company to construct and operate a telephone exchange and a telephone system in Chesterton. The rates are limited to $1 and $1.25 per month for residence and business telephones, respectively.

The American Telephone and Telegraph Company has representatives in Indiana getting the right-of-way for a trunk line from Chicago to Indianapolis. The line will follow the old state road as nearly as practicable.

The Evansville and Princeton Traction Company has employed C. E. Wakeman, formerly of Grand Rapids, Mich., and placed him in charge of its trolley and telephone line. Mr. Wakeman has introduced a new system of telephone service. By the use of a small device the conductors of this line can telephone to headquarters from any point on the road. The telephone instrument is located in the car, and a "fishpole" is used to connect the wire with the instrument.

A fire on April 16th damaged the Connersville telephone exchange to the amount of $2,000. Manager L. A. Frazee says that crossed wires caused the blaze. F.

New England Telephone News.

The bill for placing the telephone and telegraph companies doing business in Massachusetts under the direction of the gas and electric-light commissioners has been reported favorably. There is nothing very radical about its provisions, and the telephone people, realizing that the drift of public sentiment has been for some time tending in this direction, are not fighting the bill in its essential features.

The announcement that all of the three-year five per cent. gold coupon notes, issued to the amount of $20,000,000, and secured by $25,000,000 bonds of the American Telephone and Telegraph Company, had been sold, closed an incident which has caused a great deal of comment in financial circles. The fluctuations of the telephone company's stocks and bonds attracted unusual attention last week. When the notes were issued the bonds were selling around 90 and the stock around 125. Later in the week both were up a few points from these figures, and the notes sold on April 14th last at par.

Charles E. White of Willimantic, Conn., a lumber dealer, has signed a contract for 7,000 telephone poles, to be delivered to the American Bell Telephone Company, which are to be used in the construction of a line between West Hartford and Boston, some 128 miles in length.

The annual meeting of the New England Telephone and Telegraph Company will be held in New York city on May 2d. B.

Postoffices to Retain Both Telephones

Independent telephone men are highly elated over the passage of the appropriation bill making provision for the retention of Independent telephones in the postoffices instead of so limiting the funds that only the system with long-distance connections with Washington could be used. President F. S. Dickson of the United States Telephone Company and other prominent telephone men consider it a distinct victory for the Independent people, inasmuch as it would have been a great advantage to the competitors if the Independents had been left out.

TELEPHONE MEN.

S. P. Sheerin, president of the Indianapolis Telephone Company, will leave in a few days for a three months tour in Europe. Mr. Sheerin has done a large amount of work during the last year and has well earned the vacation which he is advised to take.

Harry P. Miller, manager of the Home Telephone Company of Dayton, Ohio, will be married in June to Miss Lillian Hallwood, daughter of Henry Hallwood of Columbus. Mr. Miller was formerly manager of the Central Union company at Columbus and before that was engaged in telephone work at Springfield.

MANUFACTURERS AND DEALERS.

An elaborate catalogue from the Couch & Seeley Company of Boston describes its telephone apparatus, which includes everything from the subscriber's telephone to the switchboard and accessories. The catalogue is very complete and well illustrated and describes in detail each piece of apparatus with diagrams of connections. Switchboards and distributing frames are shown, and also generating machinery for the ringing apparatus.

The International Telephone Manufacturing Company of Chicago has recently installed a complete intercommunicating telephone system in the City Hall, Chicago. Each station is provided with one of the well-known International desk sets with long-distance transmitter, double-pole receiver and metallic jack plugswitch, enabling any one station being called directly from any of the others in the system. Any number of pairs of instruments may be used simultaneously without interference

Iowa Electrical Association.

[Special Dispatch to the Western Electrcian.]

Des Moines, Iowa, April 20, 1904.—Over 100 central-station men and supply men attended the opening of the fourth annual convention of the Iowa Electrical Association here today. At this morning's session Robert Ferris of Monmouth, Ill., delivered a valuable talk on "Central-station Accounting, a Method of Charging." The question of enlarging the scope of the association to embrace the electric-railway men is under discussion, for a number of the railway men are meeting in Des Moines today, intending to join the existing electrical association or to form a new one. K.

Protection from High-tension Wires.

Numerous accidents both to the men employed and also to the electrical plants have resulted from crosses occurring while stringing wires, particularly telephone wires which are above high-tension wires. The crosses resulting from such contacts have caused a number of fires at inadequately protected telephone stations and also have resulted in fatal shocks to linemen. In one instance in western New York a telephone lineman on the pole was protected by the insulation which his position afforded, while two men on the ground who were pulling the wire were instantly killed.

One method of protection is to make a net of very stout cord and about 14-inch mesh, the size of the hole being about 30 feet long and 10 feet wide. Through the sides of this net ropes, each three spans in length, are rove, so that they may be suspended from one pole to the next and kept spaced by a stretcher, consisting of a piece of wood about a foot longer than the cross-arms. The ropes are run from the poles, between which the net is suspended, and fastened to the bases of poles adjoining each end of the span. The position of the net can be varied according to the position of greatest hazard of contact with high-tension wires. This simple arrangement, in addition to furnishing conditions of safety, also permits the work to be done at a more rapid rate, because unusual precautions are rendered unnecessary.

GENERAL TELEPHONE NEWS.

The Allen County Home Telephone Company of Allen County, Ky., has been incorporated with a capital stock of $2,500.

W. H. Johnson and Mrs. J. M. Ellis contemplate establishing a local telephone exchange at Brownsville, Texas. They will also build long-distance telephone lines.

Manager N. L. Jones of the Sunset Telephone Company of Santa Rosa, Cal., is making preliminary plans for establishing a rural telephone service at Geyserville, Cal.

The Campus Telephone Company of Campus, Ill., has been incorporated and proposes to construct and operate a telephone system. J. D. Brophy heads the list of incorporators.

Representatives of all the Independent telephone companies of Kansas are asking the State Board of Railway, Telegraph and Telephone Assessors that their rate of assessment be reduced.

The Bell company of Canada has offered the city of Brantford, Ont., the sum of $700 a year for an exclusive telephone franchise for five years, and long-distance telephones where the ordinary Blake telephones are now in use.

The New York Central Railroad Company is reported to be installing a direct circuit between Chicago and New York for private telephone purposes. The terminals will be the Grand Central station, New York, and the Lake Shore terminal, La Salle Street station, Chicago.

It is reported from Saratoga, N. Y., that the Saratoga Telegraph and Telephone Company has been consolidated with the Rensselaer Telephone and Telegraph Company of Troy and the Union Telephone Company of Glens Falls, and the three systems are to be acquired by the Commercial Union Telephone Company.

A company to be known as the West Coast Telephone Company has been incorporated, with headquarters at St. Petersburg, Fla. The company has a capital of $10,000 and proposes to construct local telephone systems at St. Petersburg, Clearwater and Tarpon Springs. J. D. Darry, H. B. Webster and A. P. Avery are interested.

Indians of the Laguna and Acoma pueblos, situated in Valencia County, New Mexico, are to have a telephone system. Superintendent Allen of the Indian school at Albuquerque states that 46 miles of wire will be strung, the Indians doing the work and the government furnishing the material. The Indians are very enthusiastic over the proposed line, it is said, which will be the first Indian telephone line in the United States.

General Electric and Allgemeine Companies in Alliance.

One of the features of the meeting of the stockholders of the Allgemeine Elektricitäts Gesellschaft which was held in Berlin on February 27th, to consider the amalgamation of that company with the Union Elektricitäts Gesellschaft, was the report of the chairman of the committee on relations to be established between the consolidated company and the General Electric Company of America and its affiliated companies in Europe. Under the agreement the territories are defined as follows: The exclusive territory of the General Electric Company comprises the United States and Canada; that of the consolidated German company is Germany (including Luxembourg), Austria-Hungary, Russia in Europe and Asia, Finland, Holland, Belgium, Sweden, Norway, Denmark, Switzerland, Turkey and the Balkan states. For other countries, including South America, a joint working is proposed. Italy will be considered later.

The General Electric and Allgemeine companies will form a company with a capital of 3,000,000 marks for the exploitation of the Riedler-Stumpf and the Curtis steam-turbine patents in the territory of the Allgemeine company. In this combination the Curtis patents are valued at 1,800,000 marks and the Riedler-Stumpf patents at 1,200,000 marks. The Allgemeine company has secured a license to supply all non-European countries with this turbine, with the exception of the United States and Canada. In these latter countries the General Electric Company has secured the Riedler-Stumpf rights. The rights of the use of the Curtis patents for marine work have been secured by the International Curtis Marine Turbine Company.

Space Telegraphy in Russo-Japanese War.

The Russian government has officially notified the United States that newspaper correspondents who send news by space telegraphy concerning the movements of Russian warships or troops will, if captured, be treated as spies. The De Forest Wireless Telegraph Company, which is conducting a space-telegraph news service for the London Times (see Western Electrician of last week), has telegraphed to Secretary Hay a protest against the attitude of the Russian government. The Times correspondent has from time to time telegraphed from the open sea news of the movement of both Russian and Japanese warships, and it is probable that the London correspondents will appeal to their government to define their own privileges and to secure an official determination of the question as to whether a neutral on his own ship outside the territorial waters of a belligerent power and without contraband of war aboard can be treated as a spy.

Chicago Street-railway Situation.

The traction situation in Chicago, so far as the Union Traction Company is involved, is again beset by further complications brought about by a decision of the United States Circuit Court of Appeals. Judges Jenkins, Bunn and Baker concurred in a decision handed down this week reversing the injunction granted by Judge Grosscup last year restraining the minority stockholders of the underlying companies—the North and West Side roads—from attacking the new leases to the Union Traction Company in any court but his own. The case decided was an appeal from the order of Judge Grosscup forbidding David A. Kohn and other stockholders of the North Chicago Street Railway Company and Jacob Miller and other stockholders of the West Chicago Street Railway Company from prosecuting in the state courts suits to prevent the consummation of the new leases of last August of the properties of these two corporations to the Union Traction Company. The majority of the stockholders of the underlying companies agreed to accept less rent than under the old tripartite agreement and also to waive rent for five years if the money was not earned.

The dissatisfied stockholders can now go ahead with their suits in the state courts, and until these courts can act, which will hardly be within a year, it is doubtful if anything in the way of a settlement, either of the differences between the traction company and its underlying companies or of its disputes with the city, can be made.

The only concern which the city has in the litigation which the Court of Appeals says may now proceed is in the prospect of a further reduction of rental paid the underlying companies. If the Union Traction Company is finally given a renewal of its privileges by the city it is for the interest of the city that the rentals be reduced even more than they have been, otherwise it is considered that it will be impossible for the lessee company to pay adequate compensation for franchise renewals. The question of leases, however, is a secondary one to the city as compared with that of the validity of the 99-year law, and may be disposed of in the words of one posted in traction matters: "If the Supreme Court shall decide that the claims under that law are of little or no value, the underlying companies will have little or nothing to lease, and the stockholders of the North and West Side roads will be lucky if they get any rentals."

In addition to their decision, the judges of the Court of Appeals also criticized the course of Judge Grosscup in attempting a settlement of the traction question. The point is made that his only duty is to collect the assets and pay the debts of the companies under his charge, and it is suggested this can be accomplished either by a sale of the properties or a wiping out of the Union Traction Company and a resumption by the underlying companies of their old rights and duties.

Notwithstanding the decision, the new local transportation committee of the City Council has declared that it will at once proceed to work out new ideas for a satisfactory settlement of the difficulties. One plan which it is said will receive attention from the committee is for an absolute unification of all the surface lines of the city. By co-operating with the mayor and dealing frankly with the traction officials the committee believes the traction question can be solved.

Test of Westinghouse-Parsons Steam Turbine.

Some interesting data upon a steam-turbine test are embodied in a report by A. B. Canaga, commander United States Navy, and E. N. Janson of the bureau of steam engineering, Navy Department.

The trial was made with one 1,000-kilowatt steam turbine built for the Cleveland, Elyria and Western railroad. It is of the two-stage type, directly connected to the revolving field of a three-phase generator, 400 volts, two-pole, 50 cycles a second. The turbine in question is of the Westinghouse-Parsons type. A reheater between the high-pressure and low-pressure turbine was not used in this machine, but substituted with an ordinary receiver pipe and separator. Steam at a pressure of 150 pounds a square inch and superheated by 25° F. entered the casing of the high-pressure turbine through a series of valves. There is first an automatic stop valve, then a throttle valve, and finally a steam strainer. The admission valve is composed of a double poppet actuated by a piston and a small relay valve, which receives its reciprocating motion from levers connected by an eccentric through gears to the turbine shaft. The movement of the relay valve is controlled by a ball governor, and the steam is admitted in puffs, the exhaust being taken out at the bottom of the low-pressure turbine and led through a 30-inch exhaust pipe to the bottom of an ordinary surface condenser. The lower part of this pipe was formed into a hot-well, at the bottom of which was placed a nozzle with a by-pass valve, connecting the suction pipe of the pump either direct to the condenser or to the hot-well. A gauge glass, with means provided to ascertain the water-level line, gave readings of the amount of water contained in the hot-well when beginning and finishing the trial. The hot-well pump discharged directly into either one of the two weighing tanks placed on scales to ascertain the amount of water condensed. After passing through transformers the electrical energy was absorbed in a water rheostat and readings obtained on the usual instruments. The weights of the turbine may be cut down to some extent by substituting steel castings where now cast iron is used—for instance, in bed plate and casing. The revolving drum and shaft is made of forged steel. The grooves containing the moving blades are slightly dovetailed; each blade and distance piece, after being dropped in place, is subjected to pressure sufficient to upset the end and thus fill out the dovetail, thereby firmly gripping the blades. For the stationary vanes the grooves are parallel. The edges are caulked after the blades are all assembled. The free ends of the longer blades are lashed with brass wire, then soldered, forming a sort of shroud or continuous band at the outer end. The blades are made from brass, drawn in long lengths to actual section required. They are afterwards cut off to any length desired.

The bearings are loaded to a pressure of slightly more than 50 pounds to the square inch, against from 300 pounds to 400 pounds in a reciprocating engine; the peripheral velocity amounts to about 50 feet a second, against about 10 feet for battleship engines.

The following table gives the results of two tests, one at the rated capacity and one at about 50 per cent. above. The turbine cylinders or casings were not lagged but simply covered over temporarily with felt:

	50 Per Cent. Overload.	Rated Capacity
Kilowatts	[illegible]	[illegible]
Equivalent electrical horsepower	[illegible]	[illegible]
Revolutions per minute	[illegible]	[illegible]
Steam pressure per square inch above throttle, lbs.	[illegible]	[illegible]
Steam pressure per gauge below throttle, lbs.	[illegible]	[illegible]
Vacuum, inch	[illegible]	[illegible]
Dryness of steam at throttle	[illegible]	[illegible]
Steam per hour per electrical h. p., lbs.	[illegible]	[illegible]

Competition caused by the Lackawanna and Wyoming Valley Electric railroad, whose fine system of interurban road was described in the Western Electrician of August 29, 1903, has been responsible for the move of the Delaware and Hudson Railroad in changing from steam to electricity on its line between Carbondale and Wilkesbarre, Pa. Although the fare has been reduced from 85 cents to 20 cents, since changing to electricity and adding more cars, the passenger receipts of the Delaware and Hudson are said to have greatly increased.

Care of Electrical Apparatus[1].

Cleanliness. By far the most important element in the proper care of all electrical apparatus is that of absolute cleanliness. The fact that dirt is prevalent about a steel plant makes it of the utmost importance that electrical apparatus be cleaned frequently and thoroughly. Not only the vital parts, but all parts of all apparatus must be kept free from dust, scale, grease, oil and other dirt, to insure satisfactory operation.

Generators.—With a direct-current generator the most essential condition, after cleanliness, for satisfactory operation, is that the commutator shall be in good condition. It must run true and be smooth. The surface should present a hard, dark, glossy appearance. Sandpapering is to be avoided unless necessary to avoid roughness. Never use emery cloth. The use of oil is objectionable, but an occasional touch of paraffin, just sufficient to stop "squealing of the brushes," is permissible. Sparking causes roughness, necessitating sandpapering. This again produces flat spots, which are indicated by the movement of brushes during operation. Flat spots promote sparking, and ultimately must be removed by turning. This is generally done while the armature is in the bearings, by the use of a turning tool. Unless the armature runs true in the bearings at no load, as well as at full load, the commutator cannot be made to run true.

A frequent source of trouble on a generator producing large currents lies in the heating of the brushes. This trouble generally arises from poor contacts at the brushes. Good contact must be insured between the brushes and the generator leads by keeping the devices supplied by the manufacturer in such shape as to prevent heating. Where brush clamps are provided, keep them tight and the joint clean. New brushes must be "ground in to the commutator" with great care, so that every point of the bearing surface of the brush touches the commutator. This is done by drawing sandpaper back and forth under the brush in place, taking care that the smooth side of the sandpaper rests entirely upon the commutator at all times. This process must be continued until the sandpaper is cutting the carbon over the whole of the bearing surface. It is a tedious but necessary operation. A brush that has once been overheated to the point of softening and crumbling is useless and should be replaced. Brushes should be so placed on the supporting arms that those on succeeding arms are staggered to prevent wearing grooves in the commutator. Generators work best with the brushes set a little ahead of the neutral point.

In large generators the armatures are generally mounted directly on the engine shaft, and, therefore, either the settling of the engine bearings or generator frame, or the wear in the bearings, may cause the armature to get out of its true position central to the bore of the pole-pieces. This eccentricity will promote sparking, and, if allowed to proceed too far, will cause very serious damage. It must be corrected at the start by lining up.

Satisfactory operation of generators involves as an essential condition the careful support and thorough insulation of all wiring connections, both on the machine itself and between the machine and switchboard and also involves the good condition of rheostats, switches, instruments and circuit-breakers. In the case of alternators, especial care must be given to the exciter and its accessories, as a failure at this point disables the generator.

Finally, the most important consideration of all is to keep all parts thoroughly clean. Compressed air (free from water) should be used to blow out the inaccessible places at least once each week.

Motors.—The most important requirement for the satisfactory operation of motors, after cleanliness, is the proper care of the commutator. This part should be perfectly smooth and should show a hard, dark, glossy finish when running. When installing a motor or changing an armature the following conditions should be observed before starting up:

(a) The armature shaft must be perfectly straight with smooth bearings.

(b) The commutator must be smooth and must run true with the shaft.

(c) The commutator must be free from short-circuits which may have been left by recently turning it in a lathe.

(d) The bearings must fit snugly to prevent lateral play of the armature.

(e) The brushes must be properly adjusted to prevent sparking.

(f) The armature should have a slight amount of end play.

(g) The motor gears, or the pulley and belt, must not cause serious vibration to the armature.

(h) The armature must be well balanced.

If these conditions are faithfully observed and the commutator kept clean, no trouble will arise, except, perhaps, from overloading the motor.

If, however, for any cause, the commutator shows signs of becoming rough, immediate steps must be taken to keep it smooth by the use of sandpaper or grindstone. Do not use emery cloth on a commutator. If the commutator gets "out of round," due to too much sandpapering (which should be avoided as much as possible), it must be turned in a lathe. Roughness causes sparking, and sparking increases roughness. Eventually the insulation between bars deteriorates and causes short-circuits. Such deterioration may be checked at the start, but must be watched very carefully, and, if it grows worse, must be attended to in the repair shop.

Motor brushes must move freely in their holders, or with their holders, but must not be loose so as to rattle in holders. Brushes should exert a firm, though not excessive, pressure on the commutator. They should bear on the commutator at every point on the wearing surface. New brushes should be sandpapered carefully to obtain a full bearing surface. Shunt and compound motors should have their brushes set a trifle behind the neutral point to prevent sparking.

In the case of motors with self-oiling bearings care must be taken to see that the oil rings run freely and efficiently, and that the bearings are filled with clean dynamo or engine oil. The oil should be drained out and the bearing refilled with new or filtered oil occasionally. The frequency of this operation depends upon the condition of the oil in the bearing. In general, it should be done at least once a month, and more often if the oil becomes dirty. To prevent dirt from getting in the bearings keep all oil covers in place, and use felt dust guards where necessary, as in a cement mill. Where grease bearings are used, keep them well filled with clean grease of a stiffness depending upon the season. Where feed wires are used, or where felt wipers are used, these adjuncts must perform their functions satisfactorily. As bearings become worn and allow lateral or vertical play of the shaft, they must be replaced or relined. The amount of wear allowable depends upon the clearance from the armature surface to the pole faces. The armature must not strike the poles. It is needless to say that armature journals must be smooth to prevent cutting.

The wiring around the frame and between the fields of a motor should be kept in good condition, which means that it should be supported neatly and thoroughly and that the insulation should be good.

The auxiliary apparatus, such as controllers, starting and field rheostats, switches, circuit-breakers, fuses and instruments, must be kept up in good shape to insure satisfactory motor operation.

The danger of fire, always present where a motor is operating, is minimized if inflammable substances are kept away from the motor. Therefore, look to the surroundings of a motor. Allow no rubbish to collect near it. Protect all exposed woodwork with asbestos. Avoid the use of wood in the construction of switchboards and other auxiliary apparatus.

Finally, it should be remembered that the most important consideration of all is cleanliness. Keep oil and water from leaking on or around a motor. Use compressed air to "blow out" armatures and fields. If dirt collects in air passages and cakes, as it is apt to in cement mills, the motor will lose its ventilation and will overheat. Therefore, keep the dirt out.

Controllers and Starters.—This class of apparatus is especially subject to the evil influence of dirt, owing to the numerous exposed live parts. Keep clean.

Most reversing controllers are arranged to break no current on reversing switches. In such cases do not allow any disarrangement of working parts to cause current to be broken on the reversing switch.

All except the smaller sizes of reversing controllers are provided with easily renewable contact segments at points susceptible to arcing. Keep segments smooth by sandpapering and filing. If segments become burned or badly worn, replace them and dress surfaces smooth.

Where controllers are provided with blow-out coils trouble will arise if the coils are not in good condition. Keep the connections good and the coils well insulated. Replace damaged coils quickly.

Where temporary jumpers have been placed across open-circuited resistance sections, take immediate steps to repair the damaged resistance.

In the case of starting rheostats provided with automatic no-voltage release coils, do not allow the starter to remain in service if the release coil is damaged. In other words, do not allow the "propping up" of rheostat arms.

In the case of oil starters used with alternating-current motors of comparatively high voltage, keep the oil tank properly filled.

Keep all electrical connections tight and all parts clean.

Switches.—Knife switches are particularly susceptible to the evil influence of dirt. While the switch is open both the blades and the jaws become covered with dust. If this is not removed it is ground into the copper when the switch is closed, not only damaging the surface, but forming an insulating joint. If this is repeated a number of times the resistance of the contact becomes high and the switch runs hot. The heat draws the temper on the jaws and makes the contact worse. Soon the switch is ruined.

Therefore, rub both sides of the switch blade and the inside of each jaw perfectly clean before closing the switch. If this is done faithfully, the switch will never work stiff. Sometimes, however, a very little lubrication may be permissible.

A knife switch that remains closed for a long period of time may gradually heat up. This generally may be overcome by moving the blade in the jaws without actually opening the switch. If it still runs hot, the switch must be opened and cleaned.

In the case of oil switches, the tank must be kept properly filled. The oil should be changed occasionally, as it becomes dirty, using the oil provided for the purpose. The oil tank should be removed occasionally to allow inspection of the contacts and moving parts.

Circuit-breakers.—The same observations made with reference to knife switches apply to circuit-breakers of the blade-jaw type, with the addition that care must be taken to have the instrument properly "set." Circuit-breakers of the laminated-bridge type are even more susceptible to the evil influence of dirt. It is not only absolutely necessary to clean all the contacts immediately before closing each time, but it is necessary to open the circuit-breaker at least once a week for the purpose of cleaning. Otherwise it will surely run hot and begin to burn at the contacts. It is then seriously damaged.

Instruments.—Instruments should be located in a place where they are easily visible, where they are free from mechanical vibration and strong magnetic or electrical disturbance, and where they are not subject to danger of damage.

They should be kept clean, and the electrical connections kept tight.

If lamps are provided to enable reading, the lamps should be in good order and lighted when necessary.

Instruments that are out of order should not be kept in service but should be removed for repair.

Arc Lamps.—Like all other apparatus, arc lamps depend for their satisfactory operation upon their being clean. The mechanism of an arc lamp is especially sensitive to the presence of dirt. The trimmer, or inspector, can avoid much trouble by faithful observance of the law of cleanliness. The top of the casing should be cleaned off every time the lamp is trimmed, for a collection of dirt against a binding post weakens the insulation, even if it does not cause an actual ground at that point. The weak insulation then causes grounds elsewhere.

In hanging any direct-current arc lamp it is very important that current flow through it in the proper direction. The binding posts are marked + or —, and if the polarity of the line is known, as it should be, no mistake need occur. As a precaution, however, the lamp should be lighted immediately after connecting. If it is properly connected, more light will be thrown down than up, and when current is cut off the upper carbon will remain red longer than the lower one.

When trimming a lamp which has spring-clamp carbon holders, care must be taken to force the carbon clear into the clamp—not merely against it.

When an arc lamp is burning properly on a 120-volt direct-current circuit, or two in series on a 240-volt circuit, the arc should be about three-eighths inch long. If the length varies much from this amount, something is wrong.

If there are two lamps burning in series on a 240-volt direct-current circuit and one goes out because the carbons become exhausted, no trouble should result. But sometimes one lamp goes out for some other reason, in which case damage may result to one or both lamps. Therefore, when it is noticed that a lamp is out, always investigate. It should either be cut out or trimmed at once.

In cutting a lamp in or out, be sure to throw the cut-out switch clear over.

The electromotive force on a series arc circuit is generally high enough so that leakage alone makes it dangerous to handle live wires and lamps without great caution. Never stand on the ground and handle a series arc lamp connected to a live circuit.

Nernst Lamps.—To determine whether a Nernst lamp needs attention:

First—Determine whether all the heater tubes become red when the current is turned on. If not, the old holder should be replaced with a new one.

Second—Determine how many glowers are lighted. The holder should be replaced:

In the six-glower lamp if two glowers are out.
In the three-glower lamp if one glower is out.
In the two-glower lamp if one glower is out.
In the one-glower lamp if the glower does not light.

Third—After replacing the holder see that all the glowers light up. If they do not, the corresponding ballasts are burned out, and should be replaced.

A new electric railway, 4¾ miles long, has been built up Mt. Vesuvius from Pugliano, the northern quarter of Resina, to the terminus of the old funicular railway. Over most of the route the cars run by adhesion, the ruling gradient being one in 12½, and are propelled by their own motors. In the middle part of the line, however, a grade of one in four makes necessary pushing locomotives, with rack rail; each locomotive is provided with two 80-horse-power electric motors. The cars seat 24 passengers each and can accommodate six more on the platforms. Current is supplied by overhead trolleys and is generated by a power plant at the foot of Monte Cateroin.

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1. This is a reprint of a little pamphlet prepared by Mr. E. B. Clark for the information of employes of the electrical departments of the Illinois Steel Company. Mr. Clark, who is assistant general superintendent of the works at South Chicago, is an electrical engineer. The pamphlet was prepared for the use of practical men, and difficult terms have been avoided. Believing that it will be of value to other practical men than those employed by the Illinois Steel Company, the Western Electrician sought and obtained permission to republish it.

The Theory of Radio-activity.

By Fred J. Hillig, S. J.

The numerous and intricate phenomena to which the disintegration of radium gives rise may be summed up in the following working hypothesis:

The heavy atoms of radium are slowly disintegrating, producing thereby a succession of radio-active substances, each one differing in its properties from the other and from the parent element. The disintegration, which is strictly spontaneous, proceeds per saltum through different stages. The transition from one stage to the next succeeding stage is marked by the expulsion of rays. Variations of temperature between 450° C. and — 180° C. do not affect these transmutations, nor is any other molecular force known to have an influence on them.

In the process of disintegration three distinct stages can be distinguished:

(1) The first stage is that of the undissociated metal radium. As such the radio-active element has the atomic weight 225 (Curie), or 257.8 (Runge & Precht), and belongs to the alkaline-earth family, with magnesium, calcium, barium and strontium as members. When the atoms of this element first break up, a new substance is produced, marking:

(2) The second stage, or that of the "emanation," as the first derivative substance is called. The emanation behaves like a gaseous vapor, having the atomic weight 100. The life of the emanation is very short, averaging only 7.79 days, after which time the emanation atom has entirely passed over into:

(3) The third stage, or that of the "active matter." It is this active matter which gives rise to the phenomenon of induced or excited activity.

At each one of these stages rays are emitted from the substance marking the respective stage, and hence, the sum total of radiation is derived from the three radio-substances, the element, the emanation and the active matter, all three radiating simultaneously.

On account of their different properties it has been possible to distinguish at least three kinds of rays, which have been termed α-rays, β-rays, and γ-rays, respectively. They all possess the common property of discharging electrified bodies, of traversing opaque bodies, and of affecting the photographic plate.

The α-rays, whose nature has been thoroughly investigated, principally by Rutherford, are by far the most important, constituting, as they do, about 99 per cent. of the total energy radiated. They are an integral constituent of the radium atom, and are given off during the different disintegrations. Only 25 per cent. of the α-rays come directly from the element radium; the remainder originates from its successive disintegration products, viz., the gaseous emanation and the matter causing excited activity, the momentum with which they are expelled varying somewhat with the substance from which they are derived.

The heating effect of radium directly accompanies the α-radiation from it and is always proportional to it.

The α-rays are material particles about the size of a hydrogen atom, carrying a positive electric charge and moving with a velocity of about one-tenth that of light. A layer of air, a few inches thick, or a thin aluminum sheet, are almost opaque to these rays. They possess electrical and magnetic deviability, but to an exceedingly smaller degree than the β-rays, and in opposite direction, which difference furnishes an easy means to separate the two kinds of rays.

The scintillations in the spinthariscope are caused by the α-rays, which impinge upon the crystals of the blende, provoking cleavage of the latter, and thus produce the flashes of light, or scintillations, which are seen in that instrument.

The suggestion that the α-particle is an atom of helium has not yet been experimentally proved.

The β-rays consist of high-velocity cathode rays, or negatively charged particles of matter about one-thousandth of the hydrogen atom, projected with a velocity approaching that of light. They have a much higher penetrating power and a greater magnetic deviability than the α-rays. Like the α-rays, they convert air through which they pass into a conductor of electricity. The γ-rays, which, with the β-rays, constitute only one per cent. of the energy radiated from radium and its transition forms, always accompany the production of β-rays. The γ-rays are always proportional to the total radiation, and are therefore used to measure the latter.

The γ-rays are no particles of matter; they are not deviable by a magnet, and possess no charge; but they are extremely penetrative, much more than even the β-rays; of all known radiation they resemble the X-rays most in their character, and by some are supposed to be nothing else than X-rays. But Strutt, who has carefully examined their nature, has found that the γ-rays differ from the X-rays as regards their ionizing effects on various gases. Taking the ionization of air as a unity for the three species of radium rays and for Roentgen rays, the ionization, say, of carbon tetra-chloride comes out as 5.34, 5.83 and 5.67 for α β and γ-rays, respectively, but 45.3 for the X-ray. In methyl iodide the difference is even more pronounced.

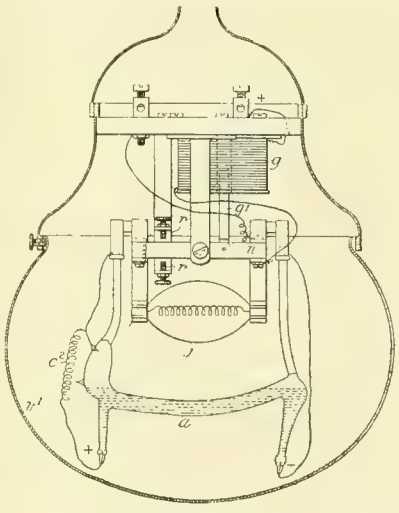
First Electric Railway in Peru.

The electric railway between Lima and Chorrillos was put into service in February last. It is the first one to be operated in Peru. The new road is eight miles long and reaches at present to Barranco, a popular neighboring seaside resort. The purpose of the road is to afford cheap and rapid transit between Lima and the much-frequented bathing resorts of Miraflores, Barranco, Buen Pastor, Chorrillos, etc. The road is destined, it is believed, to do much toward the future extension of Lima, which is rapidly losing its almost mediæval character and is reaching out quite perceptibly in various directions—the new movement being characterized by the erection of handsome buildings of modern architecture and the laying out of broad streets and boulevards. The cars and electric plant are of American manufacture. Soon another electric-railway line, between Callao and Lima will be completed. This road is about 10 miles long and will have a double track. The opening of this road will have a marked effect in drawing Lima and its port, Callao, even more closely than they are at present, and it will probably cause a sensible diminution in the rather high passenger rates now charged by the two (steam) railroads in operation between Callao and the capital.

Bastian Mercury-vapor Lamp.

The accompanying illustration shows the new mercury-vapor lamp of C. O. Bastian, who, with A. E. Salisbury, has been working on the device for some years in England.

The lamp (a) is shown in its normal "off" position. When the current is switched on the series magnet (g) is energized and draws up the core (g_1); this causes the lamp which is attached to the beam (n) to tilt, and the mercury, shown in dotted lines, is thus separated at the negative electrode. The short arc thus formed is subsequently drawn out along the whole length of the tube by the pressure



BASTIAN MERCURY-VAPOR LAMP.

of the mercury vapor generated within the tube. The play of the beam (n) is regulated by the screws (r) (r).

The light of the mercury-vapor lamp, as is well known, is practically devoid of red rays. To remedy this defect a carbon filament lamp (j) can be provided in series with the vapor lamp, and with this combination the resistance (c_2) is required as a starting resistance; (c_2) is automatically cut out when the mercury arc is sufficiently formed. The glass dome (v_1) which encloses the combination being opalescent or ground, the two lamps are indistinguishable from the exterior, and their light combines to form what is practically a pure white light, with which colored articles appear in their true characters. It will be noted that in the Bastian lamp both electrodes are of mercury; the arc appears to be of about the same cross-section as a lead pencil, though this is partly due to the magnifying action of the glass tube, and it is normally about three inches long. The device adopted and above described for striking the arc is simple in comparison with many of the methods tried by other inventors, and has the great merit that it is purely automatic. The lamp is perfectly self-regulating, being quite indifferent to wide variations of pressure, except as regards the intensity of the light emitted. The efficiency of the vapor lamp is 2.5 candlepower per watt—almost 10 times that of an ordinary incandescent lamp. Each lamp works at from 40 to 60 volts, and takes a current of 0.65 ampere, giving 80 candlepower. The lamps are specially suitable for the lighting of side streets, being for this purpose unquestionably less costly than any other artificial lighting agent, except perhaps the arc lamp; they can be mounted on the top of ordinary standards at a height of 10 feet from the ground.

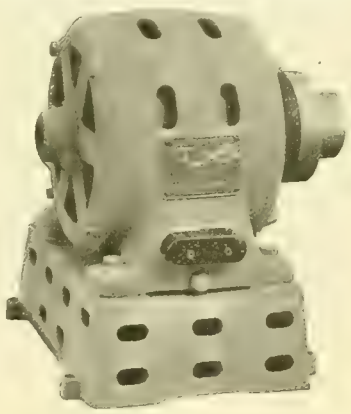
Although the color of the light can be made white as explained above, it is believed that the unmodified light will be found satisfactory for street lighting, besides being slightly more efficient than the combination.

Small Single-phase Motors.

The principal characteristics which the single-phase motor should possess to be commercially successful are: First, high-power factor and efficiency; second, high-starting torque with low-starting current; third, simplicity of design and ruggedness of mechanical construction; fourth, minimum of attention required during operation.

All these conditions are said to be met in the new motor placed on the market by the General Electric Company and illustrated by the accompanying picture. It is of the induction type, without commutator or any electrical connection to the rotating parts. The field, or primary winding, is imbedded in well-insulated slots in the laminated field. Interwoven with the main windings is an independent winding connected to a condenser in the sub-base of the motor. This condenser winding, which becomes excited by transformer action is so located with respect to the several poles of the field as to produce a cross-magnetization or revolving field. The motor, therefore, has the necessary self-starting characteristic. While running the reaction between currents in the armature and the condenser winding in the field slots is such that the condenser winding supplies the magnetizing currents of the motor. The current taken from the line is therefore of high-power factor.

Small motors of the induction type are frequently made with permanently short-circuiting or squirrel-cage armatures. This construction, while economical in cost, gives a starting current three or four times the full load current, which is objectionable on account of interference with the lighting when lamps are operated from the same circuit.



SMALL SINGLE-PHASE MOTOR.

It is well known that this difficulty does not exist in a motor provided with a wound armature having a variable resistance in series with its winding, but hitherto it has been necessary to control this resistance by a hand-operated switch while starting the motor. In the motor here shown this difficulty has been met by an ingenious construction which is entirely automatic in operation. The slotted armature has its star-connected three-phase windings carried to the terminals of a resistance within the armature head. In one end of the armature is located a centrifugal switch which, while leaving the resistance in series with the armature circuit at the time of starting, automatically short-circuits it after the motor has reached about two-thirds full speed. The current while starting only exceeds full load value for a fraction over one second.

The motor is also provided with an automatic friction-clutch pulley which permits the armature and shaft to revolve freely, the pulley with its belt standing still until the motor has reached about three-fourths speed, when the centrifugal weight expands a strap within the hollow rim of the pulley, enabling the motor to easily pick up its load. As the starting of the motor is entirely automatic, necessitating simply the closing of the line switch, the motors will start again without any personal attention should the current supply become interrupted and afterward restored.

For motors below one-horsepower capacity the field winding is of the split-phase type, one phase being directly across the circuit, while during the period of starting the second phase is connected across the circuit in series with a fireproof resistance contained in the base of the motor. This gives the necessary displacement of currents in the two windings to produce the starting torque. The starting circuit is controlled by a magnetic switch located within the frame of the motor, which operates by increase in field current during the period of starting. As the motor approaches its full speed the field current reduces to its normal running value

and the switch automatically opens the starting circuit. These small motors have permanently short-circuited squirrel-cage armatures. The switch contacts (of carbon and copper) are enclosed in a practically air-tight space, so that all danger from arcing is eliminated.

It is asserted that the motors may be safely operated for a short period at a time at 25 per cent. to 50 per cent. overload. Each size of motor has 60 per cent. or greater overload capacity before breakdown. The speed is practically constant from no load up to full load.

Controllers for Machine-tool Service

Controllers, particularly adapted for use with independently driven machine tools, are manufactured by the Westinghouse Electric and Manufacturing Company and are known as types V and W, the assortment being comprised of over 600 different sizes and capacities, to cover all the requirements of service. Type-V controllers, Fig. 1, are used upon two-wire single-voltage circuits, eight forward speeds and four reverse speeds being obtained by resistance in the shunt-field circuit. In the type-W, Fig. 2, used upon three-wire two-voltage circuits, the speed variations are obtained by means of the two voltages, as well as the shunt resistance, provision being made for six forward speeds on the lower and nine on the higher voltage, and six reverse speeds on the lower voltage.

The controller drum is made of metal and secured to an insulated shaft. The contact strips are of hard rolled copper. The fingers are also made of hard rolled copper and provided with lock nuts and adjusting screws. All parts are liberally proportioned and are made easy of access. The cover can be removed by withdrawing with the fingers the pins which hold it in place, and access to the leads is quickly obtained by removing the strips screwed

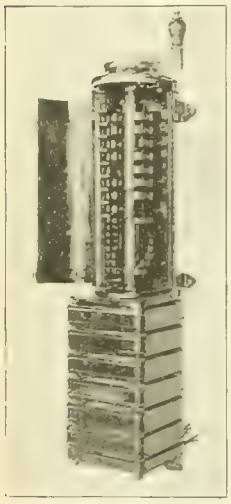


FIG. 1. CONTROLLER FOR TWO-WIRE CIRCUITS.

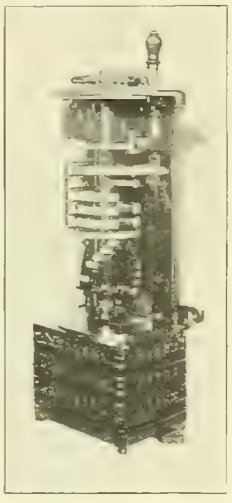


FIG. 2. CONTROLLER FOR THREE-WIRE CIRCUITS.

to the back of the controller. The contacts, the arcing tips on the main contacts and the fingers are easily removed and renewed.

Another important particular which assures the adaptability of these controllers to various conditions is the fact that the handle and ratchet are so designed that they may be removed from the controller and placed at any point which is convenient, and which permits connection to the controller by means of bevel gears and shafting. This not only adapts the apparatus for distant control, but it enables the operator to use the identical handle, ratchet and indicator dial which are furnished with the controller.

The notches in the ratchet are positive, and the design is such that as each step is reached a key drops into a notch and stops the handle, holding it firmly in place until released by a pressure upon the thumb stop in the end of the handle. The operator is thus able to watch his work uninterruptedly while applying power or changing the speed.

In the type-V controller the starting resistance is inserted when the first contact is made, being cut out when the handle is moved to the second position. In the type-W, a cam lifts from the contact the finger whose function is to cut out the starting resistance, and thus leaves the resistance in circuit when starting or when changing to a higher or a lower voltage. By means of a dash pot, the return of the finger is delayed for a predetermined interval of time, the speed of the return being regulated by means of a screw. The checking medium is a non-freezing liquid. If desired, the dash pot can be removed without disturbing any other portions of the controller.

Arc shields are placed between all contacts which carry the main current, and, in addition, all sizes above 10 horsepower have a powerful magnetic blowout coil. In capacities to and including 10 horsepower the resistance, which is of the embedded type, is regularly mounted directly beneath the controller. In larger sizes it is mounted separately. The leads are conveniently located and have screw connectors.

CORRESPONDENCE.

Great Britain.

London, April 9.—An important announcement has been made in connection with the relations between the Marconi Wireless Telegraph Company and the government. The great bone of contention between the company and the Postoffice has been that the latter will not accept messages received by the company for inland transmission in the same way as is now done for the submarine cable companies. The reason for this on the part of the Postoffice has been repeatedly given in Parliament, and is that the technical advisers to the Postoffice were not satisfied that long-distance wireless telegraphic transmission was in such a state of perfection as to warrant the Postoffice taking messages in the manner desired. Negotiations have been constantly proceeding, however, and the public statement is now made that the Postoffice is ready to conclude an agreement with the company, presumably with this object in view, although the specific details have not yet been divulged. But the view of the company is that the heads of the agreement in contemplation will give the greatest satisfaction to the public generally, while safeguarding the interests of the shareholders.

Reference was made a few weeks back to the passing of a bill by a committee of the House of Commons authorizing the Dolter Surface Contact Electric Traction Company to construct a few miles of tramways upon its system in Torquay. When the bill was before committee it was found that the company, in order to gain the consent of the local authority to its proposals, had inserted a clause giving special protection to the corporation in respect of possible damage to its gas pipes, etc., from electrolytic action, and on the strength of this agreement the committee insisted that a similar clause should be given to the Torquay Gas Company. When the bill came before the preliminary authorities of the House of Lords, however, it was decided that both clauses were practically unprecedented, or, at any rate, had been deleted from another bill last year. Consequently both of them have been struck out of the bill. Another matter which the House of Lords has interfered with is the agreement between the Torquay corporation and the Dolter Electric Traction Company. Naturally to all this the municipal corporation strongly objects, and it is quite possible that the spectacle may be witnessed of a local authority opposing a scheme which it has already sanctioned and supported. At any rate, it is suggested that a petition against the bill should be filed in order to express the council's strong disapproval of the action of the House of Lords. This opinion of the Torquay corporation is to be communicated to the House of Lords, before a committee of whose house the bill still has to come.

The "electrified" lines of the Northeastern Railway Company have at last been put into public service. Only a small portion of the route, however, is at present in operation, but the time taken for this part of the journey was some 25 per cent. less than that under the old steam regime. Practically the whole of the track upon the Newcastle suburban lines has been converted, and it is merely the delay in the completion of the power house that has been responsible for the belated opening of the lines to the public.

The Wolverhampton corporation has just received parliamentary powers at the hands of a committee of the House of Commons, for the construction of several further miles of electric tramway upon the Lorain surface-contact system. The agitation against this system which so manifested itself last year seems now to have quite died out.

A statement has been made in the House of Commons concerning the enforcement of the rules which were drafted for the application of electricity in coal mines by a departmental committee. These regulations were abstracted in the Western Electrician. The government is now of the opinion that the rules in question are so numerous and complicated that some time should be allowed for their consideration by mine owners and managers.

The moderate members on the London County Council have raised the question that the actual receipts upon the London County Council electric tramways have fallen short of the estimates made at the commencement of the financial year in March, 1903. The council admits that there will be a possible shortage of some $300,000 at the end of March, 1904, as compared with the estimates, but the matter is to be dealt with again at a later period. The council has decided to erect a temporary generating station at the works of the City of London Electric Lighting Company for the purpose of further supplying electrical energy to its southern tramways. Two such temporary plants already exist—one at Loughborough and the other at Greenwich—but they will all be dismantled when the main permanent power station at Greenwich is completed. The proposal to construct a tramway along the Victoria Embankment has once again been rejected by the House of Commons.

The Goldsmiths' Company has placed the sum of $5,000 in the hands of the Royal Society as the nucleus of a radium-research fund, with the object of assisting and stimulating research in this direction. The Royal Society has gladly availed itself of the offer.

G.

New York.

New York, April 16.—The highly obnoxious "near-side" car-stopping ordinance was repealed this week. Now that the former state of things is to be restored, not a few folk are coming forward to defend the near-side system, for it is urged that on quite a number of streets, known as fire streets (that is, thoroughfares specially paved with asphalt and along which the fire apparatus traverses the city), it has always been and always will be compulsory for the cars to stop on the near side of crossings, even when no passenger desires it.

The Pennsylvania Railroad Company is taking steps to acquire all the real estate on both sides of Thirty-second Street between Ninth and Tenth Avenues. This is a considerable addition to its original plans for the New York terminal, which will occupy the whole of the adjacent block, but it is not stated precisely for what purpose the additional property is needed. The extra cost of this scheme will be about $1,500,000, the passenger station and surroundings being already estimated to cost $10,000,000.

Mayor McClellan is considering a proposal to create the office of chief lineman, the occupant of which shall supervise the telegraph system of the Police Department. The salary of the office will be not less than $1,200 and not more than $1,500 per annum.

It now appears that an oversight of Lighting Commissioner Oakley, by failing to insert in the advertisements for lighting tenders words enabling him to reject unsatisfactory bids, will oblige him to accept the one and only tender received for the street electric lighting, in spite of the evident fact that competition has been eliminated in this matter.

A third-rail accident occurred on Tuesday morning. A workman at Bleecker Street dropped his chisel on the contact rail, with the result that for a few moments there was a short-circuit, but luckily the chisel soon fell to the street below. On Thursday morning a horse fell into an excavation full of live-power wires. It is not known whether or not the animal experienced any shock, but the men engaged in the work of rescue acted in a very gingerly manner, and it took four hours to disentangle the beast. On Thursday morning also the axle of a Brooklyn Bridge car broke, and short-circuited the bridge cables at a busy time, resulting in the tying up of a portion of the traffic for an hour. For some reason not explained it is noticed that whenever the bridge wires get short-circuited there is invariably a long delay in turning off the current.

Some smart work was done a few days ago by the local fire department in extinguishing a fire which broke out in the warerooms of the Carleton-Chase Electric Company at 24 Hudson Street. The conflagration threatened to assume large proportions, but in less than an hour the blaze was over. At another fire at Bergen Beach this week some difficulty was found in getting the engines to the scene, and by a lucky inspiration they were hitched on to a couple of trolley cars and so conveyed at high speed to Bergen Beach.

There was a heavy snowstorm up state yesterday, which seriously impeded the street-car traffic over a large area. At Buffalo many of the lines were suspended altogether, while at Syracuse the tracks could not be cleared on account of the snowplows having been stored away for the summer season. Reports of traffic delays come also from Rochester, Ithaca and Glens Falls.

Very early on Tuesday morning fire destroyed about 30 trolley cars in the shops of the International Railway Company at Cold Spring, Buffalo, the loss being estimated at about $150,000. The cause of the fire was a car igniting while standing on a switch near the paint shop.

An interesting event on Wednesday was the trip through the New York subway made by August Belmont, John B. McDonald and other officials of the Interurban company from One-hundred-and-twenty-fifth Street to City Hall. The improvised train on which they traveled was propelled by an oil locomotive. This is the first time that a train of any kind has been through the tunnel, previous journeys of inspection having been made on cars moved by the hand power of Italian workmen.

On interesting outcome of the taking over of the Staten Island Ferry by the city of New York is a scheme to elevate the car tracks at the Staten Island end. Dock Commissioner Featherston is responsible for the proposal, which is necessitated by reason of the larger ferry boats which will be used, and the carrying out of the project will place the Staten Island traction companies on an equal level in more senses than one.

The Electric Launch Company of Bayonne, N. J., is in receipt of an order from the United States War Department for 120 boats for the Artillery Corps to be used in placing submarine mines. The boats will be capable of handling 500-pound mines.

At Trenton, N. J., on Thursday a charter of incorporation was granted to the Indiana and Michigan Electric Company. The capital is $2,000,000. Another new incorporation is the Northern Electric Company, with a capital of $10,000, the directors being T. J. Ryan, Lulien Barnes, Jr., and C. A. Schriefer, all of New York city.

The $20,000,000 worth of notes of the American Telephone and Telegraph Company, which were bought by Speyer & Co. of this city, and Lee, Higginson & Co. of Boston, were sold rapidly. The notes are for three years at five per cent., dated

May 1, 1904. They were offered in a limited amount simultaneously in London, Paris, Berlin, Frankfort and this city, at, it is said, 99 and interest, which is equivalent to a 5⅛ per cent. basis. The notes are secured by $25,000,000 of the company's four per cent. bonds, and they are deliverable on May 10th.

An enterprising firm of shoe retailers is now calling attention to its stores in this city by exhibiting small tubes of radium in each of its establishments. Appended to each tube is a copy of a certificate from Professor George B. Pegram to the effect that the radium is the genuine article imported from the Curies' laboratory at Paris. D. D. W.

New England.

Boston, April 16.—The Massachusetts railroad commissioners have been asked to approve an issue of $100,000 additional stock and $200,000 more in bonds by the Boston and Worcester Street Railway Company for the purpose of adding to double-track facilities and rolling stock. The capital now issued amounts to $1,465,000 and the bonds to $1,250,000.

At a meeting of the directors of the Hoosac Valley Street Railway Company in North Adams last Saturday it was voted to seek authority for an issue of $100,000 additional stock and $300,000 additional bonds, bringing the former up to $500,000 and the latter up to $400,000. Plans for extensive construction work necessitate the proposed increases. Colonel Frank S. Richardson, president of the company, resigned his office and retired from the directorate on account of pressure of other business and A. H. Rice of Pittsfield was elected as his successor. Ezra D. Whitaker, ex-treasurer of the company, was elected vice-president to succeed Mr. Rice. The vacancy in the board of directors will be filled later.

The Skowhegan and Norridgewock electric railway has been sold at auction to Amos K. Butler for $10,500. The property includes six miles of road in Skowhegan, Me., and suburbs, and it operates a mail route paying $250 anuually. The road was built in 1894 at a cost of $56,000 and over $10,000 has been expended on it since. A summer-resort park is included in the outfit. B

Indiana.

Indianapolis, April 18.—Construction work was resumed by a large force on the Kokomo-Logansport division of the Indianapolis Northern branch of the Indiana Union Traction Company's system. Much of the work on the road that was done last fall must be done over on account of the recent floods. One of the biggest tasks will be the raising, straightening and replacing of the new steel bridge over the Wabash River, which now lies in the bottom of the river. General Manager A. L. Drum announces that he will at once begin the construction of the company's lines connecting Muncie with Alexandria and Anderson with Elwood and Frankton. The Anderson-Newcastle line will also be built this spring, and subsequently this line will be extended to Cincinnati. It is highly probable that the Muncie and Portland traction line will also be built through to Celina, Ohio, by way of Albany, Dunkirk, Redkey and Portland.

The directors of the Muncie, Hartford City and Ft. Wayne traction line will extend the road to Ft. Wayne at once. The company is having some trouble with the City Council at Bluffton, because the franchise offered provides for stopping of cars at all street crossings. This the company does not want to do.

The Dayton and Greenville Traction Company, the Union City Traction Company and the Dayton and Muncie Traction Company have effected an agreement and filed articles of merger. This arrangement will give a direct line between Muncie and Dayton, Ohio. The new organization will be known as the Dayton and Muncie Traction Company, and the service through to Ohio will be opened at once.

The survey of the Oil Belt traction line from Alexandria to Hartford City was begun last week. It is proposed to have this road in operation by next fall. This company and the Indiana Union Traction Company each have a franchise in East Washington Street, Alexandria, and the first to occupy it will get the right-of-way.

The power house of the Indianapolis and Cincinnati Traction Company at Rushville is rapidly nearing completion. The smokestack that is rising above it will be 190 feet high and 17 feet in circumference.

The Evansville and Princeton Traction Company has passed to the full control of the Heston interests of Princeton. This was accomplished by the purchase of stock from the Evansville holders. The company is rock-ballasting the line, with a view to reducing the running time of the 38 miles to one hour or less.

The through-trip tickets from Indianapolis to Dayton, Ohio, now for sale, are proving very popular. These tickets bear coupons that are good on the three lines—the Indianapolis and Eastern, the Richmond Interurban and the Dayton and Western.

The Wabash-Rochester Traction Company is asking for 20 acres of ground and the subscribing for $50,000 of the company's bonds in consideration for the locating of its power house. A mass meeting was held at Rochester on the 15th, and efforts made to raise the required amount.

The Town Board of Roanoke has contracted with the Ft. Wayne and Southwestern Traction Company to light the streets and business houses. A substation will be removed to Roanoke and a new depot built in connection with it.

The local electric-lighting plant of Jasper has been purchased by the Town Board for a consideration of $7,400. The board will make improvements.

The Bicknell City Council has granted a franchise to Joseph H. Barr & Co. to erect and operate an electric-light, heat and power plant in Bicknell.

The City Light and Power Company of Booneville has filed articles of incorporation for the purpose of building an electric-light, heat and power plant in Booneville.

Taylor O. Ballard has resigned as superintendent of the Franklin Electric Light Company's plant and has been succeeded by P. F. Morgan. The new superintendent proposes to make necessary improvements and purchase the necessary machinery to insure satisfactory service. F.

Ohio.

Cleveland, April 16.—It is said that the attempt to get a bill passed that will allow the tracks of the Miami and Erie Canal Transportation Club to be used for steam-railway purposes has been given up.

L. H. Henderson has been engaged in securing rights-of-way for the Ohio River and Western Railway Company, which is planning to build a line from Zanesville to Bellaire. It is said that the passenger business will be handled with electric cars and the freight by steam-railway trains.

The car barns of the Canton-Akron road at Massillon collapsed recently, and the building is almost a total loss.

Traction lines about Steubenville are arranging a schedule by which they will be able to make close connections, and thus insure patrons the best possible service.

The De Forest wireless system of telegraphy was put in operation between Cleveland and Buffalo Thursday. The first messages sent were exchanged between the postmasters of the two cities. The plants have been in course of construction for some time.

Mass meetings are now being held in Cleveland to discuss the franchise question. At a meeting held this week the citizens decided that nothing but seven tickets for 25 cents, universal transfers and better service could be accepted in exchange for an extension of franchises.

It is said that the general offices of the Cleveland, Painesville and Ashtabula electric road may be moved from Cleveland to Painesville, in order that they may be nearer the seat of operations. Within a short time the arrangements will be made to connect this line with the Cleveland, Painesville and Eastern, and through cars will be run from Cleveland to Ashtabula.

A bill has been passed by the General Assembly giving waterpower companies the right of eminent domain, in furnishing electricity generated by such power.

The American Car Brake Company of Cleveland has been incorporated with a capital stock of $50,000, by Theo. E. Felt, L. J. Glenn, Robert K. Mickey, Adelbert J. Robson and George Reese. A plant will be built within a short time for the manufacture of a power brake, to take the place of the air brake used on both steam and electric cars at the present time.

Back platforms may be done away with on the new cars which the Cleveland Electric Railway Company has ordered. The room thus saved will be devoted to a smoking compartment or utilized for seats in the regular way.

An arrangement has been completed by the Western Ohio Railway Company and the Dayton and Troy Traction Company by which a through service will be inaugurated between Lima and Dayton. Each road will furnish a car, and two trips each way will be made daily.

The Lancaster Traction Company of Lancaster will erect a handsome office build on West Main Street in that city. The Scioto Valley Traction Company will use it for offices and station purposes.

The Banner Electric Company of Youngstown has been incorporated with a capital stock of $100,000 by N. L. Norris. Thomas Carr, F. C. Kirchner, C. S. Croon and O. W. Cassady.

The Toledo Northwestern Railroad Company of Toledo has been incorporated with a capital stock of $10,000, to build a line from Toledo to Jackson, Mich. C. W. Merrill, J. M. Ormund, R. W. Barton, W. C. Gayhart and H. C. Adams are the incorporators.

An extension will be built to the power house of the Toledo Railways and Light Company for four new boilers that are now being built in Toledo. The contract for the building will be let within a short time.

The Conneaut and Erie road in Ohio will shortly be merged with the company of the same name in Pennsylvania. The companies were both organized to build the line from Conneaut to Erie, Pa.

The new turbine power plant of the Portsmouth Railway and Light Company at Portsmouth has been completed. Two turbine engines are now in use and another will be added within a short time.

Manager F. O. Olson of the Sandusky Southwestern states that the $1,500,000 bond issue has been taken by the United States Investors' Surety Company of New York. The system planned by the company will be 161 miles in length and will connect Sandusky, Lima, Kenton, Bellefontaine and Wapakoneta.

Not much has been said of late in regard to the state franchise-commission bill, but it will doubtless have considerable opposition when it comes up. Some changes may be made in it that will make it more suitable to the public in general. Outside of the large cities, no serious objections seem to have been made to it, but city officials desire to have matters completely in their own hands.

It is now thought that the National Carbon Company of Cleveland may erect a plant in Chicago for the manufacture of a specialty. A meeting will be held soon to take action on the preferred dividend, when this matter may also receive further attention.

A bill has been introduced in the General Assembly making is possible for municipalities to build and operate street railways operated by any power except steam. The bill enumerates the powers that a municipality may exercise in the matter. Should it pass, they will be able to transact any business that a corporation now does. O. M. C.

Michigan.

Detroit, April 16.—A. B. du Pont has returned to Detroit and was banqueted here Saturday night. He denies the statement that he lost his position as manager of the St. Louis street-car lines on account of labor trouble. The reason of his leaving, he says, was that his friends sold out their interests.

A judgment has just been awarded the Seidler-Miner Company of Detroit against the village of Trenton in the Circuit Court for $3,000 for work done for the village in connection with the new municipal lighting plant. The court will probably be asked to spread the amount of the judgment on the tax-roll.

The proposed interurban railway between Jackson and Toledo seems to be in fair way for construction. Nearly all right-of-way has been purchased. All the village franchises have been secured, and nearly all of the township franchises. The survey has been commenced.

The Bay City council is considering a plan for throwing over the proposition to bond the city for $50,000 for a municipal lighting system. It was voted recently, by a small majority, to bond the city for this amount.

The Lansing and St. Johns railway, which has been operated as a steam road, has just been equipped with electric power. B. J. Arnold's single-phase traction system was not, however, adopted, as was originally intended, as the experimental motors, it will be remembered, were recently destroyed by fire. Mr. Arnold's invention may be applied later.

The stack at the Escanaba Street Railway Company's power house was wrecked by a severe rainstorm this week, which caused the suspension of street-car service and also all other lines of business which were supplied with power by this company. C. G. W.

Northwestern States.

Minneapolis, April 15.—The council of Duluth, Minn., is formally on record as favoring a municipal electric-lighting plant to furnish city and commercial lighting.

Henning, Minn., is considering the advisability of installing a plant for lighting the streets of the city.

The council of Albert Lea, Minn., will consider the cost of installing an electric-lighting plant by the city.

The Citizens' Railway and Light Company and the Davenport and Suburban Company have accepted the franchises recently granted them at Muscatine, Iowa.

The Berry interests were voted a franchise at Iowa City, Iowa, for the interurban line from Davenport.

L. A. Tinnes will put in an electric-light plant at Bird Island, Minn.

Bids will be received by the city clerk at Rochester, Minn., for electric apparatus and wire for the lighting plant. R.

Rocky Mountain States.

Salt Lake City, Utah, April 14.—The establishment of a plant and the construction of a tunnel at the Ox Bow in the Snake River, appears now to be a matter of early consummation. The financing of the deal was the work of C. M. Mullen of Baker City, although ex-Governor Hunt of Idaho has been named as the president of the corporation.

Work on the Harriman-Reno electric road is to be commenced within a few weeks, according to a recent statement made by the management. The leading promoter of the proposed system is S. W. Griffith of Fresno, Cal.

A local branch of the Amalgamated Association of Street and Electric Railway Employes has been established at Salt Lake City with a large membership. The Utah Light and Railway Company's manager, however, expresses the determination of the company to continue to employ non-union men.

The Ogden Rapid Transit Company of Ogden, Utah, has received a large consignment of rails, with which it will repair and [illegible]

The Independent Telephone Company at Salt Lake City, Utah, will be ready to commence operations within a few days, all the [illegible] way of laying cable, etc., having [illegible]

G.

Pacific Slope.

San Francisco, April 15.—The supply and repair departments of the San Francisco Gas and Electric Company have been removed from the company's building in Post Street to its new building at Fifth and Tehama Streets. The meter-testing department under Chief Finley is fitted with the latest appliances.

The Arndt-Richmond Electrical Works company has been dissolved, Lester C. Richmond retiring. Paul E. Arndt will continue the business at the present place, 317-319 Mission Street, San Francisco, under the name of Arndt Electrical Works.

H. A. Woods, formerly superintendent of the Independent Electric Light and Power Company, has returned from a business trip to Los Angeles.

A new gas and electric-light plant is being planned for Santa Barbara, for which $50,000 has been subscribed. Within the next week the promoters expect to have $200,000, the amount necessary with which to begin the work. The City Council will be asked to grant a franchise to the new company.

The electric plant of the Humboldt Transit Company is to be located on the west water front of Eureka. Plans are now being perfected by the company's consulting engineer in San Francisco for a 1,000-horsepower plant. It is the intention to sell power.

John C. Limegrover, electrical engineer, has resigned a position at the new Tule River power plant to accept a position with the California Electrical Works, San Francisco.

Among the visitors in San Francisco last week were J. Cross, builder of the Napa and Suisun electric road, and M. Eckart, electrician of the Oroville Dredger Company. A.

Texas and Mexico.

Austin, Texas, April 14.—The City Council of Bryan, Texas, has granted a franchise to H. B. Dorsey of that place for the erection and operation of an electric-light and power plant.

Two applications for franchises to establish an electric-light plant and a waterworks system at Sour Lake, Texas, are pending before the City Council. One application is by Sloan, Maxwell & McVeigh of Sour Lake, and the other is by Mrs. C. W. Allen of Houston.

The Southern Pacific Railroad Company will install an electric power plant at El Paso, Texas, for the operation of the machinery of its railroad shops.

The formal inauguration of the new street-railway system at Tulancingo, Mexico, was made the occasion of a popular celebration on the part of the citizens of the town.

The Luz de Borda Mining Company is preparing to install an electric power plant at its mines in the Maravatio district, state of Michoacan.

The Almoloya Mining Company is asking for bids for the erection of a 150-horsepower electric power plant to be built at Dorado Station, on the line of the Mexican Central railroad in the state of Chihuahua, Mexico. D. W. Shanks is general manager.

It is stated the deal for the purchase of the street-railway system in the city of Hermosillo, Mexico, by an American syndicate is about closed. The proposed consideration is about $800,000 gold. It is the plan of the prospective purchasers to convert the present horse-car lines into electric transit lines. Important extensions of the existing system will also be made. Rafael Izabel of Hermosillo is interested.

The new electric-light plant at Tapatitlan, Mexico, has been formally inaugurated.

The Mexican government has granted to Francisco Garza Trevino of Monterey a concession for the establishment and operation of a large power plant to be located on the Ramos River in the Cadereita district, state of Nuevo Leon, Mexico.

F. J. Marley, representing an American syndicate, has made application to the Mexican government for a concession to establish an electric power plant in the state of Chiapas. It is proposed to furnish power and lights for the city of San Cristobal and neighboring towns.

It is stated that there is at present in use in the City of Mexico electric power to the amount of 14,000 horsepower.

The United Mining and Milling Company is preparing to erect an electric power plant on the Maconi River at Maconi, state of Queretaro, Mexico, for the purpose of affording power for its mining machinery.

A consolidation has been effected of the properties of the Industrial Transportation Company and the Street Railway Company of San Juan Bautista, Mexico. The name of the merged concern is Transportes de Tabasco, and it has a capital stock of $400,000. It is stated that important improvements and extensions of the consolidated street-railway system will be made.

The Sherman Light and Power Company has been organized at Sherman, Texas, with a capital stock of $100,000, for the purpose of establishing an electric-light and power plant. The incorporators are headed by J. Lobit of Galveston.

The San Antonio Traction Company of San Antonio, Texas, is preparing to build its West End electric line. It will make other important improvements.

Governor Pimentel of the state of Oaxaca, Mexico, has purchased a complete electric-light and power plant, which he has donated to the town of Tlaxiaco in that state.

Lic Munecas y Zimavilla has obtained a franchise from the City Council of Campeche, Mexico, for the establishment of an electric-light and power plant there.

The waterfall of El Salto de Santa Ana, situated in the district of Lagos, Mexico, is to be utilized for motive power and irrigation purposes. Jefe Rubio of Lagos is interested in the project.

George B. Hyde of Silao, Mexico, has applied to the Mexican government for a concession to construct and operate three different electric-power plants in the state of Puebla, Mexico.

It is announced that arrangements have been made by which the mines of the district of El Oro, Mexico, will be supplied with power from the great electric generating plant that is now being constructed at Necaxa by the Mexican Light and Power Company. F. S. Pearson of New York, president of the company, is in Necaxa. He said the dam just begun will be the highest in the world with one exception. The wires, insulators and latticed-tower iron poles have all been ordered, and they will soon be upon the ground. The company has just secured the material for a railroad which will be 41 kilometers long, for use in construction work. H.

PERSONAL.

J. F. Lawless has resigned as manager of the San Francisco Gas and Electric Company of San Francisco, Cal.

F. V. T. Lee has been made manager of the Pacific Coast branch office of the Fort Wayne Electric Works at San Francisco.

Lord Kelvin was recently nominated chancellor of Glasgow University by Sir John Ure Primrose, Lord Provost of Glasgow. In the absence of any other nomination Lord Kelvin was unanimously elected.

John P. Moore of Columbus, Ga., until recently with the General Electric Company at Schenectady, N. Y., has accepted a position as electrical engineer for a mining company in the state of Durango, Mexico.

C. E. Senger has received an appointment to the position of assistant superintendent for the California Gas and Electric Company of San Francisco. He will be engaged in various field operations for that company.

W. H. Fitzhugh, superintendent of the municipal electric-lighting plant at Bay City, Mich., has been appointed electrical inspector under the ordinance governing electrical construction, recently adopted in that city.

Raymond Wells of Schuylerville, N. Y., was accidentally killed recently at Speyer Falls. He was a civil engineer employed by the Hudson River Power Company, and while making measurements his steel rod came in contact with an electric wire and he is said to have sustained a shock of 30,000 volts, dying seven hours afterward.

B. S. Hanchett has been made general manager of the Grand Rapids Street Railway Company. He has continuously served this company for 20 years, commencing as an office boy when he was 14 years old. Mr. Hanchett succeeds to the position held by G. S. Johnson, whose death occurred on January 31st.

Henry Rustin, chief electrical and mechanical engineer of the Louisiana Purchase Exposition, has tendered his resignation, owing to continued poor health. Mr. Rustin's health was impaired by the strain of his work and he was forced to withdraw from active duty, his work being taken up last November by Mr. E. B. Ellicott of Chicago, who has since continued to fill the position.

Mr. R. G. Arnold, secretary and treasurer of the Arnold Electric Power Station Company of Chicago, was married on April 5th to Miss Hazel McLane, daughter of Mr. George A. McLane of New York city. After a short trip in the East Mr. and Mrs. Arnold are to return to Chicago and for the summer will take up their residence in Lake Bluff. Mr. Arnold has for several years been connected with the Arnold company, of which his brother, Mr. Bion J. Arnold, is president, and has formed a wide acquaintance among the electrical and mechanical interests of the East and Middle West. Many friends will extend to him their heartiest congratulations on the occasion of his marriage.

ELECTRIC LIGHTING.

It is proposed to construct a municipal electric-light plant at Central City, Ky.

The Gainesville Telephone Company contemplates installing an electric-light plant at Cookeville, Tenn.

H. O. McMair of Citronelle, Ala., is interested in a movement to establish an electric-light plant in Citronelle.

The city of Doniphan, Mo., has granted a franchise for the construction and operation of an electric-light plant in the city.

C. H. Wilkins of Deadwood, S. D., an electrical engineer, has been canvassing the town of Belle Fourche, S. D., relative to the organization of a company for building an electric-lighting, heating and power plant. Plans have been drawn for the building of a plant to cost $8,000.

The City Council of Wilton, Iowa, has called a special election for May 2d to vote on issuing additional bonds for improving the electric-light plant.

The Union Light and Power Company of El Reno, Okla., has been incorporated with a capital of $250,000 by H. T. Smith, R. S. Trulock and E. E. Blake.

Robert Wilson, who purchased the Potomac (Ill.) electric-light plant, will extend the system to Henning, Ill., where he will light the streets and business houses.

The electric-light plant at Haley, Idaho, has been sold to the Idaho Electric Supply Company, of which Mr. Leo Cramer is president. The new management may install new machinery.

The plans for the new municipal electric-light plant at Hannibal, Mo., which is to cost $100,000, have been drawn. The plant will be located at the corner of Front and Center Streets.

A proposition to purchase the municipal electric-light plant at Ocala, Fla., has been made to the City Council by W. N. Camp. Mr. Camp proposes to develop a waterpower near the city which is capable of producing 1,000 horsepower.

Detailed information on the subject of electric lighting at Punta Arenas, on the Strait of Magellan, Chile, South America, can be obtained from the Chilean legation, Queen's Gate Terrace, 29, London, S. W. Bids will be received until June 28, 1904.

ELECTRIC RAILWAYS.

The Fiscal Court of Henry County, Ky., and the Newcastle City Council will sell an electric-railway franchise on April 26th. The applicant is the same company that is now putting in an electric-light and ice plant at Eminence. It is proposed to connect the two towns, and probably extend the line to the Kentucky River or possibly to the Ohio at Carrollton.

Mayor H. L. Ponder and S. C. Dowell of Walnut Ridge, Ark., were in St. Louis recently to complete arrangements for the organization of the Hoxie and Walnut Ridge Electric Light, Power and Transit Company. The company is capitalized at $65,000, and its primary purpose is the installation of an electric railway between Hoxie and Walnut Ridge. These towns are connected now by a mule-car line.

The fourth annual report of the St. Louis Transit Company shows an increase in earnings of over $200,000. There is still a deficit, but the figures show it to have been reduced that amount. The St. Louis Transit Company leases the United Railway Company. The earnings for 1903 were $7,295,847; operating expenses and taxes, $4,513,514; interest and rental, $2,845,119. The total mileage was 32,535,626, and the number of passengers carried, including those from transfers, was 210,238,108.

At a recent meeting a majority of the City Council of Springfield, Ill., refused to permit a reconsideration of the action of that body in voting to give the Illinois Central Traction Company a perpetual franchise, and thus prevented the consideration of any of the amendments required to protect properly the interests of the city. The nine aldermen who voted away invaluable privileges for all time to come stood together again in resisting the attempt to perfect the ordinance and in making its enactment final, so far as the council is concerned. The mayor, however, at this time has not signed the ordinance.

Interurban interchangeable mileage will be discussed by members of the Ohio Interurban Railway Association at a meeting to be held at the Hollenden Hotel, Cleveland, on April 28th. It is planned to sell a coupon book containing $12 worth of coupons for $10. One coupon will be taken off for each mile of travel. In this way the reduction will be made from the regular rates. The plan will be discussed from every standpoint at this meeting. W. H. Abbott will probably discuss turbines for power stations also, and some other important matters will be brought up.

SOCIETIES AND SCHOOLS.

The conference committee having in hand matters concerning the Union Engineering Building in New York has selected six well-known firms of architects who will join in a limited competition for the plans of the building. In addition, there will be an open competition, in which leading competitors will be compensated by four prizes. The six firms in the limited competition will be paid for their plans. This method, it is believed, will give the committee a wide range of desirable designs. Gano S. Dunn is representing the American Institute of Electrical Engineers on the conference committee during the absence of Dr. S. S. Wheeler, who is in Europe. The committee has secured the service of Professor W. R. Ware to act as its professional adviser in the matter of architectural competition.

In recognition of the services of the late Dean J. B. Johnson of the College of Engineering of the University of Wisconsin, the engineering building has been named Johnson Hall. The building stands as perhaps one of the best proofs of Dean Johnson's

work at the university and it was through a movement originated in the student body that his memory has been thus honored. A fund was also raised with which a handsome oil painting of the dean was made and also a memorial tablet, both of which now decorate the reading room.

The annual meeting of the American Institute of Electrical Engineers, at which the election of officers will take place, will be held in New York city on May 17th and 18th.

The American Society of Civil Engineers announces that it has completed a real-estate purchase which will make possible the enlargement of its clubhouse in New York city.

The programme for the twenty-seventh convention of the National Electric Light Association is rapidly taking definite shape. Papers and reports by the following-named gentlemen are already in press: Charles H. Williams, E. F. McCabe, W. H. Atkins, LaRue Vredenburgh, Arthur Williams, W. F. White, Francis Hodgkinson, Robert Howes, J. D. Andrew, W. F. Wells and W. H. Cole. It has been decided to hold the meeting for four days, the last day to be reserved largely for entertaining and sightseeing in Boston and vicinity, full particulars of which will be announced very soon. The New England Passenger Association and the Trunk Line Association have granted the rate of a fare and a third from points in their territory to Boston for delegates and friends attending the convention. Advice will be sent you as soon as action is taken by the other passenger associations.

PUBLICATIONS.

A steam-turbine catalogue just issued by the Westinghouse Machine Company of East Pittsburg, Pa., is full of interesting and instructive things about this both ancient and modern form of prime mover. A brief history of the development of the Westinghouse-Parsons steam turbine is at first given, followed by the principles and methods of construction of the modern turbine. The catalogue is handsomely illustrated, an especially fine picture representing a 600-horsepower turbine-generator installed for the Johnston Harvester Manufacturing Company in Batavia, N. Y. Data and results of tests on 13 different turbines of various capacities are contained in the concluding pages of the book.

A mailing card of unique design is being sent out by the Central Electric Company of Chicago. The card contains a map of a part of Europe and Asia showing the route of the Trans-Siberian railroad, Japan also being shown and the scene of the present war. Russia's and Japan's navies are compared in two tabulated lists; lists are also given of the available military forces of each, Russia's troops now in the Far East and important distances. A large map of the seat of the war is given on another side of the card, showing all the cities and railways. The card is instructive and adapted to be carried in the pocket ready for reference in following the progress of the war. A copy may be had upon application.

TRADE NEWS.

Cuthbert & Black, electrical engineers of Chicago, have removed to rooms in the Central Union Block, 271-285 East Madison Street.

J. H. Parker, F. M. Schweers and A. Raedlerin of Chicago have incorporated as the Greer Electric Company and will deal in electrical instruments.

Sargent & Lundy of Chicago, the well-known consulting engineers, will occupy their new quarters on the seventeenth floor of the Railway Exchange, Jackson Street and Michigan Avenue, about May 1st.

The American Electrical Machine Company of New York city, organized by E. M. Waring and C. M. Francis of Brooklyn and L. Mancher of New York, has been incorporated with capital of $50,000.

The place of business of James S. Barron & Co., corner of Franklin Street and West Broadway, New York city, was totally destroyed by fire on April 8th. With characteristic enterprise the firm made immediate arrangements to resume business.

Among recent new Illinois incorporations is the Magnetic Flasher Electric Company of Chicago, incorporated by A. G. Dicus, J. H. Minges and Frank Kraemer. The company has a capital of $50,000 and proposes to manufacture electric-light flashers and electrical supplies.

The Reliable Electric Company, 212 West Clinch Avenue, is a new Knoxville (Tenn.) industry. The members composing the firm are J. C. Kimball and Samuel Levy. Both are well known, having devoted considerable time to the electrical business. They propose doing all kinds of electrical work.

The Nernst Lamp Company has recently removed its Boston office from 131 State Street, to No. 501 Atlantic Avenue. The office will, as heretofore, be in charge of George C. Ewing as district manager, and will carry a complete stock of Nernst lamps and supplies, insuring prompt service to customers.

Rumors of a trade agreement between the Westinghouse Electric and Manufacturing Company and the Siemens-Schuckert Works Company are again afloat in Berlin. It is said that an agreement between the American and German companies would complete the scheme for an interchange of inventions, patents and experience.

The New York Herald of April 16th says: "Deputy Sheriff Porges received an execution yesterday against Thompson, Son & Co., a corporation, dealers in electrical machinery, at 114 Liberty Street, for $3,140, in favor of Henry Schroeder on two notes payable on demand, payment of which was demanded on August 21st last and not paid. Mr. Schroeder was formerly treasurer of the corporation. John H. Thompson, Jr., the president, was served with the summons. The company was incorporated in February, 1901, with a capital stock of $100,000, and has a workshop in Brooklyn."

The Canadian Engineering Company, with a capital stock of $10,000, has been granted a charter to form a company to manufacture engines, boilers and electrical machinery. The office will be in Montreal. The incorporators are William Henderson, George Clark, W. E. Mitchell, W. E. McAllister and George A. Bovin, all of the city of Montreal.

A deal whereby the Taylor Signal Company of Buffalo, N. Y., and the Pneumatic Signal Company of Rochester are to be merged into one firm, to be known as the General Railway Signal Company, is said to have been completed, and the men back of the project hope to have the new concern in operation within 60 days. The company is capitalized at $5,000,000.

Platinum and its allied metals, which depend almost entirely upon the Ural Mountains for their crude supply, have already felt very decided results of the Russian-Japanese war, owing to heavy withdrawals of forces from this mountain district by the Russian government, the effect of which has naturally caused an advance in current rates. For some time there has been an increasing demand for platinum and its alloys in the electrical and chemical fields, which is constantly being supplemented by the increasing use of gas engines, automobiles and various new electrical appliances having platinum contacts and attachments. In consequence of its limited supply and increased demand it is probable that prices will be advanced.

BUSINESS.

The valve equipment illustrated and described on page 292 in the Western Electrician of April 9th was developed by the Coffin Valve Company of Boston and the Northern Electrical Manufacturing Company of Madison, Wis., and both companies are to be credited with its design.

Secretary E. L. Goldschmidt of the Northern Wire and Cable Company, Milwaukee, reports his company as progressing favorably. This institution is devoting itself to the manufacture of magnet wire, and feels that it should receive a liberal patronage from western electrical manufacturers interested in quick deliveries from stock near at hand.

The V. R. Lansingh Company of Chicago, western distributor for the product of the Holophane Glass Company and the Illuminating Appliance Company, announces that it has just received the entire contract for lighting the Singer Manufacturing Company's booth in the Manufactures Building at the St. Louis Exposition. This booth is a large and ornamental one, and the Holophane system of lighting was adopted after exhaustive tests. So satisfied was the Singer company with these tests that it also gave an order for equipping its Sixth Street store in St. Louis in a similar manner.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) April 12, 1904.

756,813. Long-distance Telephone System. Michael Beck, Minneapolis, Minn. Application filed November 12, 1900.

A transmitter and a receiver having a common diaphragm are used. Circuit connections from the telephone bell and diaphragm to the main line comprise a switch lever movable to cut in and out the bell and diaphragm in reverse order. An expansible bulb is connected to the switch lever, and a heating coil within the bulb constitutes a part of the electrical connections to the bell.

756,824. Telephone Selecting Device. Lawrence E. Brock, Celina, Ohio. Application filed May 13, 1902.

Main and local telephone lines, a step-by-step ratchet disk and means for operating it are specified. An auxiliary disk operable by the ratchet disk and having a number of contacts for alternately closing the circuit through the main line and through the local telephone line to thereby insure the proper closing of the circuit after an incomplete rotative movement of the auxiliary disk, is also included.

756,846. Electrogoniometer. Alexandre Grammont, Pont de Cherny, France. Application filed July 10, 1902.

A power-factor-indicating apparatus for alternating-current circuits comprises a local circuit connected on one side in shunt with the main circuit, and inductively connected on the other side with one of the mains. A potential indicator and a phase modifier in the local circuit, and a goniometer or angle indicator, operated by the phase modifier, complete the apparatus.

756,850. Electrical-wire Station. William E. Hamilton, Columbus, Ohio. Application filed June 18, 1903.

A portable electrical-wire station comprises one or more brackets adapted to be mounted on suitable supports, reels formed of insulating material, mounted on the brackets and electrical conductors wound on the reels. Binding posts adjacent to the reels are adapted to engage the conductors and form an electrical connection between them and other conductors whereby the current is cut off from any wire remaining wound on the reels.

756,857. Electrician's Tool. Herbert H. Hutchings, Chester, Pa. Application filed June 19, 1903.

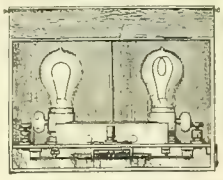
An instrument for stripping wires contains an opening formed longitudinally of a size sufficient to fit a cable. To an extension extending upward from the body of the instrument is pivoted an adjustable knife, the body being provided with a slot through which the knife extends when in its vertical or normal position. A stop formed with the extension limits the movement of the knife in one direction.

756,859. Trolley Catcher. Montgomery H. Johnson, Utica, N. Y. Application filed July 15, 1903.

A trolley-catching device consists of a line reel, vertically movable by a sudden draw on the line, a catch with which the reel comes into engagement when moved vertically, and a spring for turning the reel in winding up slack of the line.

756,864. Electric Lock. Jay Livingston, St. Louis, Mo. Application filed May 22, 1903.

Recessed in an electromagnetic lock is a bolt with a catch for engaging the bolt. An electromagnet for withdrawing the catch, and means for automatically holding the catch out of pawl-engaging position after the magnet has been deenergized make up the details of the device.



NO. 756,976. PORTABLE TESTING SET.

756,870. Electric-railway Switch. Melbourne A. Marks, Jr., Brookline, Mass. Application filed February 4, 1903.

Magnetically operated devices control a switch point. Two pairs of contact bars are supported by a trolley wire; one bar of the first pair being in permanent circuit with the wire, but the other normally insulated therefrom and connected with one of the magnetically operated devices. The two bars of the latter pair are put into circuit by the passage of a trolley wheel between and in contact with them. Both of the first pair of bars are permanently insulated from the wire, but one is connected with the other of the magnetically operated devices, the latter being wired to the trolley wire.

756,891. Rotatory Electric Tube Furnace. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Application filed November 21, 1901.

A tubular electric furnace, open at both ends, is adapted to rotate during its operation.

756,937. Synchronizing Device. Nathan E. Church, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 27, 1902.

Combined with two alternating-current machines are means for indicating to the attendant when the two machines are running at approximately the same speed, means for automatically coupling the machines in parallel whenever they coincide in phase, and a manually operated device whereby the attendant can cause the coupling means to operate or not, at will.

756,941. Spark Gap for Roentgen-ray Apparatus. John T. H. Dempster, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 18, 1898.

Combined with synchronously moving spark-gap terminals are means for adjusting the length of the spark gap while the terminals are in motion.

756,954. Magnet-coil Spool. Henry Geisenhöner, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 13, 1902.

A coil spool for field coils comprises a body member and end-retaining members secured thereto, the retaining members having portions curved to fit the body portion and intermediate portions looped to form [illegible]

756,957. Electric Safety System for Railways. Jacob Hanna and Charles S. Gilman, Rivera, Cal. Application filed May 7, 1902.

A track-rail conductor constitutes one side of the circuit, an insulated normally closed conductor constitutes the other side of the circuit and extends along the track. An electric motor connected to operate the circuit is adapted to operate the air valve of the brakes on a car.

756,960. Rotary-converter System. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 24, 1899.

A number of centrifugal circuit controllers are placed at different points in the distributing station in a distributing circuit. An indicator operated by the several circuit controllers shows which circuit controller has been operated. (See [illegible])

756,966. Panel Board for Electric Distribution. George H. Jones, Chicago, Ill. Application filed November 20, 1903.

Substantially parallel load bus bars, a raceway between the load bus bars [illegible]

load contacts located at intervals along the bus bars are embodied in the system. A meter bus bar, a meter connected to the load bus bar and to the meter bus bar and a set of fixed load contacts, each adjacent to its respective load contact on the load bus bar, but insulated therefrom, are also contained.

756,976. Portable Testing and Comparing Instrument for Electric Incandescent Lamps. Albert McCandlish, George Lane, Bredbury, England. Application filed June 26, 1903.

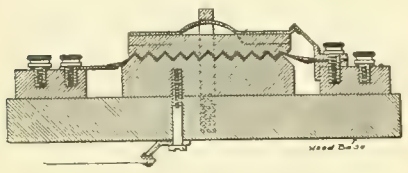
A casing, both ends of which are hinged, is painted black on the inner side. A number of electric-lamp sockets adjacent to a laterally arranged partition at one end of the casing, and on either side, a watt or ampere meter in the other end of the casing, an electric lamp in each of the sockets, comprise the testing apparatus. (See cut on previous page.)

756,979. Handle for Rotary Snap Electric Switches. Charles G. Perkins, Hartford, Conn. Application filed October 29, 1903.

Details are described.

756,980. Electric Railway. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 5, 1902.

Secured above the third rail is a sectionalized metallic protecting strip overhanging the rail on both sides, the adjacent sections of the protecting strip being out of contact with each other.



NO. 757,300.—LIGHTNING ARRESTER.

756,991. Electric Condenser. Matthew O. Troy, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 19, 1902.

Associated with the case of the condenser, consisting of a body portion and a cover, is a terminal for the condenser consisting of a flat piece of metal lying flat against an outside edge of the case.

757,007. Lamp Terminal. Howard I. Wood and Ralph C. Robinson, Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Application filed July 26, 1902.

A main terminal is detachably carried by the conducting rod, and movable clamping means are also carried by the rod, the main terminal and the clamping means being formed with co-operating surfaces for positioning the main terminal.

757,019. System of Motor Control. Frank L. Butler, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 13, 1902.

In the system are embodied a motor controller comprising a number of separately actuated contacts, a pneumatic actuating device for each contact, and a master controller comprising separate and independently actuated valves for controlling the devices individually from a distance. Mechanical means allow of actuating the valves in any predetermined order.

757,030. Signaling Apparatus. Ernest A. Faller, New York, N. Y., assignor of one-half to James W. Chisholm, New York, N. Y. Application filed June 22, 1903.

Combined with a series of rotatable selective devices are a corresponding series of axially supported rotatable make-and-break devices, one for each selecting device, adapted to make continuous electrical contact of predetermined duration and at successive periods with its selective device.

757,031. Semi-automatic Telephone Exchange. Ernest A. Faller, New York, N. Y., assignor of one-half to James W. Chisholm, New York, N. Y. Application filed July 1, 1903.

Displaceable selective devices for use in pre-establishing a signal co-operate with rotatable make-and-break devices, one for each of the selecting devices for transmitting the signal and adapted to make slidable contact with the corresponding selective devices at successive periods. At the central office selecting devices receive the signals and automatically make the desired connections when the operator inserts a plug in the jack above the signal lamp.

757,036. Process of Producing Chemical Compounds. John J. Griffin, Washington, D. C. Application filed January 16, 1902. Renewed September 3, 1902.

Chemical compounds are produced by passing an electric current from an anode of a carbide through an electrolyte which reacts chemically on the carbide and which yields an electrolytic product which will react on the product of the chemical reaction to give the desired compound.

757,056. Means for Protecting Electrical Measuring Instruments. Maurice C. Rypinski, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 25, 1901.

A rod of high resistance is placed in series with the measuring coil to roughly gage the energy of a circuit, and a circuit-closing switch in shunt to the rod permits the energy to be accurately measured.

757,064. Electric Igniter for Gas Engines. Harry J. Smith, Buffalo, N. Y., assignor to the Alberger Company, Buffalo, N. Y. Application filed August 3, 1901.

A trip lever and catch operated by an eccentric on the engine shaft move the make-and-break mechanism for producing a spark.

757,070. Rail-bonding Construction. Edward G. Thomas, Waltham, Mass. Application filed March 19, 1903.

The bond has a flexible portion, each end of which is secured in fixed relation to one of the rails at a point located at a substantial distance to one side of a line passing through the other point and running parallel with the length of the rails.

757,079. Electric Arc Lamp. James J. Wood, Fort Wayne, Ind. Application filed September 4, 1903.

In an alternating-current arc lamp are a regulating magnet having a coil yieldingly supported, a link pivotally connected at one point to the fixed structure and pivotally connected at another point to the coil, and a feed mechanism connected to the armature of the magnet.

757,107. Safety Device for Electric-railway Systems. George Gibbs, New York, N. Y. Application filed August 26, 1903.

Included in the system are a working conductor and the usual circuit-breakers. There is also an auxiliary circuit, and means capable of being energized by current flowing in the auxiliary circuit for opening the feed circuit, a terminal of the auxiliary circuit being in proximity to the working conductor.

757,119. Fluid-pressure Cut-off and Alarm. Robert M. Hughes, Cadiz, Ohio, assignor of one-half to Frank H. Atkinson, Cadiz, Ohio. Application filed February 2, 1904.

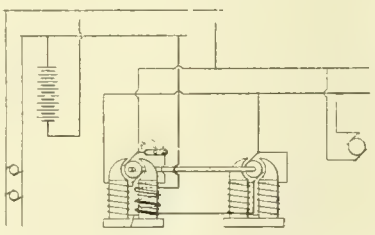
An electric bell is caused to ring by a circuit-closer which operates when the pressure reaches a certain predetermined point.

757,138. Third Rail for Electric Railways. Patrick T. McGowan, Avoca, Pa. Application filed December 22, 1903.

A base consists of opposite, horizontally extending flanges. A web rises from the base, and a laterally extending flange at the top of the web has a brush-engaging side surface that inclines downward and inward.

757,164. Battery Cell. Emerson Whitman, Lynn, Mass. Application filed July 2, 1903.

A cylindrical member of porous carbon is surrounded by a coating of glass, the glass permeating the pores of the porous carbon.



NO. 757,405.—BOOSTER.

757,185. Manufacture of Cyanamide Salts. Georg Erlwein, Berlin, Germany, assignor to the firm of Cyanid-Gesellschaft mit Beschränkter Haftung, Berlin, Germany. Application filed August 16, 1902.

The process of producing cyanamide salts of calcium consists in heating by means of an electric current a mixture containing lime, carbon and a conducting material in the presence of a nitrogen-bearing gas.

757,191. Device for Preventing Railway Collisions. Charles Holtmann and Joseph F. Butler, Pittsburg, Pa. Application filed March 5, 1903.

When the locomotive reaches the point on the track where it is to be automatically stopped the wheels of the two trucks bridge an insulated break in the track energizing a relay, which in turn closes the circuit of a magnet in the cab. The magnet operates the valve of a pneumatic device, which simultaneously closes the throttle and throws on the air brakes.

757,192. Tip or Terminal for Electric Wires. Stephen C. Houghton, San Francisco, Cal. Application filed December 30, 1903.

At one end of a pin is a wire-engaging clamp. A tube through which the pin is projected is supplied with a split ferrule.

757,257. Telephone Receiver Support. James A. Brown, Warren, Ohio. Application filed October 8, 1903.

An arm to hold the telephone receiver to the ear during conversation is described.

757,271. Electromechanical Gong. Frederick W. Cole, Newton, Mass., assignor to the United States Fire and Police Telegraph Company, Boston, Mass. Application filed October 4, 1902.

Electromagnets operate a hammer, which rings the gong.

757,302. Electric Current Regulator. Newton Harrison, New York, N. Y., assignor of one-half to William Henry Laird, New York, N. Y. Application filed April 21, 1903.

Combined with a motor, a generator and switch is a chemical interrupter and a self-induction coil provided with means whereby the sections of the self-induction coil may be thrown into and out of the circuit to vary the self induction in the motor circuit.

757,319. Typesetting or Composing Machine. Jules Lagarde, Clermont-Ferrand, France. Application filed October 29, 1902.

Electrical controlling mechanism for typesetting and composing machines consists of a reader, operated by a perforated strip, which transmits current impulses to a multiplier and the multiplier directs current impulses, according to the order and combination determined by the reader, to circuits operating the keys of typesetting or composing machines.

757,340. Telephone Support. Howard H. Oothoudt and William F. Stahl, Toledo, Ohio. Application filed January 29, 1904.

A metallic bracket arm made of a single piece of wire co-operates with a hinge member to which the ends of the wire are pivoted, the wire being bent to form radial slots. A clamping member carried by each of the slotted portions, and a winged nut and a screw for holding each of the clamping members in an adjusted position are the main features.

757,341. Relay Magnet. William Palmer, Jr., Rincon, New Mexico. Application filed June 14, 1902.

Two horseshoe magnets are arranged parallel to each other. These magnets attract an arm which connects two independent circuits.

757,346. Electric Signal for Railways. William B. Ramsay, Hickory, N. C. Application filed May 29, 1903.

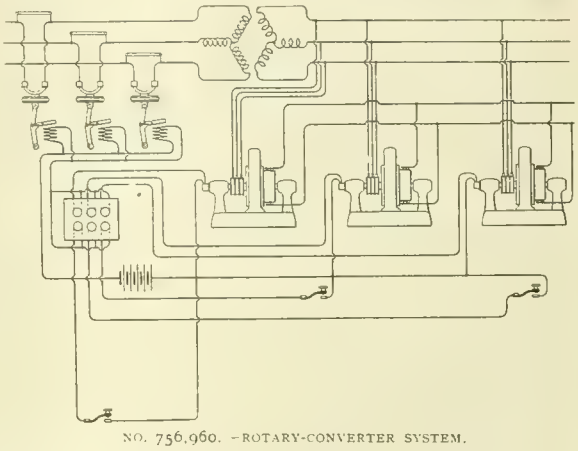
On each train is a local battery and alarm circuit, each of the circuits having two terminals. Traveling contacts engage both the traffic rails and the roadbed conductor. Switching devices are carried by the train, and a double cam is arranged on the roadbed and serves to shift the switching devices and change connections between the terminals of the train circuits and the rails in accordance with the direction of travel of the train.

757,364. Combined Lighting and Alarm Device. John Thorsen, Chicago, Ill. Application filed September 24, 1903.

Details are described.

757,388. Lightning Arrester. Garrison Babcock, Chicago, Ill. Application filed September 20, 1902.

Fixed line and ground carbon plates and a fusible retardation wire between the plates and having its terminals connected respectively in series with the circuit or instrument and provided with a suitable insulating covering are the main features. (See cut.)



NO. 756,960.—ROTARY-CONVERTER SYSTEM.

757,394. Means for Variably Operating and Controlling Electric Motors. Rudolf Eickemeyer, Yonkers, N. Y.; Rudolf Eickemeyer, Jr., Carl Eickemeyer and Mary T. Eickemeyer, executors of Rudolf Eickemeyer, deceased. Application filed June 2, 1893.

Associated with an electric motor having an armature located in a suitable magnetic field and provided with separate windings and commutators, is a switch which separately controls the windings for operating them in series and in parallel, and which, while working the windings in parallel, will also weaken the field of the motor for increasing its speed.

757,396. Storage-battery Grid. George W. Frost, Columbus, Ohio. Application filed February 9, 1904.

A frame, retaining strips on the opposite faces and in staggered relation, and a web extending from each strip substantially through the grid, are the features of the invention.

757,405. Booster Apparatus. Lamar Lyndon, New York, N. Y., assignor to the National Battery Company, Jersey City, N. J., and Buffalo, N. Y. Application filed August 21, 1902.

Combined with a main generator and consumption devices are an auxiliary generator in series on the line and a motor operatively connected with the armature of the auxiliary generator, the motor having two field circuits, one of which is in series on the line and the other of which is provided with a switch whereby the current through that circuit may be cut in or out as desired. (See cut.)

757,406. Booster Apparatus. Lamar Lyndon, New York, N. Y., assignor to the National Battery Company, Jersey City, N. J., and Buffalo, N. Y. Application filed August 21, 1902.

A main generator and a storage battery, an auxiliary generator in series on the line, and a motor operatively connected with the armature of the auxiliary generator are specified, the motor having two field circuits which are wound to oppose each other and one of which is in series with the line while the other of which is in shunt across the brushes of the auxiliary generator.

757,418. Insulating and Suspending Device. Joseph Sachs, Hartford, Conn., assignor to the Johns-Pratt Company, Hartford, Conn. Application filed January 5, 1903.

An insulated and weather-protected hook for suspending arc lights and the like is described.

757,422. Dry Battery. Alfred F. Swan, Bayonne, N. J., and Allen W. Rose, New York, N. Y., assignors of one-half to the Patent Development Company of America, New York, N. Y. Application filed July 22, 1903.

A carbon element extends entirely across the cell and divides it into two parts so as to carry active material on each side of the carbon. The zinc elements are suitably separated from the carbon and the active materials and extend also across the cell.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, APRIL 30, 1904 No. 18

Precautions, Electrical and Otherwise, to Prevent Fire in Chicago Theaters.

One of the Chicago papers said, with grim humor, after the terrible Iroquois Theater fire, "The loud noise you hear is the slamming of the stable door after the horse is stolen." But if the stable door were ajar on the fateful afternoon of December 30th, as, alas! was too true, it is at least wise to secure it firmly now, with such precautions to prevent a similar calamity as human foresight can suggest. A determined effort to do this has been made in Chicago.

After the fire, as will be remembered, every theater in Chicago was closed for six weeks or more, and, as a result of the thorough investigation which followed, stringent ordinances were passed by the City Council relating to the construction and equipment of theaters, which have been rigidly enforced, with the result that the theaters now running are thought to be as safe from a repetition of the disaster as it is possible to make them. Among the last of the houses to open was the Powers Theater, situated on Randolph Street, and the fire-protection equipment of this theater forms the basis of the present article.

Features of safety in the building and its equipment, aside from the providing of ample exit facilities, may be divided into two classes—those things which prevent the breaking out of a fire and those designed to assist in putting out the fire or to prevent its spread, should it once be started.

To the first class belong the general fireproof construction of the stage and auditorium and the especial precautions taken with the electrical installation The second class comprises the fire-fighting apparatus and waterworks system installed in the building, the water curtain and steel and asbestos curtains and the damper in the roof of the stage.

Between the stage and auditorium there is a solid brick wall of the same thickness as the outside walls of the building, making practically two separate structures of the stage and auditorium, the only opening between being under the proscenium arch. Concrete construction has been put in underneath the stage, which has otherwise been overhauled and made fireproof.

The electrical installation has been carefully looked after by the Chicago Edison Company, which furnishes current for the building. The switchboard, which is shown in Fig. 1, is mounted about six feet above the level of the stage floor and in the right-hand corner of the stage, from the viewpoint of an occupant of the stage facing the auditorium. It is supported by angle-iron construction, as shown, and is mounted in a recess with the front of the board flush with the proscenium wall. Back of the board, the recess, walled in solid with brick and cement, is three feet six inches in depth. The dimmers, fuses and all the switchboard wiring are mounted in this recess and are thus shut off from any external fire completely, and no fire which might be caused by the blowing of a fuse or a short-circuit on the back of the board could be communicated to the rest of the building as long as the marble front of the board remained intact. To provide ventilation in the recess, without which the dimmer rheostats would become hot, two air passages lead to the outside of the building, one for the intake and the other for the outgoing air. The door giving entrance to this chamber is two inches thick and is built of two heavy plates of steel with an air space between. The dimmer rheostats are controlled by wires running over pulleys, the wires running through small holes in the marble and being operated by shafts, shown at the top of the board in the picture. The floor on which the board rests, and which is supported by steel beams, is of slate 1¼ inches thick, the crevices filled with cement.

From the switchboard the electrician can control the stage lighting, the auditorium lighting and the motors which operate the steel curtain and the pumps. There are, however, 27 exit lights which cannot be controlled from the switchboard, being fed directly from the outside mains, and controlled from the lobby adjacent to the foyer. These are placed over each exit and must be kept burning at all times during a performance and as long as the house is occupied before and after. These exit lights are also supplemented by sperm-oil lamps, which are to be used if, by any chance, the current supply is interrupted. All corridor and hall lights are also controllable only from the lobby.

The motor for raising and lowering the steel cur-

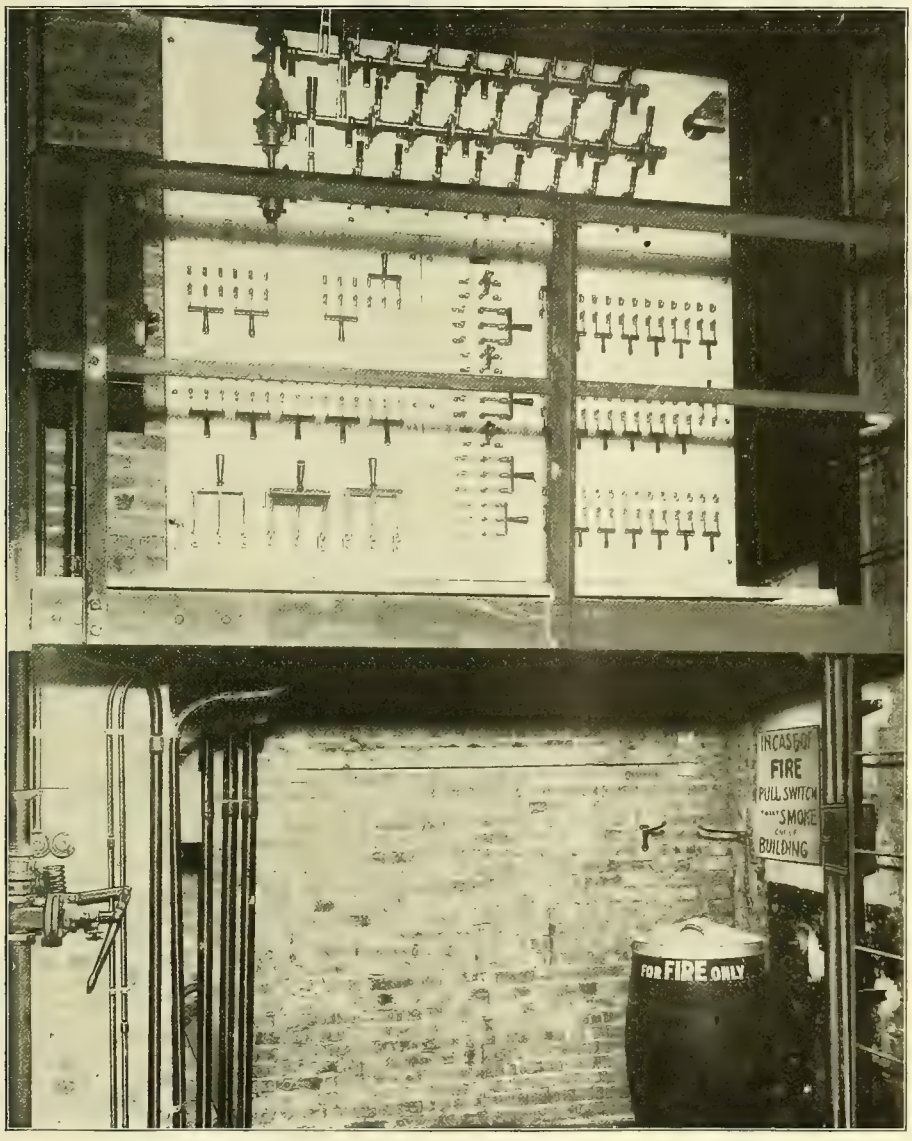


Fig. 1. View of Stage Switchboard Mounted Flush with Proscenium Wall.

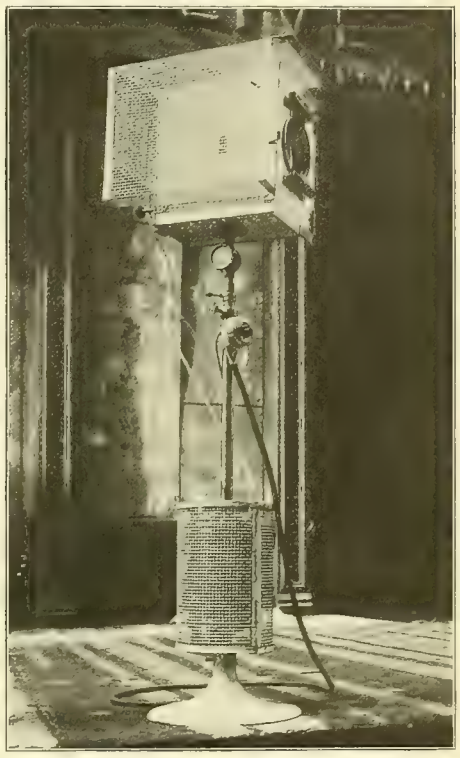


Fig. 2. Protected Spot Light.

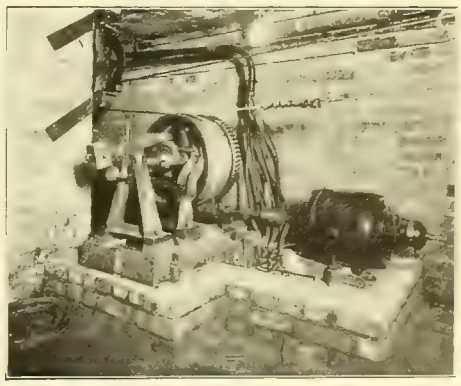


Fig. 3. Motor Hoist for Steel Curtain

NEW ELECTRICAL APPARATUS IN CHICAGO THEATER.

tain (see Fig. 3) is installed in the basement, below the stage, and is of two horsepower, driving the drum for the steel cable by a worm gear on the end of the shaft. This motor is controllable from only one point, the electrician's gallery in front of the stage switchboard. The rheostat is enclosed in a sheet-iron box, shown at the left of the gallery in Fig. 1, the motor being supplied direct from the service mains through an iron-pipe conduit, so that it is entirely separate from any of the house circuits. A full reverse controller is used, enabling the curtain to be run either up or down at full speed.

Five sets of border lights of 120 lights each, 40 lights to a color, are used. The border lights and also the footlights are mounted in steel troughs and are fed by a specially constructed six-conductor cable. Each conductor is rubber-covered, wound with braid. Tape is then wound around all six conductors, followed by one-sixteenth inch of rubber and another layer of tape. Over all is a layer of braid soaked in fireproof paint. Two of these cables run to each border.

Fig. 2 is an illustration of a new protected spot light, designed by T. J. Cleland, chief electrician at McVicker's Theater, Chicago. With a protected lamp of this kind the disaster of December 30th would not have happened. It is specified in the ordinances relating to theaters that all arc lights must be subject to the approval of the city electrician, and the type of spot light here illustrated is one which fully conforms to the rules. The spot light, which is to be used in the gallery, is mounted on an aluminum base in order to get the necessary strength and stiffness without making the lamp too heavy to handle conveniently. In the lower cage, surrounded by steel-wire netting of about one-fourth-inch mesh, is the resistance coil, which is wound with asbestos-covered wire. On the metal standard above the coil is the arc lamp of 1,000 candlepower which is used for the light. This is entirely enclosed by a galvanized-iron box, in turn protected by wire netting, which completely surround it with the exception of a circular opening about five inches in diameter, in the front, for the lens. The lamp itself is slidably mounted in the box to permit of focusing the light. The specifications state that only one opening is to be allowed in the box besides the one for the lens. It is necessary, however, to have a focusing rod and a feed rod for the lamp. To get both rods into the box through the specified opening the focusing rod is made hollow and the feed rod passed through it. The lamp shown has not been used as yet, but will be placed in the gallery in a short time. A flood light, designed along the same lines; is, however, in use, and it is probable that all the theaters in Chicago will be supplied with spot and flood lights of this type.

Everything about the electrical wiring has been carried out with the greatest care as to details. Loricated conduit is used throughout, and all fuses are enclosed in double steel boxes. All suspended or bracket lights surrounded by glass in the auditorium or any part of the building are provided with wire netting underneath and no electric light is inserted in the woodwork of the building without being protected by proper fireproof material.

Among those devices which will be used in case a fire should break out, the steel curtain is one of the most efficient means for keeping the flames from the audience. This curtain, which is rigid, but vertically movable of course, weighs about one ton and is made up of a framework of angle iron covered on the side toward the audience with sheet steel and on the back with asbestos board. As already explained, the curtain is raised and lowered by a motor, but should anything happen to the motor installation the curtain may be lowered by hand.

Back of the steel curtain is an asbestos drop curtain reinforced with woven wire. The proscenium arch is looked upon as one of the most vulnerable points, and it is still further protected by a system of piping fed from a tank on the roof, by means of which a solid curtain of water may be precipitated upon the stage in front of the arch should the exigency arise, the sprinkler heads melting out as soon as heated by the flames. Protected as this opening is, it seems almost impossible that fire if once started could be communicated to the auditorium.

The tank upon the roof of the stage is supplied with water by a motor-driven pump in the basement. The motor is of 10 horsepower, geared to the pump. An air compressor, also motor-driven, supplies air pressure to the water tank above the surface, thus insuring a good head in the standpipe system, which is also connected to the tank. Numerous hose reels are placed in different parts of the house, the hose ready connected to the standpipes and the reels so arranged that unwinding the hose turns on the water. Hand chemical sprinklers are distributed at convenient points, as are also barrels of water and fire pails. One of these water barrels, boldly lettered, is shown in Fig. 1.

In the stage roof is a large ventilator, which is normally closed by a damper hinged in the middle. One edge of the damper is weighted so as to bring the damper into a vertical position when a catch is released. This catch is held in place by a small solenoid upon a closed circuit. When this circuit is broken, as it may be by several switches at various points on the stage, the solenoid is de-energized, releasing the catch. The damper then opens and the smoke and gases can escape through the roof. One of the small boxes containing a switch is shown in Fig. 1 on the right-hand wall beneath the switchboard. Should a panic occur and none of the switches be opened the wires of the solenoid circuit would burn off, opening the circuit automatically.

Two or more competent and experienced firemen must, according to the city ordinance, be on duty at each theater during the time it is open to the public, and it is the duty of the firemen to see that all apparatus for fire protection is in proper working order. One fire-alarm box is placed on each floor and gallery of the auditorium, one upon the stage and one in the ticket office.

What has been done at the Powers Theater is typical of every amusement house which has been allowed to open in the city, and it is hoped that the danger of fire has been reduced to the minimum. The work of installing the fire-protection apparatus seems to have been carefully conceived and executed. It remains for the theater staffs and the city authorities to keep the equipment up to its maximum efficiency and to insist upon the employment of well-trained, competent employes.

Wave Meter for Space Telegraphy.

Professor Slaby of the Charlottenburg Technical High School has designed a handy apparatus for measuring the wave-length of a space-telegraph sending apparatus readily and accurately. While testing a linear vibrating system generating quarters of a wave-length of one meter which were received by a rectangular loop receiver (see Fig. 1), Professor Slaby obtained the same tension curves both for (A B C) and (A E D) comprising nodes located in (B) and (E) and tension maxima in (A) on one hand and (C) and (D) on the other, the tension in the two latter points being absolutely identical and of the same phase. A phase difference amounting to 180° (the tension remaining the same) was obtained between (D) and (C) by connecting (D) to a wire (D F) two meters in length so as to allow of half a wave being produced therein, which resulted in the tension between (F) and (C) growing on to values nearly twice as great as those formerly obtained in (C) and (D).

Further increases were noted as, in order to give the additional wire a more convenient form, it was

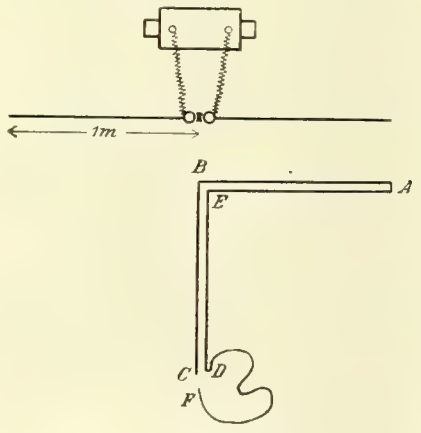


FIG. 1. WAVE METER FOR SPACE TELEGRAPHY. — RECTANGULAR LOOP RECEIVER.

wound up to form a coil. Whenever to the tension maximum of an oscillating circuit a wire $\frac{\lambda}{2}$ in length was connected, the terminal tension could be raised to multiple values in the case of the additional wire forming a coil. This is why such coils tuned for the wave-length of the system are termed "tension multipliers." The experimenter also found that the increase in the terminal tension was attended by a contortion of the wave previously quite regular, so that the beginning of the coil would form neither a perfect tension node nor a current node.

Professor Slaby gives a rather simple theoretical explanation of this phenomenon, showing that any earthed wire systems receiving an electric impulse of a certain frequency will vibrate in resonance in case that what he terms the "vibration capacity" (that is to say the product C L of the electrostatic capacity by the self-induction) is the same, so that the equation $T = 2\pi\sqrt{CL}$ is satisfied. The electrostatic capacity may be rather different without the above equation ceasing to be satisfied. The energy of the oscillating system, however, which depends on the electrostatic capacity, will be altered in proportion. It is shown that a system of n parallel wires placed at distances apart as high as possible will have a self-induction as small and an electrostatic capacity (and accordingly vibration energy) as high as possible. Such oscillating systems are therefore most suitable for transmitting electromagnetic energy for space-telegraph purposes. The surface tension at the ends of the wire cannot in fact increase beyond admissible limits so as to produce a radiation of electric masses (electrons) which would mean a noticeable loss of energy.

Now the opposite would be true in the case of a visible sign being required in the circuit, depending

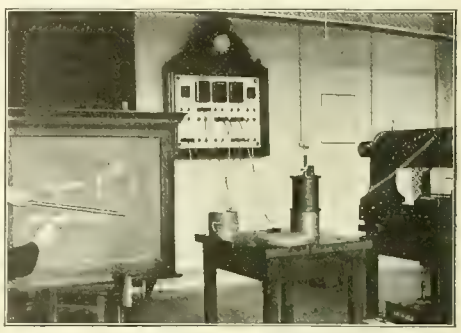


FIG 2. WAVE METER FOR SPACE TELEGRAPHY. — PROFESSOR SLABY'S APPARATUS.

on whether the dimensions of the latter correspond to the maximum energy input, that is whether the circuit is tuned for the frequency of the oscillation transmitted to it. As in the latter case, a strong radiation of electrons should be aimed at, the vibration capacity should be chosen so as to ensure a surface tension as high as possible by combining a minimum electrostatic capacity with a maximum magnetic capacity or self-induction. This is obtained by designing the vibrating conductor as a coil.

By simple theoretical considerations the professor shows that the electron radiation of such multipliers is in the first place dependent on the pitch of the coil. Wires of a minimum diameter coated with a very thin insulating material should therefore be used in this connection. Copper wires 0.1 millimeter in thickness comprising a single silk winding or else an extremely thin insulating coating of cellulose acetate gave quite satisfactory results. This copper wire was wound on glass tubes or ebonite or oak tree rods of different diameters, and the resonance length of the latter in the case of a unipolar earthing was ascertained for a given wave-length. Professor Slaby gives an approximate relation between the capacity, self-induction and vibration of a coil from which the wave-length may be inferred with accuracy to a fraction of one per cent.

As regards the question of how the vibration energy from the circuit tested may be transmitted to the multiplier rod, a monopolar earthing was readily made in the laboratory (the floor of which is laid throughout with zinc plates, thus constituting an artificial earth of sufficient capacity). The capacity of the human body, being about 100 microfarads, proved perfectly sufficient. The arrangement of the apparatus is shown in Fig. 2. Keeping in the left hand a multiplier rod provided at one end with a metallic ring touching the latter and carrying the thumb and index of the right hand alongside the rod the free end of the latter would begin sparking as the index reached the resonance position, the more strongly as this end was turned toward the oscillating circuit. A more accurate adjustment may be obtained by carrying over the multiplier rod a short metallic rod grounded by means of a wire fixed to a metallic plate lying on the ground. The best results were obtained by causing the violet radiation from the sparks to act on fluorescent bodies. When placing crystals of barium platino-cyanide in the end of the rod an extraordinary intensity of the luminous effect was noted so as to obtain a light-green spot noticeable even in direct sunlight. When intermixing leaf gold with small leaves covered with the above crystals a bright green luminous torch was noted as an evidence of the multiplier rod being tuned.

When considering that the determination of a wave-length, according to previous methods required a whole series of observations, extending at least over half a day, the multiplier rod, allowing of the tuning of space-telegraph stations being checked almost instantaneously, and in a way as accurate as possible, may be said to embody a most valuable advance, likely to materially further the development of space telegraphy. G.

ALTERNATING-CURRENT WORKING.

By W. B. Gump, Asso. Mem. A. I. E. E.

Part III.

Alternators.

A knowledge of the principles of construction and operation of alternators is of the highest importance since a defect in the alternator (however slight in itself) will influence the entire transmission system.

It cannot be expected that the subject can be completely covered in a current article of this nature. The purpose in view is to give such facts and demonstrate such principles as are essential in understanding the fundamental features involved.

Alternators may be classified as "single-phase" and "polyphase." In both they are essentially multipolar, since the peripheral speed has a limitation, and

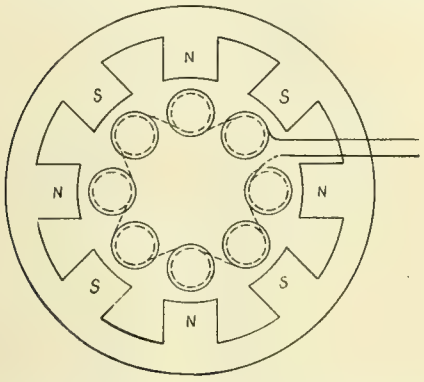


FIG. 18. ALTERNATOR COILS CONNECTED IN SERIES.

the frequencies range between 25 and 125 cycles per second. Therefore it is obvious that a bipolar machine of a capacity (save the very smallest) could not be driven at the required speed with safety. As in direct-current machines, alternators have their fields excited by a direct current. In place of the commutator the current is led from brushes which rest upon "collector rings" or "slip rings." In the majority of machines up to 300 kilowatts the armature revolves as in the case of a direct-current machine. In most large alternators, however, it has been found advantageous to revolve the field magnet and have the armature stationary. This is because the difficulties confronted in insulating a revolving armature of a high voltage usually settle the question in favor of exciting the field—which requires but a low voltage—through slip rings, and thoroughly insulating the armature in a stationary position. In most

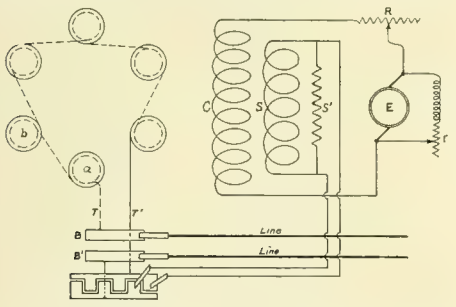


FIG. 19. DIAGRAM OF AUTOMATIC FIELD REGULATOR.

alternators of the revolving magnet type the armature is outside and the field revolves within. The great Niagara machines, however, are exceptions and are notable for the fact that the field magnets revolve outside the armature. Such a machine is known as the "umbrella type," the main shaft operating in a vertical position.

Single-phase Machines.

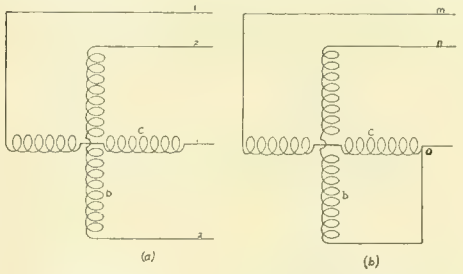
The connections of a single-phase alternator are comparatively simple, especially the armature connections. The simplest scheme is merely a set of coils connected in series as shown in Fig. 18. It should be noticed that there are the same number of coils as there are poles, so that the direction of current in every other coil is the same, corresponding to the poles. In consequence of this the coils must be connected opposite; alternately (N) and (S). There may be twice as many poles as coils, in which case the coils must all be connected in the same direction. This is obvious from the fact that each coil is under a pole of the same sign (either (N) or (S), or in a similar phase relation between the two), at any instant.

Calculation of Electromotive Force.

The electromotive force of an alternator may be calculated by using a formula similar to that of the continuous electromotive force, the difference arising from the use of a constant, the "form factor" of the electromotive-force wave. Consider first the electromotive force of a bipolar machine having a single coil. It is evident that one complete revolution will complete one cycle; hence one revolution per second of a bipolar with one coil has a frequency of unity. During its revolution the electromotive force rises to maximum twice and twice decreases to zero, completing one cycle. Now suppose we have four poles instead of two. Then there must be either two coils or four coils. In either case the frequency will be doubled, and with one revolution per second the frequency will be two. From the demonstration given it is evident that the frequency is half the number of poles multiplied by the revolutions per second, or $F = \frac{P\,n}{2\times 60}$

If a coil is revolved through one cycle it will be seen the coil is penetrated twice by the flux of one pole, that is, each conductor of a coil cuts the lines of force under two poles during one complete cycle.

It is well known that the electromotive force generated in a single coil of a direct-current armature is the average electromotive force per conductor times the number of conductors. In the case of alternating electromotive force, however, it is the effective value which must be employed. The ratio of the



Two-phase Four-wire Circuit. Two-phase Three-wire Circuit with Common Return.

FIG. 20. TWO-PHASE CIRCUITS.

effective to the average for a sine wave is 1.11; therefore the equation for the electromotive force becomes $E = \frac{2.22\,\Phi\,f\,c\,N}{10^8\times 60}$

in which Φ = flux per pole,
f = frequency,
c = number of conductors in series,
N = revolutions per minute.

Single-phase alternators are used almost entirely for lighting, since single-phase current has not been successfully utilized for power purposes except in small installations. Its development is progressing to such an extent, however, that a very few years may see our electric railways operated entirely by single-phase apparatus.

Field Excitation.

It is necessary in most alternating-current circuits to maintain a constant voltage the same as with di-

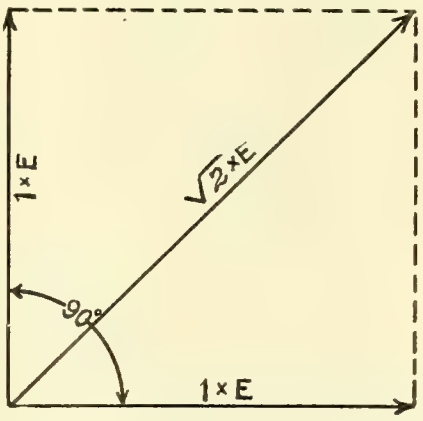


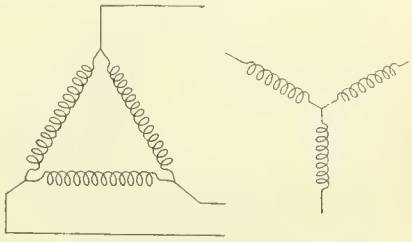
FIG. 21. CURVE OF RESULTANT ELECTROMOTIVE FORCE.

rect current. There are several methods, each of which is arranged to modify the strength of the field. The simplest method is rheostatic regulation by hand The method more common, that of automatic regulation, is shown diagrammatically in Fig. 19, in which (a b) are armature coils and (C) is the field coil.

The main field (C) is excited from the exciter (E), whose field strength is controlled by the rheostat (r). The strength of field (C) is furthermore regulated (as conditions may demand) through (R). The terminals of the armature (T) and (T') lead out to collector rings (B) (B'), the terminal (T') first conducting the current through the rectifier (C') to the series coil (S), whose strength is regulated by the shunt (S'). This arrangement corresponds to a direct-current compound-wound machine, the series coil (S) strengthening the main field by virtue of the main current being conducted through it. Thus the voltage is kept up automatically.

Polyphase Machines.

Since polyphase alternators are of such great importance it will be well to devote the remainder of the article to that class of apparatus. It is well to



Delta Connection. Y Connection.

FIG. 22. THREE-PHASE CONNECTIONS.

consider first the relation between current and electromotive force. In the two-phase system there are two separate single-phase circuits 90° apart. A two-phase four-wire circuit is diagrammatically represented in Fig. 20a. The electromotive force between the wires of each phase respectively may be

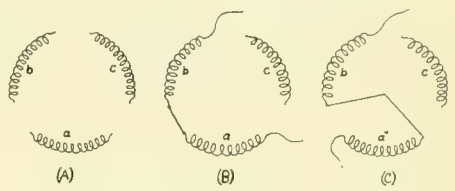


FIG. 23. DIAGRAMS SHOWING PRESSURE RELATIONS IN THREE-PHASE SYSTEM.

represented by E. No connection is made between the two circuits. The current in each is A amperes. A two-phase three-wire system is shown in Fig. 20b, in which (O) is a common return wire. Representing the electromotive forces of coils (b) and (C) respectively, in Fig. 21, the resultant of the two coils becomes $\sqrt{2}$, so that the voltage between (m) and (n) is $\sqrt{2}E$ volts, that between (n) and (o) or (m) and (o) being E volts. If A amperes flow in (m) and (n), then $\sqrt{2}$ A amperes flow in the common return wire (o). Four-phase systems are uncommon and will not be considered here. The most common

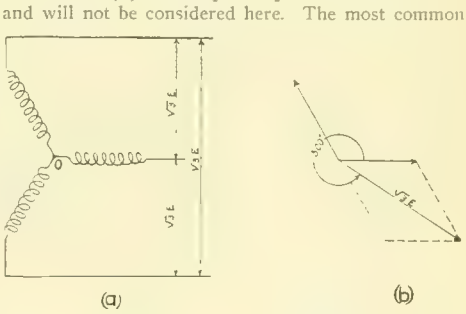


Diagram of Connection. Vector Diagram of Resultant Electromotive Force

FIG. 24. THREE-PHASE CIRCUITS.

system employed is the three-phase. The armature of a three-phase alternator is connected in one of two ways—"delta" or "Y." The delta connection is shown in Fig. 22a and the "Y" connection in Fig. 22b.

The pressure and current relations in a three-phase system are more puzzling than those of two-phase, so in order to make these relations clear several diagrams are shown demonstrating the relations graphically. Observing Fig. 23, let A, B and C, respectively, represent three coils which revolve in a bi-polar field. It is obvious that the coils will generate currents differing in phase by 120°. Now let the coil B be connected so that (a) and (b) are in series. As these coils are 120° apart, they would have to be added geometrically to get the resultant value of the electromotive force. Next observe Fig. C which is connected with coil (a) opposite to (b). This is the same as a "Y"-connected armature. In this case the electromotive forces must be subtracted. It amounts to adding the two values vectorially at 300°. The vector sum is shown in Fig. 24b, the resultant E being equal to $\sqrt{3}$ times the electromotive force of one coil, or $E = \sqrt{3}E$. The Y connection is usually

represented in diagram, as shown in Fig. 24a. The "delta" or "mesh" connection is shown in Fig. 25. Here the voltage between any two of the terminals is E, while the current in each line is ($\sqrt{3}$ A) amperes, since each line wire is led from two coil terminals. Thus the current is increased while the voltage remains the same. When once these relations are fixed in mind it is not hard to remember them. It is of the utmost importance that they be well understood in order to apply them to the transformer which will be taken up later.

Armatures.

Armature windings (both single-phase and polyphase) may be either "concentrated" or "distributed." If there is but one slot per hole per phase, the winding is said to be "concentrated." If, however, the winding is extended over several slots per hole, the winding is "distributed."

A two-phase (concentrated) winding is diagrammatically represented in Fig. 26. For the sake of simplicity only four poles are drawn, rendering the connections more easily understood. A three-phase winding is shown in Fig. 27. The armature is delta connected, as will be evident if the connections are traced, each ring carrying two terminals. A three-phase Y-connected armature is shown in Fig. 28. The electrical center of the armature is at (b), which corresponds to (O) in Fig. 24.

A few points regarding armature reaction should be taken up before going further. It will be understood from Fig. 29 that as the armature moves in the direction of the arrow an electromotive force will be set up in the conductors, the maximum value being reached when the opposite inductors of a coil are respectively under a (N) and (S) pole. The effect of the magnetism is to drag in the trailing

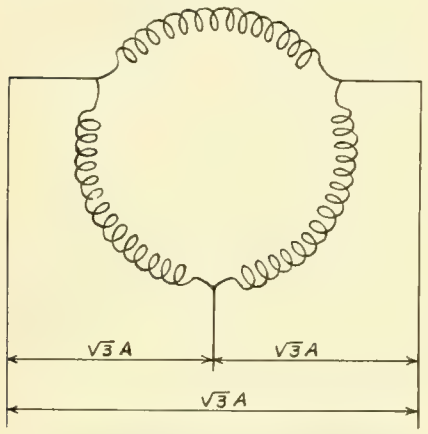


FIG. 25. DIAGRAM OF DELTA OR MESH CONNECTION

pole tips, and this is aided by the magnetism of the armature as well as that of the field. This increases the flux density in the pole tips, which decreases the permeability. The length of air gap is also increased, hence the regulation of the machine is affected. If the current lags the armature will be in advance of position shown in Fig. 29 when at maximum current. The effect will be to cause a distortion of the flux and a demagnetizing action ensues. If the current is leading, then the opposite effect takes place—that is,

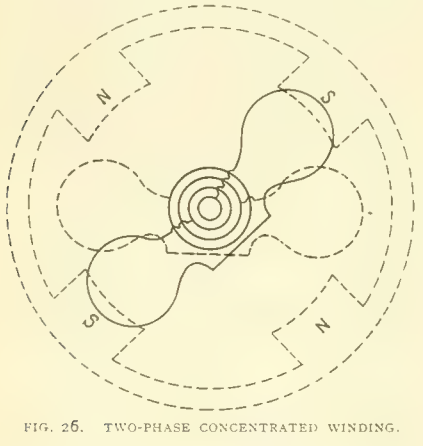


FIG. 26. TWO-PHASE CONCENTRATED WINDING.

the armature current is maximum before the armature coil reaches the position shown; hence the magnetism is cumulative. From these facts it is evident that an inductive load will affect the regulation, distorting the field, and decreasing the field strength. The regulation therefore is much better on a lighting load than on a power load, especially on a line using induction motors. The latter tend to lower the power factor of the system, thus increasing the current output for a given power.

The next point of importance to be considered is armature reactance. All armatures are constructed with a comparatively low resistance, which in most cases is practically negligible; the inductance L is generally so high, however, that the reactance $2\pi f L$ at right angles with the resistance creates a high impedance. Most alternators therefore will stand a dead short-circuit for a short time without injury. Alternators which are to run in parallel should have considerable armature inductance.

Synchronous Impedance.

The terminal electromotive force of an alternator under load is not the same as the electromotive force on open circuit, the speed and excitation remaining constant. The electromotive force of the machine on open circuit is made up of the following items which can be added vectorially:

(1) Terminal voltage E,

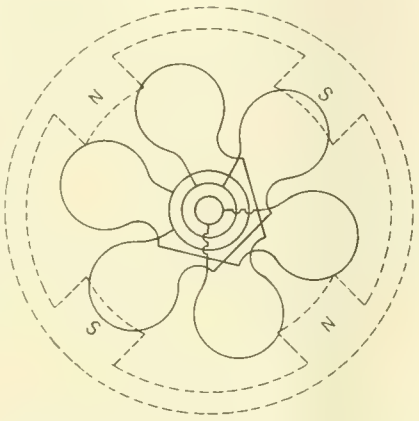


FIG. 27. THREE-PHASE CONCENTRATED WINDING.

(2) Ohmic drop in armature C R,

(3) Armature inductive drop,

(4) Voltage loss due to reluctance by field distortion,

(5) Voltage loss due to demagnetizing action from a lagging current, or magnetizing action from a leading current.

The items from (2) to (5) inclusive may be accounted for by a mathematical quantity called the "synchronous impedance." It is equal to the impedance which, if connected in series with the external circuit, having the same impressed voltage as that of open circuit will cause the same flow of current which does flow. The synchronous impedance may be

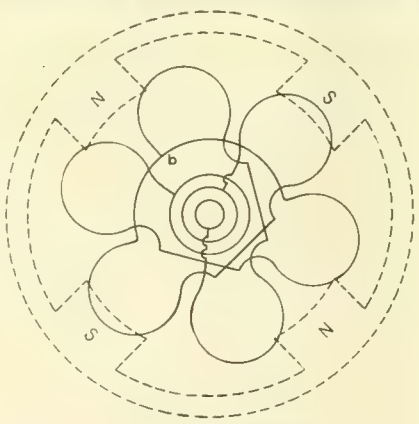


FIG. 28 THREE-PHASE Y-CONNECTED WINDING.

ascertained in the following simple way: Run the alternator at the proper speed, then short-circuit the armature through an ammeter. Now excite the field until the desired load is indicated. Observing carefully the current flowing, break the load circuit and ascertain the open-circuit electromotive force. This divided by the current will give the "synchronous impedance." The component at right angles to the armature resistance is termed "synchronous reactance." Combining it vectorially with the resistance R will, of course, give the synchronous impedance.

Regulation.

Alternators used for lighting must necessarily have close regulation. A method commonly employed to maintain constant potential has already been explained. The Westinghouse company employs a novel method of regulation. A composite winding is used, the compensating coils being supplied by current through a series transformer which is carried on the inside of the armature. The entire armature current passes though the primary winding, which consists of but few turns. The current in the secondary and hence in the compensated winding is proportional to the primary or armature current. On the end of the shaft is a commutator which has the same number of segments as there are poles on the machine. Now if the brushes resting on this commutator which carries the secondary current rest between adjacent segments at the instant when the alternating-current value passes through zero, a maximum pulsation will be received in the compensating circuit. Hence shifting the brushes forward or backward from this point will change the amount of compounding of the field.

In the case of large alternators regulation is ac-

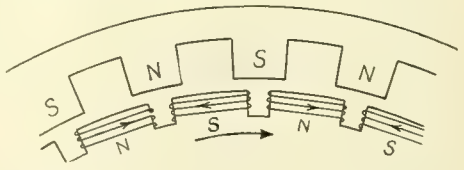


FIG. 29 DIAGRAM ILLUSTRATING ARMATURE REACTION.

complished entirely through the medium of the exciter, and the windings are seldom made composite. It is evident that rheostatic regulation in the main field of a large machine would involve a C^2R loss of considerable magnitude. A rheostat in the field of the exciter, however, handles but a small amount of current and effects the regulation through a wide range, accomplishing the desired result in the main field with a very small loss. The rheostat is controlled by hand in nearly every case, the exciter pressure being from 80 to 125 volts. The latter voltage is quite common for machines of from 2,000 to 5,000-kilowatt capacity.

Efficiency.

The efficiency of alternators increases with the size of the machine, the proportion of full load remaining constant. Efficiencies range from 90 per cent. in a 50-kilowatt machine to 97 per cent. in a 5,000-kilowatt. The efficiency will of course vary

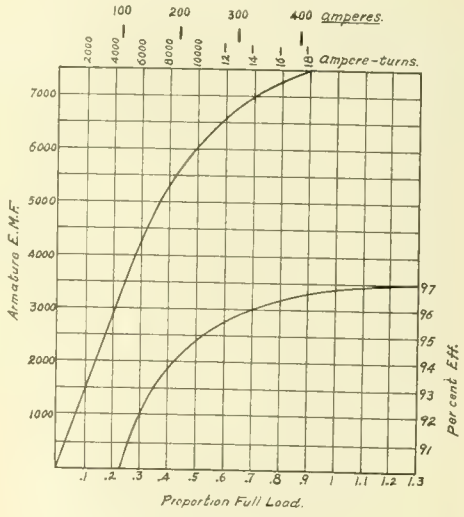


FIG. 30. EFFICIENCY CURVES

with the load. The curves in Fig. 30 show the efficiency and the "no-load saturation" for a 5,000-kilowatt alternator. It will be seen that at one-quarter full load the efficiency is considerably above 90 per cent.; at half load it is nearly 95 per cent., while at full load it closely approaches 97 per cent., and slightly increases for overloads up to 1.3 full load.

Before concluding, a word should be said regarding "inductor" alternators. These have not been discussed because they do not represent the typical alternator, and have not been thought sufficiently important to dwell upon. By an "inductor" alternator is meant one in which the field and armature are stationary. The moving element is some form of rotor containing projections termed "inductors," which make and break the magnetic circuit, causing a change of flux which induces an alternating current in the stationary winding. Machines of this type are not as efficient as those with a wound armature, but they do not require the care and attention demanded by the other machines, and for this reason they are given an important place in smaller plants, since they are cheaper and easier to operate than the latter.

[*To be continued.*]

The city of Orillia, Ont., is about to raise $100,000, to be spent on the further extension of its electrical power-transmission works.

London Trunk Telephone Exchange.

Trunking service between the London Postoffice telephones and the provincial cities and continental towns has hitherto been carried on through a large trunk exchange located in the General Postoffice. Recently, however, a new exchange has been completed and put in operation, which is located in the same building as the central local exchange. An interior view of this well-equipped plant is shown in Fig. 1.

In the equipment there will be positions ultimately for 42 trunk operators. Each switch section is divided into three panels, controlled by two operators; five trunk circuits are terminated on each of the outer panels, which also carry the multiples of the junction circuits serving the minor local exchanges. The junction circuits of the principal local exchanges are multipled on the middle panel of each section, where they are accessible to either operator. Transfer circuits for interconnecting trunk circuits are provided on each of the trunk panels, as well as foreign, reserve, and the usual official circuits. Apparatus is also provided for terminating a number of local subscribers' circuits which are used only for extensions to the trunk system.

In the center of the room are the recording operators' tables, at which all outward trunk calls from local exchanges are received. The operators at these tables record the particulars of the calls on printed tickets, which are then distributed to the operators at the corresponding trunk sections. When a trunk circuit is at liberty the London operator proceeds to call the local subscriber who originated the demand, and at the same time calls up the distant trunk-exchange operator, who obtains the attention of the distant subscriber. At the moment when the two subscribers commence conversation the time is recorded on the record ticket by means of a "calculagraph," which consists of a clock let into the keyboard shelf between two operators at every section, and actuating type wheels, by which the hour, minute and quarter-minute are stamped on the ticket. On the conclusion of conversation the ticket is again stamped, so that a permanent record of the duration of the conversation is obtained without possibility of error. The tickets, which bear all the necessary data, are afterward collected and sent to the accounts department to enable the latter to make out the periodical claims for payment.

During the daytime each operator takes care of no more than five trunks. At night and at slack times, however, as many as 15 trunks are thrown on one operator. The present equipment of the exchange comprises 40 operators' positions for provincial trunks, two positions for foreign circuits, one learner's position, two transfer sections and two reserve positions. Each switch section is divided into three panels. The outer panels each receive the terminals of five trunk circuits, and the multiples of the junction circuits serving the minor local exchanges. The junction circuits of the principal local exchanges are multipled on the middle panel within easy reach of the operator on either side. These circuits are worked on the call-wire system, and an independent set of call-wire keys connected with the various exchanges concerned is provided at each operator's position.

The trunk-clearing signal is given automatically on the withdrawal of the connecting plug at the distant exchange. Each pair of connecting plugs and cords is equipped with two signalling lamps—one white and one red. The white lamp glows when a clearing signal is given from the distant end of a trunk circuit and the red lamp when a clearing signal is sent by a London local subscriber over the junction circuit, or if the connection be accidentally severed at the local exchange.

Each cord circuit is also associated with two keys; one, the ringing and speaking key, is used for ringing on the trunk circuit, and for connecting the operator's speaking apparatus with the corresponding pair of cords; the other, the ringing and disconnecting key, is used for ringing subscribers when required over the junction circuits, and for disconnecting the junction from the trunk circuit, if necessary, to enable the operator readily to ascertain the locality of a fault. The "calculagraph" already mentioned is situated with its time-stamping attachment between the two operators at each section, while racks on the front of the switchboard hold the tickets.

Connections between the trunk section of a provincial exchange and the new trunk exchange are shown in Fig. 2. The trunk circuits are worked during the day on the equipotential system; at night, open-circuit working is adopted, with magneto calling and clearing.

Normally the "polarized indicator relay" (P. I. R. "B") shows "line free," the pointer being held to the right by a current from the four-volt battery. When a plug is inserted in the switch spring the indicator is cut out of circuit, as well as the battery and the relays (R_8) and (R_9). The operator at the provincial exchange then presses her magneto ringing key, which actuates relay (R_7) at the trunk exchange, bringing relay (R_8) into operation by current derived from the 22-volt battery. (R_8) remains closed and the lamp above the switchspring lights up. At the same time the pilot relay is actuated, lighting the pilot lamp, which remains lighted so long as any call remains unanswered. At night the switch shown in the right-hand corner is reversed, causing the night relay to act and ring a bell whenever the pilot lamp lights. As shown in the diagram, the insulating plugs at the ordinary and concentration sections determine whether the call shall be received at the former or the latter position, is actuated by the ringing current and brings (R_8) into action, reversing the indicator needle to the left, where it remains. At the same time the white lamp in the cord circuit of the London operator lights up. When the provincial exchange operator answers the call by inserting a plug, the London operator presses the talking key to give the particulars of the call; the insertion of a plug at the provincial exchange causes the lamp (L) to be extinguished.

The act of withdrawing the plug at the provincial exchange lights up the lamp (L) just mentioned in the cord circuit at the London exchange, thus giving the clearing signal. Similarly the withdrawal of the plug at the London exchange prior to that of the plug at the provincial exchange gives a clearing signal in the cord circuit of the operator at the latter station.

FIG. 1. LONDON TRUNK TELEPHONE EXCHANGE.—INTERIOR VIEW SHOWING SWITCHBOARD.

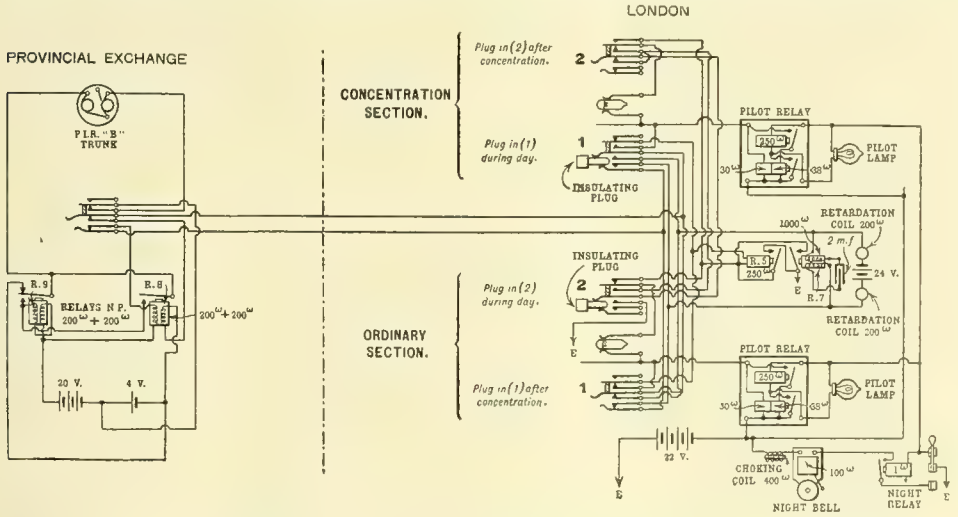


FIG. 2. LONDON TRUNK TELEPHONE EXCHANGE.—CONNECTION BETWEEN LONDON AND PROVINCIAL EXCHANGES.

the action being precisely the same in either case. It will be seen also that if either of the insulating plugs be transferred from one switchspring to another the lamps at both sections will light up, as explained in describing the "concentration" system.

The operator at the trunk exchange answers the call by inserting a peg in the switchspring, which disconnects the 24-volt battery and the apparatus connected therewith, and at the same time extinguishes the calling lamp and the pilot lamp, unless a call is being made on another trunk circuit ending on the same panel. The trunk operator then receives particulars of the call and makes the required connection.

The operation of calling a provincial exchange from the trunk exchange is as follows:

The trunk operator inserts a plug in the switchspring and presses the battery ringing key in the cord circuit; the relay (R_3) at the provincial exchange

Cascades at the Fair in Operation.

The three great cascades which form the crowning glory of the architectural picture at the St. Louis Fair were tested for the first time on the night of April 19th.

The water was turned on from the big pump at 8:30 o'clock, after the decorative lights had been turned on for half an hour. The handful of invited spectators at the foot of the cascades on either side of the grand basin saw the water burst out from the mouth of a dark cavern in the uppermost fall and roll like a mass of molten silver into the basins beneath. Disappearing beneath the causeway, the stream came into sight again and slowly found its way over the cascade steps to the basin at the foot. It was fully 10 minutes before the water reached the bottom.

Simultaneously, the four fountains in the basin spouted forth like geysers and the spray, caught up by the wind, was dashed across the terrace on the west side. From the central plaza the water appeared as a thin veil thrown across the rows of lights, its motion being barely discernible.

President Francis, Director of Works Taylor, Directors S. M. Dodd and C. W. Knapp and Constructing Engineer Ellicott witnessed the test, and agreed that the effect could not be equaled.

Only one of the three big pumps was in operation. The flow of water was estimated at 30,000 gallons a minute. The three pumps, which are electrically operated, will have a normal capacity of 90,000 gallons, with a limit of power up to 120,000 gallons. Two of the pumps are already installed and the third is being set up. When the full power is in use the central cascade will take 60,000 gallons and two smaller ones 15,000 each.

Electrical Supervision in Washington, D. C.

The Senate bill for the control of electric wiring in the District of Columbia has been reported back to that body considerably amended from what it was as originally reported in the Western Electrician of April 2d. Among many other amendments the provision for an assistant electrical engineer and a clerk is eliminated. The provision for the requirement of license fees from electrical contractors has also been eliminated as well as the creation of a board to pass upon their qualifications and to grant them licenses. It is the belief of the committee that these features of the original bill were unnecessary, because the danger of fire can be avoided by the proper inspection after electrical work has been done. The commissioners of the District of Columbia are given more power in the control of the use of electricity for light, heat and power purposes in the District.

The Present Status of Space Telegraphy.[1]

By G. Ferrié.

Eight years have now elapsed since the birth of space telegraphy and over two years have passed without notable improvement in this novel mode of communication. It would seem proper to classify the various proposed principles developed, but without insisting upon the minute details which are of secondary importance, and which for the most part are familiar to our readers.

The relative problems of transmission and reception of signals being completely independent of each other, we will examine these separately.

Transmission.—But one method of producing electrical oscillations of high frequency is known—the discharges of a condenser. At the same time these may be enfeebled or kept at initial strength. This latter condition has not been practically successful in this form of telegraphy, and the former only are made use of in actual work.

The methods of this class, that is to say those in which the oscillations are more or less enfeebled for exciting the antennæ (A in the diagrams), are of three characters:

Direct excitation.

Indirect excitation by induction.

Indirect excitation by derivation.

1. *Direct Excitation.*—The antenna (A) is considered as one of the armatures of a condenser, of which the earth (T) constitutes the other. The charge is operated by connecting a source of high potential (B) to each armature by intercalating an oscillator (C) between the two. (Fig. 1, Marconi, etc.)

The oscillations produced by the discharge are greatly enfeebled, and the first has a much greater energy than the others. In reality it is only this one which acts, and its effect is analogous to that of a percussion. The source of energy here is a Ruhmkorff coil.

The energy from the secondary of an industrial transformer cannot be utilized. The tension of the charging current is limited by the construction while the loss is considerable; it not infrequently produces an arc at the oscillator, for the capacity of the antenna is insufficient to permit of disruptive sparking. We may, however, realize a combination analogous to direct excitation by first transforming an alternate current of large output at feeble tension into oscillations of feeble output and high tension. These last are then made use of for charging the antenna.

To accomplish this a derived circuit is connected to the terminals of the secondary (R) of an industrial transformer (K), Fig. 2, selected to establish the resonance of the secondary (R) in accord with the frequency of the alternate current. This condenser is discharged by an oscillator (C) across the primary (P) of a Tesla coil. The secondary (S) of this is connected to the antenna (A) and to the earth (T), and also to the oscillator (C_2).

The number of turns of the coils of (P) and of (S) are so graduated as to obtain a maximum spark at (C_2) and a high energy efficiency, while the oscillations of the antenna are more or less enfeebled according to the form of alternate current employed.

We may thus adopt a Tesla-Oudin form (Fig. 3) in place of a Tesla-d'Arsonval as above.

In all these forms the antennæ will vibrate in quarter waves—that is to say, the oscillations will have a maximum of intensity at the earth and a minimum at the summit, and inversely as to tension.

2. *Indirect Excitation by Induction.*—This process consists of producing oscillations in a closed circuit, which communicates its vibrations by induction to the antenna. Using induction coils having a high tension energy the operation is as follows: The exciting circuit, mounted in derivation upon the winding (B), Fig. 4, is composed of the oscillator (C), the condenser (K), and the primary (P) of a Tesla-d'Arsonval transformer. The secondary (S) is connected direct between (A) and (T). (Braun, Marconi, etc.)

To insure prime efficiency it is necessary to attune the periods of the excitation and those of the antenna in harmony. This is accomplished by placing a thermal ammeter (H) in derivation upon the earth wire, and by varying the proportions—adjusting the relations of the elements of the other circuit. The proper balance is obtained when the maximum of intensity is shown by the ammeter (H).

Experience has shown that it is advantageous to form the windings of the primary (P) and the secondary (S) of but few turns, and less as the antenna is shorter. To accomplish this it is first necessary to make an approximate regulation of the capacity action at (K) and a final adjustment by varying the number of turns of (S). The oscillations thus obtained are less enfeebled than by the process of direct excitation.

When using the industrial-transformer system the arrangement shown in Fig. 4 cannot be utilized for the reasons given in the case of direct excitation. It is preferable to make use of an arrangement of double transformation (Fig. 5, Marconi). All the energy of the transformer (R) is used to charge a condenser of large capacity (K) which discharges through the oscillator (C_1), across the primary (P_1) of a Tesla coil. The induced oscillations in (S) are used to charge at high tension a second condenser (K_2), properly adjusted in its discharge through a second Tesla coil, to produce oscillations proportioned to the length of the antenna. This is similar to the case in which induction coils are made use of, while at the same time it is best to regulate the first Tesla transformer (P_2S_2), so as to obtain a maximum spark at (C_2). The oscillations thus obtained are but slightly enfeebled.

Experimenters have even employed these transformers for still further refining the oscillations.

Finally, in all these induction systems we may augment the efficiency by arranging Tesla transformers in parallel, upon the same oscillator, or upon separate oscillators, and by dividing the condensers into several parts, each actuating a Tesla coil.

The period governing the vibrations of the antenna in the induction systems, is evidently that of the combined form of the antenna proper, of the secondary of the Tesla coil and the earth wire. This combination vibrates in a quarter of the wave, as in a former case; that is, the oscillations have a maximum of intensity near the earth and a minimum at the summit. It is necessary to shorten as much as possible the included portion of this inferior part of the secondary (S), while experience has shown that it is advantageous to have as high an intensity as possible in that portion of the antenna which serves for the radiation of the energy in space. This question will be examined with more of detail in studying the theory of the role of the antenna.

3. *Indirect Excitation by Derivation.*—In this method excitation is accomplished by placing the antenna in connection with the earth by derivation on an oscillating closed circuit. (Slaby, Rochefort.)

Using induction coils, the arrangement is analogous to that in Fig. 3, while the primary (P) of the Tesla coil (Fig. 6) is made up of a certain number of turns of the secondary (Oudin form). The adjustment is accomplished in a similar manner.

This arrangement is objectionable because of its giving birth to two distinct oscillations having different periods, one of these in the circuit (ASPT), the other in the circuit (ASKCT). Their periods are markedly unequal. As only one of these is available for use, the other is valueless.

In using industrial transformers in place of induction coils, the arrangement is that shown in Fig. 7, which is analogous to that in Fig. 5.

We may also cut up the condensers and arrange the divided circuits to act on the Tesla coil. The oscillations thus obtained by all these derived-circuit systems are enfeebled similarly to those oscillations produced by analogous systems of induction.

Oscillations of Full Strength.—The processes so far described give birth to oscillations more or less enfeebled. It has been suggested, in order to prevent this weakening, to substitute an electric arc for the oscillator, and utilize a phenomenon similar to the arc chantant (singing arc), but having a much higher period. This arc may be that produced between carbons or the mercury form. (Dudell, de Valbreuze, Hewitt.)

Again, the antenna may be excited by the three methods—direct, induction and derivation. Fig. 8 shows an example of excitation by induction. The exciting circuit includes the coil (L), condenser (K), primary (P), of a Tesla arrangement and the arc (E). The continuous current reaches the arc through the coil (F). The oscillations thus obtained are absolutely regular and of a clean-cut period. But the energy employed is unfortunately very limited, for the tension of the charge and the capacity of the condenser are both quite feeble. One is fixed by the potential of the arc, while the other is governed by the necessity of accord with the antenna.

Receivers.—The receiving of signals transmitted by any one of the methods described should, first of all, be made by means of an antenna of equal period with that of the transmitter. The simplest method is to use identical antennæ. But when this is impracticable by reason of installation, one of these may be modified so as to obtain equal periods.

To measure the period of an antenna, place it in energetic vibration by direct excitation, and measure the frequency of the oscillations thus obtained, by one of several methods, either direct or indirect.

The simplest method consists in connecting in derivation at a point near the earth a well-insulated horizontal wire (L), Fig. 9, and at the same distance from the earth a thermal ammeter (H) is

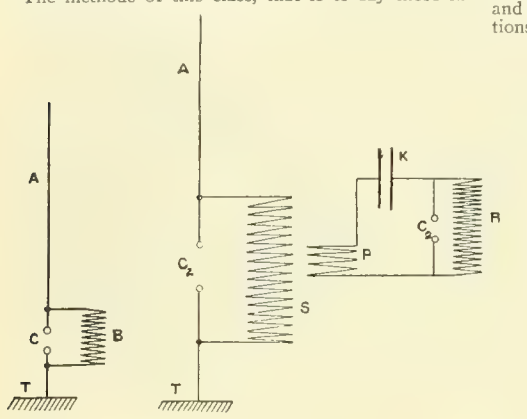


Fig. 1.

Fig. 2.

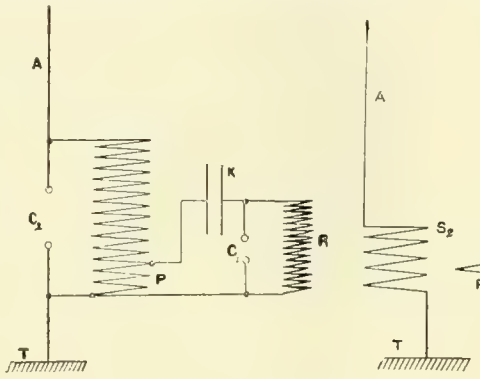


Fig. 3.

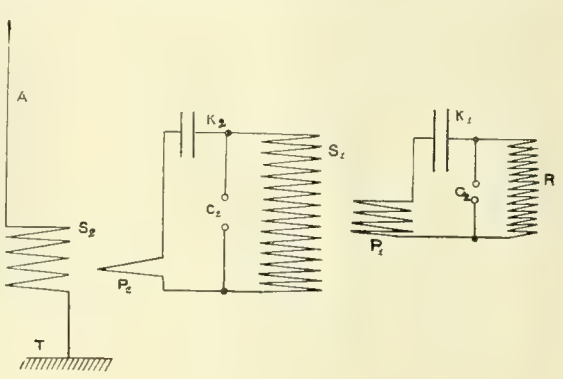


Fig. 5.

THE PRESENT STATUS OF SPACE TELEGRAPHY.

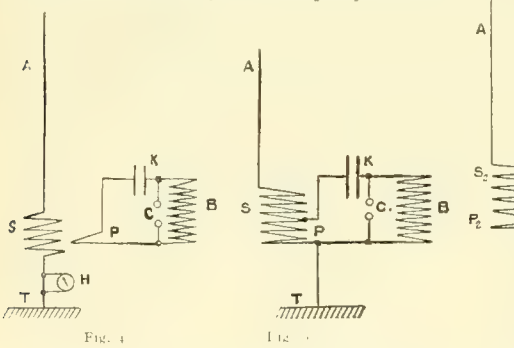


Fig. 4.

Fig. 6.

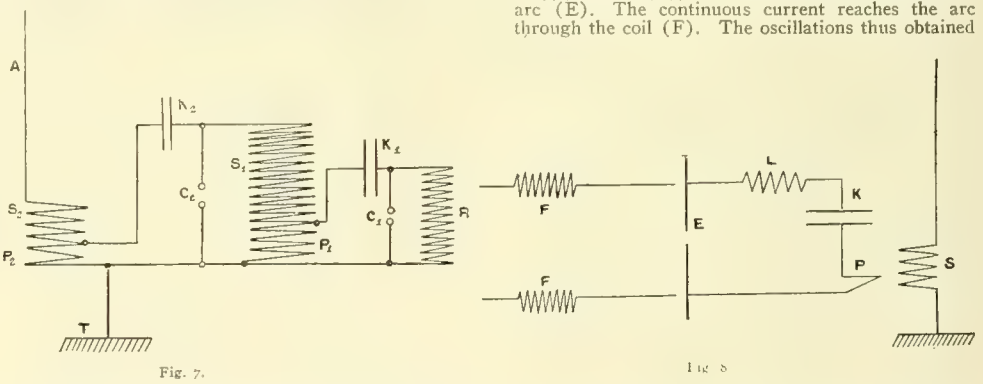


Fig. 7. Fig. 8.

THE PRESENT STATUS OF SPACE TELEGRAPHY.

1. Translated from l'Eclairage Electrique of March 12, 1904, for the Western Electrician.

connected near the point of derivation. This wire (L) is then extended until the ammeter indicates a maximum. This length then will correspond with the wire representing the quarter wave of the oscillations of the antenna.

To adjust the two antennæ, the forms are modified, the number of wires, also, until the same wavelength is common to both. When this adjustment is complete there are several methods by which to recognize the waves received, which will be examined in detail, it forming an object of special study. One of these obeys brusque variations of energy induced by elevations of tension. These are the ordinary coherers. Others are sensitive to intensities of the oscillations. Such are the bolometers, the hysteresis detectors, etc.

The dispositions utilized for making use of coherers may be classed as follows:

First—Direct action.

Second—Indirect action by induction.

Third—Indirect action by derivation.

Fourth—Mixed indirect action (combined induction and derivation).

Direct Action.—The coherer (C), Fig. 10, is direct-connected to the antenna (A) and to the earth (T). The relay-battery circuit is connected in derivation to its terminals (Popoff). The antenna may be considered as entirely isolated, for its inferior extremity ends at the coherer (C), of which the resistance is practically infinite, and at the coil (f), of which the impedance forms a screen for the oscillations. It vibrates, then, in half-wave length, and presents a maximum of tension at its two terminals. This, being obedient to variations of tension, is well placed for its duties. But to obtain the maximum effect it is necessary that the receiving antenna should have, in this case, a period double that of the transmitter, because this vibrates in quarter waves. This is inconvenient, for each station requires two antennæ, a transmitter and a receiver.

Direct Inductive Action.—This combination includes an oscillating transformer, which acts in a manner to submit the two eletrodes of the coherer to high tensions of contrary signs. The primary of the transformer should be attached to the antenna as nearly as possible to the earth contact, for at this point the oscillations have their maximum of intensity.

A first solution consists in cutting the secondary into two equal parts (S_1, S_2), Fig. 11, connected by the condenser (K), the exterior extremities being connected to the terminals of the coherer (C), and the interiors to the battery circuit. This forms a Hertz resonator, in which the gap is replaced by the coherer. This resonator is (CS_1KS_2C). When this is put in vibration by the induction of the primary (P) the stationary half wave there produced presents two maximums of tension, equal, but of contrary signs at the two extremities—the two electrodes of the coherer. To obtain the best results it is necessary to tune this resonator to accord with the antenna, which has been previously attuned to the transmitter. It suffices to give any convenient length to the secondaries. (Marconi.)

Experiment has shown that the condenser (K) may be omitted (Fig. 12). The action of the combination may then be explained thus: The coherer is influenced by the action of two oscillating distinct circuits—(CS_1f_1), (CS_2f_2). Each of these has one terminal at (C), the other being indeterminate because of the pressure of (f_1) and (f_2). The effect of these two coils is similar to that of a greatly lengthened line, in which the vibratory movement is gradually lost, as shown by Mr. Perot. But the oscillations induced in (S_1) by (P), for example, do not affect (C) in the least. The coherer is consequently submitted at its two extremities, to two flows of equal tension, and of contrary sign following the windings of (S_1) and (S_2).

One of the theoretical results of this explanation is verified by experience; the regulation of the lengths of (S_1) and (S_2) is a matter of slight importance. The same transformer gives in effect very good results with lengths of wave varying between 100 and 1,000 meters.

It is then nearly impossible by this process to protect a receiver against a transmission of signals foreign to those for which it is destined.

Indirect Action by Derivation.—It is an acknowledged fact that a conductor connected in derivation upon an osillating circuit, will have a vibratory movement, of which the amplitude is maximum when the conductor has a period equal to that of the oscillating circuit.

To apply this fact to the reception of Hertzian signals (Slaby), a few turns (P) of the solenoid (S), Fig. 13, are connected to (A). The free terminal of (S)—that is, (a)—is connected to the coherer (C). The other electrode of this is connected to earth through a condenser (K). When the antenna vibrates under the action of the Hertzian waves transmitted by the distant station, the solenoid (S), which is in derivation, takes up the vibratory movement.

To obtain a maximum effect on the coherer, it is requisite that the stationary wave which has established itself in (Sf_1) present a rise of tension in (a). Hence, it is necessary that the elements of (S) should be in accord with it. Or, in place of submitting but one of the electrodes of the coherer to the tension produced by the oscillations, we may adopt a method where the action upon the coherer is symmetrical—in harmony with it—and avoid the use of the condenser. To do this it is only necessary to connect the coils of the primary (P) at the middle of the solenoid, to the exterior terminals of a coherer (C) of three electrodes (Fig. 14). The circuit of the relay battery is intercalated between the primary (P) and the central electrode of the coherer. (Rochefort.)

In all these cases of action by derivation a vital necessity is a perfect attuning of the parts to obtain the maximum effect.

Indirect Mixed Action (Induction and Derivation Combined).—We may avail ourselves of the advantages of the last two systems by combining their two methods of action (Figs. 15 and 16).

The primary (P) acts by derivation upon one of the electrodes of the coherer (C) by the intermediation of the half secondary (S_2), and by induction upon the other electrode, through the second half secondary (S_1).

The arrangement in Fig. 15 does not necessitate perfect attuning, while that in Fig. 16 will not give a maximum result unless all parts are in perfect accord.

System of Detectors.—In the use of detectors the direct-action form seems the better adapted (Fig. 16), for these instruments are sensitive, and in the lower portion of the antenna the oscillations are at a maximum. It is only necessary then to attune the receiving antenna with the transmitter to obtain the best results.

These systems do not require the use of a relay for receiving the signals, as they are always combined with the telephone (E), Fig. 17, and sometimes with a battery, according to the system employed.

It is also possible to use an induction system (Fig. 18) or a derivation system (Fig. 19) for augmenting the selective effect. But a portion of the energy received is lost.

Choice of Systems of Transmission and Receiving.—With a minimum of energy one has the advantage of employing a direct-excitation system (with induction coils), and a coherer-receiver with either an induction or mixed arrangement. An excellent efficiency of the energy in use is thus obtained.

Under similar conditions, if a coherer-receiver with indirect-derivation action is made use of, there is a loss in range, but there is, on the other hand, a gain in protection of the receiver against exterior perturbations. In thus sacrificing transmitting distance for the same energy expended, the protection is augmented for oneself and for neighboring stations if one uses a system of indirect excitation by induction, and if the receiver is an indirect-derivation coherer arrangement.

But this protection is in reality feeble in all cases, and is notably so except for very different wave lengths.

The use of detectors augments this protection for indirect-excitation systems, but interferes with the receiving of telegrams and with calls.

The use of unmodified oscillations does ameliorate results, but for extreme distances it is necessary to utilize a very considerable energy, despite the phenomena of actual resonance which inevitably accompanies such an installation.

In short, none of the processes now known guarantees perfect efficiency in its work.

This is a grave fault in universal telegraphing through space; yet there are conditions where it is possible to exchange communications with a properly equipped distant station; such, for instance, is the case with vessels at sea, which may thus communicate with each other or with their particular stations. So that, all things considered, aerial telegraphy is a valuable method of communication, but so limited in its applications that there is little cause for apprehension that it will ever replace the present methods of telegraphic communication.

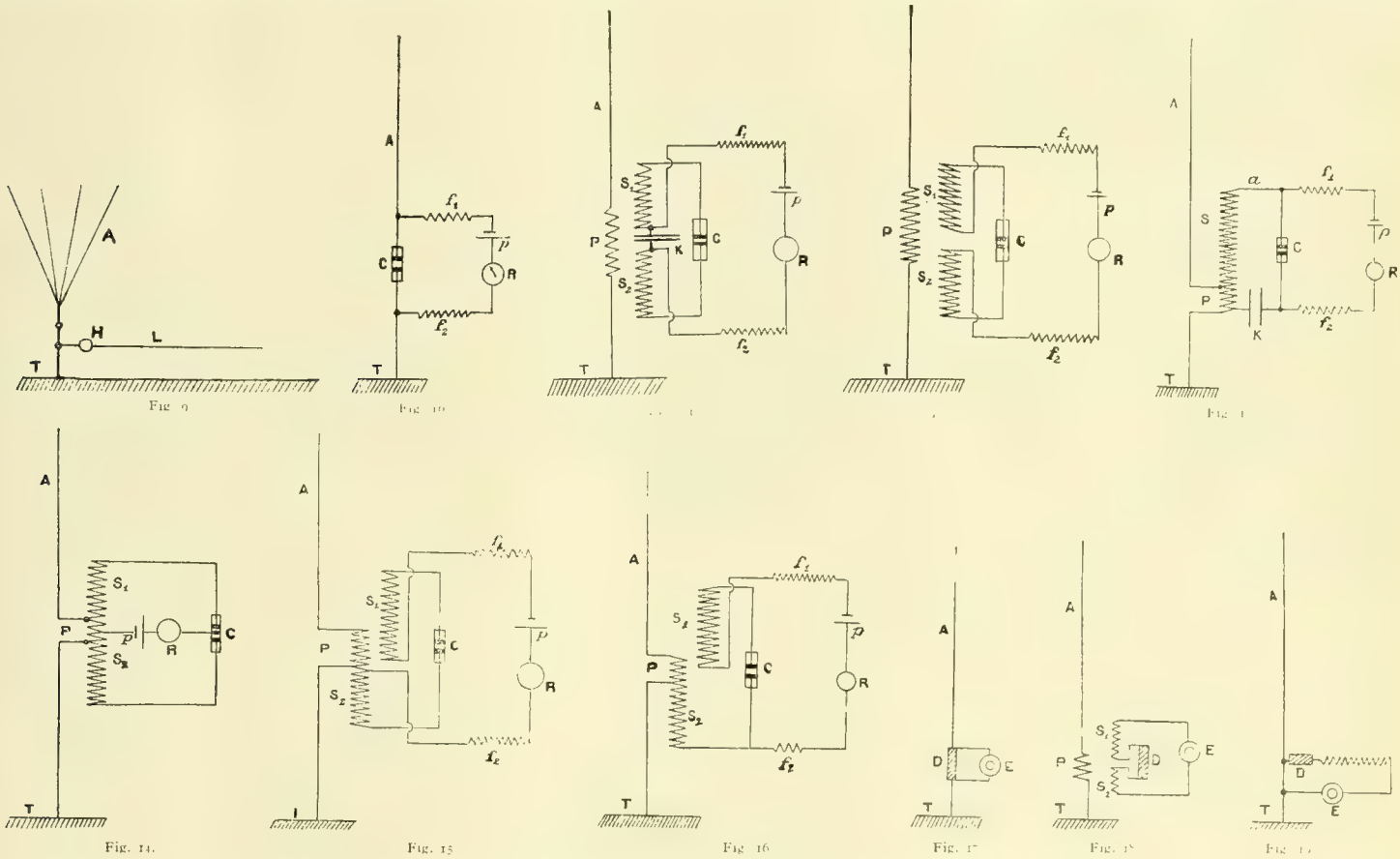


Fig. 9 Fig. 10 Fig. 11 Fig. 12 Fig. 13

Fig. 14. Fig. 15 Fig. 16 Fig. 17 Fig. 18 Fig. 19

THE PRESENT STATUS OF SPACE TELEGRAPHY.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.

Canadian Electrical Association (annual meeting), Hamilton, Ont., June 15th to 17th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

MR. FERRIÉ'S thoughtful article on "The Present Status of Space Telegraphy," translated from one of our French contemporaries and presented in full in this issue, is worthy of careful attention. It is written in a judicial spirit by a man who is an authority on the subject, and it presents a comparison, from the technical point of view, of different systems. The author concludes with this declaration: "All things considered, aerial telegraphy is a valuable method of communication, but so limited in its applications that there is little cause for apprehension that it will ever replace the present methods of telegraphic communication." This expresses concisely the opinion of many thoughtful observers, who have been led to conclude that where wires can be strung the wireless system will have no cause for existence. But there still exists a wide field for the employment of the new system in places where wires cannot be used—a fact which has very recently been emphasized by an official declaration of the Russian government.

READERS of the Western Electrician will be interested in the account presented this week showing the electrical and other precautions against fire in the reopened theaters in Chicago. While it was no failure in the electrical plant that caused the terrible Iroquois Theater fire, it is gratifying to observe that hereafter boxed-in arc lamps are to be used for "spot lights" and "flood lights;" that exit lights are to be on a separate circuit controlled from the street entrance, and that many other precautions are to be taken. However, the calamity of last December was not due to the lack of wise regulations, but primarily to the distressing negligence of operating an open-arc lamp near a flimsy drapery. If all arc lamps are encased, this particular form of accident cannot happen, but others may, with the very best of apparatus. Good men are needed as well as good tools. Every stage employe should exercise constant, intelligent vigilance; the apparatus should be tested at frequent intervals, and the management should sternly impress on all hands that in no spectacular or dramatic emergency should the methods or appliances of fire protection be disregarded for even a moment. Then, with such apparatus and precautions as have been adopted in the Powers Theater, there should be little danger—we do not dare to say no danger—of a calamity such as that which is linked so sadly with the name of the Iroquois Theater.

SOME curious properties of the N-rays are communicated by A. Charpentier in a recent issue of the Comptes Rendus. The experiments indicate that the new rays, or rather newly discovered rays, may be made useful in mapping out the nervous system of a living subject. If a small fluorescent screen is held in the hand or placed on the tips of the fingers its luminosity is increased if any other part of the skin is touched with a portable source of N-rays or with the end of a wire conducting N-rays. The increase of luminosity varies according to the more or less close nerve connection existing between the fingers and the point touched. Thus it is great when the trunk nerve of the arm is touched. The nerve may thus be followed right up to the brain, and it is found that in the brain itself the sides are changed, and the centers on the side opposite the fingers must be touched in order to produce a sensible effect. Mr. Charpentier points out that a similar mapping out of the nervous system may be carried out by means of electricity, but that the procedure is painful, whereas the N-rays are not felt. A screen placed over the heart shines out when the N-rays are applied to the neck where the pneumogastric nerve crosses, or, better still, to the inferior cervical and superior dorsal regions of the medulla. Physicians should be particularly interested in this discovery, which may be of considerable value to medical science.

AS MAY be judged by the report in this issue, the annual convention of the Iowa Electrical Association held in Des Moines last week was well worth while. This association is composed of central-station men exclusively. Its relations with the supply men are entirely cordial, but there is only one class of membership, and to that only men actively connected with the actual operation of electric-light plants in the state of Iowa are eligible. Sessions are held during two days only, but these are packed full of business. The Iowa central-station managers are practical, businesslike men. They meet in convention with the dominant idea of getting good out of the meeting by interchange of views and experiences and by affording one another the strength of co-operation. They know what they want, go after it in direct, practical fashion, and get it. They take a live interest in their association and are willing to give a little time to help one another. Thus at the Des Moines convention there were 14 papers or "demonstrated talks," in addition to the Question Box. All these papers or addresses were read or delivered, and nearly all were discussed. They were not too long and were helpful and practical. Of the 14 papers on the programme 10 were delivered by central-station men, members of the association, two by members of the faculty of the Iowa State College and only two by persons from outside the state, in this case representatives of manufacturing companies. This shows the extent to which the sturdy Iowa association relies on its own membership. In all cases save one the author of the paper or the man down for an address was present and did his own talking.

In this issue a general idea is given of all the papers, while some are printed in full or reserved for future publication. It may be truthfully said that all the papers and addresses were good, but perhaps those on station accounting, combustion of Iowa coal, meters, steam turbines and methods of increasing station output were especially noteworthy. Cordial recognition, too, is due the first Question Box issued by the association. This was distributed in the form of a pamphlet of 62 pages, and was the work of members of the association, collected and arranged by Mr. W. J. Greene of Cedar Rapids as editor. The book contains much valuable information, classified, and it is provided with an index. It is a credit to the association.

Standing in the front rank of state electrical societies the Iowa Electrical Association has added to its prestige by the Des Moines convention.

ONE of the most difficult questions for the central-station manager to answer is one asked in the Question Box at the recent convention of the Iowa Electrical Association. It comes up at practically all electric-light conventions, and although the answers to it are much more scientific during the last five or six years than formerly, it is still perplexing. It is this: "What system of meter rates comes nearest being fair and just to all classes of consumers using current for lighting purposes?" A veteran electrical man, to whom the question was submitted, gave it up. "The longer I remain in the business, the more difficult an answer becomes," he said. However, electric-light companies must have a system of charging, of course. The old flat rates are condemned on every side as entirely inadequate and inequitable, unjust to buyer and seller alike. Meter rates are indicated, but there are numerous systems of making up a price-list based on measurement of current supply. Every fellow who has devised a system of charging thinks his own plan the best, and so it is, possibly, for his plant, his investment, his hours of maximum demand, his proportion of day load, and so on. But the small central-station manager, who is anxious to learn all he can from the experience of others, may be interested in the following answer to the question from the Cedar Rapids Electric Light and Power Company:

Any rate which recognizes the elements of maximum demand and kilowatt-hours used in such a manner as to make every consumer pay his proportion of the fixed expenses, including interest and depreciation, and a fair profit, above cost of manufacture, on current used. A rate of (a) cents per kilowatt-hour for the first (n) kilowatt-hours per month per lamp maximum demand and (b) cents per kilowatt-hour for all current used in the same month in excess of that amount, with a minimum yearly bill equal to the cost of readiness to serve, is, in our judgment, preferable to the Doherty rate of (d) cents per lamp maximum demand plus current used at (c) cents per kilowatt-hour. We have tried both, but now use the former almost exclusively. We consider both fair, but the former is more satisfactory to consumer. Of course (a), (b), (c), (d) and (n) will vary in different places to suit local conditions.

The system preferred in Cedar Rapids is thus seen to be a "turning-point" method of charging, and it may be remarked that this system, with local variations, is now in use in many central stations. It seems to appeal more to the customer, as being more readily understood than the Doherty system, which is, perhaps, more exact.

IOWA ELECTRICAL ASSOCIATION.

Des Moines was the scene of a successful electrical convention last week. It was the fourth annual meeting of the Iowa Electrical Association, and was a busy, practical, creditable affair, in every way worthy of the organization, which stands in the front rank of state electrical associations. The attendance was about 120, of whom two-thirds were central-station men, the supply men making up the remainder. The list of the names of those who registered is given on page 357. The convention was held in the Savery House, and the delegates paid close attention to business. Mr. D. F. McGee, a progressive young central-station man of Red Oak, filled the chair acceptably as president, and by his gentle persistence kept things moving along. Mr. W. S. Porter of Eldora, the efficient secretary, managed the executive details with urbanity and skill.

Opening Business.

At the first session on Wednesday morning, April 20th, Mayor Mattern of Des Moines was present, and he welcomed the association in cordial terms. Then, after some routine business, President McGee read his annual address. Mr. McGee urged an increase of membership and warned his confreres not to get into a rut. Only a small proportion of central-station plants earn dividends. Managers should frequently meet and discuss present-day problems. Close attention to the meetings, discussions and papers was urged.

Secretary W. S. Porter read his report. He brought up the point of admitting electric-railway men and central-station men from other states. The efforts of the transportation and entertainment committees of the supply men were praised. The matter of admitting electric-railway men to membership was briefly discussed, without action.

Treasurer Rufus E. Lee of Clarinda showed, in his report, that the finances of the association were in a flourishing condition.

A nominating committee, consisting of W. J. Greene of Cedar Rapids, George S. Carson of Iowa City, Austin Burt of Waterloo, Robert Ferris of Eldora and Professor George W. Bissell of Ames was elected by ballot.

W. L. Bowers of Davenport, P. E. Bellamy of Knoxville and F. L. White of Traer were appointed a committee on president's address, and afterward made a suitable report.

Central-station Accounting.

Robert Ferris of Monmouth, Ill., owner of the Eldora (Iowa) electric-light plant, then gave a valuable talk on central-station accounting. Mr. Ferris exhibited a number of blanks designed to systematize electric-light-plant accounting. He told of the working of the state commission of Massachusetts, which supervises central stations. This commission has adopted a series of forms, which is the basis of Mr. Ferris' system. Proper forms place responsibility on the office, not on the men working in the station, who are required to fill out certain slips. The system comprises time cards, daily office reports, ledger accounts (summaries for the month), station daily-report sheets, records of weather, order blanks, contracts, meter bills, coal receipts, slips for goods received, meter records, jobbing accounts, forms of remittance, register forms for individual accounts, requisition slips, application blanks, etc. The system is to record what is actually done in the station and adapts itself to double-entry bookkeeping. Men should be provided with every facility to keep absolute and true records. A separate slip or sheet is provided for every thing of importance. On the meter books is kept a complete record of the customers' equipment. Mr. Ferris said: "I shall make a somewhat startling statement. By this method of accounting we discovered that we were selling current in Monmouth on a flat-rate basis at 3.7 cents a kilowatt-hour less than it cost us to make it." The speaker described the "turning-point" system of charging, about to be put in force in Monmouth, where flat rates are to be discontinued. The gist of it is contained in the following from a circular announcing the change: "We will call 50 watts the equivalent of one 16-candlepower lamp and consider the capacity of all lamps and appliances on that basis. We will charge each customer each month at the rate of 20 cents per thousand watts, until enough current has been used to equal 40 cents for each 16-candlepower lamp burned at any one time. This amount is called the turning point, and for all over that amount the cost will net 10 cents per thousand watts. We will then discount the bill to the turning point 10 per cent., if paid at the office of the company within 10 days from date. No bill, however, will be presented for less than $1 each month."

At the afternoon session Austin Burt of Waterloo explained the accounting system used in his stations. It is a question how much a small station is interested in the expense of installing an elaborate system of blanks. Seventy-five per cent. of the 172 central-station companies in Iowa are in towns of less than 5,000 population. The problem is to get the largest net income. In Waterloo and Cedar Falls a daily report is kept by the engineer. It shows the plant-time of operation and is returned to the office once a week. It shows maximum load, consumption of water, oil, etc. On the back of this report the load curve is plotted from half-hour readings. The report is entirely automatic; the engineer makes it, and he must give it half-hourly attention. The engineer takes an interest in it. When Mr. Burt went to Waterloo the station was using, on the average, only 13 per cent. of the capacity of the engines. Now it uses between 70 and 80 per cent. The engineer's report gives a line on this economy of operation, so that it may be regulated. In reading meters a card, suitable for filing, is used. Only the readings are put on the card, with such information as is necessary in figuring the bills. Meter readers should be dependable, honest men, not boys. Customers' bills should not be too complicated. Too many figures are confusing; let the consumer see at a glance what he has to pay. Net amounts are entered on the customer's ledger. Ninety-nine per cent. of customers take advantage of the discount. The rate in Waterloo is 16 cents a kilowatt-hour up to the "turning point" and eight cents beyond that. All consumers should be on meters. An adding machine is a great help to show total current sold each month and total revenue. Mr. Burt explained at considerable length the construction, stock and mercantile accounts in use by his company. A complete monthly statement of the whole business of the company, in all departments,

W. L. BOWERS, PRESIDENT OF THE IOWA ELECTRICAL ASSOCIATION.

gas, electric and mercantile, is made on a printed form. Provision is made for a summary of all departments and for general data, with space for comparison with preceding months or years.

Iowa Coals.

Professor George W. Bissell of Iowa State College at Ames read a good paper on "Combustion of Iowa Coals." This paper is printed in full elsewhere in this issue. J. A. Innes of Eagle Grove and Robert Ferris took part in the discussion. In answer to a question the professor said that Iowa and Illinois coals are about on a par in theoretical value.

H. E. Chase of Des Moines, inspector for the Hartford Steam Boiler Inspection Company in the state of Iowa, was called on. There is more steam coal than lump coal used in his territory. The reason given is that it is cheaper. A good quality of steam coal, properly handled, is cheaper than lump coal. There are more steam plants that have not enough draft than those that have too much draft. With insufficient draft, lump coal can be burned to better advantage. F. L. White of Traer said that tests some time ago showed that Iowa steam coal gave within five per cent. of the heating value of mine-run coal. J. G. Boyd of Sioux City said that furnace conditions must fit the fuel to be burned. Grates should be adapted to the work to be done. G. S. Bellamy of Knoxville is using 35 square feet of grate surface to 1,400 or 1,500 feet of heating surface in the boiler. Behind the bridge wall there is a space or combustion chamber at least six feet below the level of the boiler. This provision is important in burning slack. Several discussed the use of baffle walls, placed behind the bridge walls, some advocating their use and others deprecating it.

Boiler Scale.

P. E. Bellamy of Knoxville read a paper on "Scale Incrustation in Steam Boilers from a Chemical Standpoint." He outlined the various ways of attacking this problem, including the use of compounds. Perhaps the best way is to have a formula for a compound made by a chemist in each case after analyzing the feed water. Frequent analyses are necessary, as the composition of water often changes. Mr. Zahm described the system of using compound in use in Mason City. A tank in the pump suction is provided, and in this the compound is introduced. O. J. Johnson of Sac City, M. A. Harrison of Osceola and others took part in the discussion.

Storage Batteries.

Edward Reavy of Davenport presented a brief paper on "Storage Batteries in Connection with Central Stations." In the Davenport plant a battery is used in connection with rotaries, and the result is very satisfactory. The company would now consider it almost impracticable to operate without the battery. Reliable service, insured by the battery, is very important. In the discussion E. L. Draffen of Chicago, a battery expert, said that depreciation was figured usually at five per cent. He believed storage batteries were useful in small stations. John A. White of Chicago, another battery man, said the Davenport battery was used for regulation on railway circuits. It was never really discharged. In the case of a battery used for peak work, the watt efficiency would be about 80 per cent. The figure of 95 per cent. efficiency at Davenport should not be taken as applying to all cases; it would be too high.

Value of Meter Testing.

"Electric Meters" was the subject of a paper written and read by George S. Carson of Iowa City. Mr. Carson made a plea for accurate meters. His paper was of practical value and will be given in full in a later issue. In the discussion Mr. Zahm said that out of 100 customers' meters tested 97 ran slow, from seven to 56 per cent. The testing of meters about every six months is very essential. Injuries to jewels and tips and charred commutators are common. Mr. Burt said that meters should be capable of adjustment for light load. The expense of testing is considerable, but it is a good investment. Mr. Carson said that, in the question of accuracy, judgment should be used in selecting the meters. An instrument adapted for measuring 50 lights should not be put in for an installation of 15 lights.

Steam Turbines.

"Data on Steam Turbines" were given by J. B. Wilkinson of Chicago. The speaker described the Westinghouse-Parsons type of turbine. He quoted from a test to show the nicety of regulation. Full boiler pressure is used at all loads. The turbine is entirely automatic. Its durability is shown by five years' use; its efficiency is lasting. There are now installed Westinghouse turbo-generators of 55,000 kilowatts capacity, with three times as much building. There has been no case where a reciprocating engine has been used in a plant where a turbine of this make has been installed. Mr. Wilkinson gave some results of a test of a large turbo-alternator built for the New York subway plant. His comparison of the turbine and the reciprocating engine was highly favorable to the former. The costs of the two systems, considering a Corliss engine installed, would be, roughly speaking, identical. As to gas engines, under the best conditions in each case, the gas engine and the steam turbine would be about equally efficient. The turbine would be cheaper. Steam turbines are not particularly successful when run non-condensing. The Westinghouse turbines are not built at present in sizes of less than 400 kilowatts, although smaller sizes may be supplied later.

Mr. Wilkinson's paper was the last of the day.

Incandescent-lamp Testing.

The first feature of Thursday morning's session was the reading of a paper on "Lamp Testing" by Professor P. B. Spinney of Iowa State College. The speaker reported progress in the incandescent-lamp testing of the electrical department of the college with which he is connected. Comparatively few lamp tests have been made heretofore in a disinterested way. A growing demand is met in Iowa by the establishment of the testing bureau. High-efficiency lamps should not always be used. Where increased load does not involve increased cost, as in a waterpower plant, low-efficiency lamps are desirable. Lamps are not exactly alike; a certain variation is to be looked for, but this must be confined within reasonable limits. A lamp should be replaced when its candlepower has fallen to 80 per cent. of its initial value. Every moderate-sized plant should provide itself with some (perhaps inexpensive) means of lamp testing. These need not be elaborate, comparison being made occasionally with a standard photometer in a testing bureau. Professor Spinney, in conclusion, displayed a number of lamp curves and target diagrams showing efficiency. He said that both candlepower and wattage tests should be made; one alone may be misleading. Mr. Boyd, in the discussion, said that the wattage reading of a lamp was absolutely worthless without a photometer test. Mr. Carson said that it was found that when a central-station company had testing facilities it had less trouble with its lamps; the manufacturers, under such circumstances, send fewer lamps that have to be sent back.

Street Arc Lighting.

"Series Arc Street Lighting" was the subject of the paper read by M. A. Harrison of Osceola. The speaker described the alternating-current series enclosed-lamp system in use in his plant. The regulator is connected in series on the line and designed for 25 lamps, but works as well with 35 which are installed. Mr. Harrison described the regulator

which is, of course, designed to keep the current constant. The average life of the cored carbons is 80 hours. Carbons are one-half by 12 inches. Some difficulty is experienced in the contact between the lower carbon and the carbon holder. By changing the design of the latter slightly this difficulty could be easily obviated. The light is pleasing to the public. Mr. Harrison thought it advisable that current for street lighting, in his case at least, should be metered, as there are some differences on outages, dark hours, and the like.

A similar paper was that on "Multiple Street Lighting" by Rufus E. Lee of Clarinda. In the Clarinda system 53 lamps fed from five transformers are used. The writer thought the secondary circuits would give better results as two-wire circuits than as three-wire circuits. One-half-inch carbons are used. These seem better than the three-eighths-inch carbons formerly used. Mr. Burt pointed out that with the multiple system lamps of different capacity in amperes can be used.

Nernst Lamps.

Nernst lamps were discussed in a brief paper sent in by G. C. Gardner of Mt. Vernon and read, in the absence of the writer, by Mr. Greene. The opinions advanced were formed on an operative basis. The results were very satisfactory to Mr. Gardner's company and to the customers. Maintenance takes more time than with incandescent lamps. Cleaning is performed every six weeks. The company makes free renewals. The customer gets a large increase of illumination at the same expense. The quality of light is attractive. Lamps are operated on a meter basis on 220-volt circuits.

Mr. Greene himself corroborated Mr. Gardner. In Cedar Rapids the Nernst lamps are put out by two methods. In one the customers buy the lamps; in the other the station furnishes the lamps. The "turning point" of charging varies in the two cases. The cost of maintenance has been 0.6 cent a kilowatt-hour so far. The lamps are inspected weekly. Free renewals are furnished. The candlepower seems to be constant after the first 20 hours. The cost of maintenance is not much in excess of that of incandescents. Mr. Burt said that his company had successfully lighted a church with three six-glower lamps. It is necessary to have close regulation of the voltage. After the glowers burn out, if the current is not turned off, the heaters are apt to burn out. The Nernst lamp furnishes the best competition with the gas "arc" lamp. Mr. Greene added that the three-glower size was the best for this competition. It takes 270 volts. Mr. Innes also spoke of the need of careful voltage regulation. Nernst lamps require careful attention by persons familiar with them. Mr. Burt said that there was really more necessity for taking care of the Humphrey gas arc lamp than of Nernst lamps.

The general opinion was that the Nernst lamps are not satisfactory on direct-current circuits. But it was said that the lamps are being perfected for this purpose.

Refilled Lamps.

J. A. Innes of Eagle Grove then spoke of the refilling of incandescent lamps. A 650-hour test showed that the performance compared favorably with some makes of new lamps. The price is about half that of new lamps. The speaker emphasized the necessity of lamp testing or of buying only of makers of established reputation. Professor Spinney agreed with the speaker. Mr. Innes spoke of a $14 photometer which he thought was accurate to within a quarter of a candlepower. Mr. Carson spoke of the kind offer of the Iowa State College to test lamps from Iowa stations at the nominal rate of $1 a dozen, if carriage is paid both ways.

Increasing Output.

"The Best Method of Increasing the Output of Lighting and Power Plants" was the subject of a helpful paper prepared and read by A. W. Zahm of Mason City just before the noon adjournment. Discusson of Mr. Zahm's paper was the first event of Thursday afternoon's session. The question of supplying current for refrigerating plants was brought up by Mr. Burt. Mr. Zahm said that he would not advise central stations to go into this business but rather to encourage others to engage in it. In Mason City it is stipulated that these plants shall not operate between 5 and 8 p. m. during six months of the year—the winter season. In relation to sign lighting, Mr. Carson and Mr. Burt thought that the regular rates should be charged. The latter, also, thought that churches should be charged the highest rate, because they must be taken care of at irregular intervals, often, taking large capacity at times of peak load. But Mr. Zahm said the peak of the load was off by 7:30 p. m., in nine cases out of ten. Church lighting came at about eight o'clock, and was therefore desirable.

Thawing Ice in Water Pipes

Mr. Burt brought up the question of thawing pipes in winter. This work is simple, requires no special apparatus, except a 10-kilowatt transformer in the case of alternating current, and brings in a good revenue. The cost of doing the work is not great, but a charge should be made for "professional services." All the central-station men agreed that this comparatively new branch of work was profitable and should be encouraged. Several gentlemen related their experiences, referring to the use of both direct and alternating current. Mr. Thomas said that a rough rule for electromotive force was one-half volt per foot for two-inch pipe. When the slightest flow of water is produced the current can be taken off; the water pressure will do the rest.

Single-phase Motors.

W. A. Layman's paper on the "Operation of Single-phase Motors on Lighting Circuits" was read, in his absence, by W. Owen Thomas. The paper was based on tests made by Mr. Sparrow and was illustrated by diagrams. The small single-phase motor lends itself especially to the development of power business by central stations. Polyphase stations are successfully operating single-phase motors up to 35 horsepower; the limitation of size is one of balancing the circuits. Mr. Layman urged many reasons why single-phase motors should be used. In the discussion Mr. Thomas said that, for elevator and crane work the series alternating-current motor is available. This is simply a direct-current motor with laminated pole pieces.

By request, Mr. Thomas spoke briefly on the hydro-electric development at Sault Ste. Marie, Mich., with which he is thoroughly familiar, being consulting engineer for the plant. About 30,000 horsepower is generated. Two-thirds of the current is used for the electric furnaces of the great carbide plant. Mr. Thomas' talk was very interesting, and he was extended a vote of thanks.

W. J. Greene of Cedar Rapids presented the "Question Box" in the form of a printed pamphlet of 62 pages. The mass of information thus presented is very valuable, and Mr. Greene was officially congratulated on his work and thanked for it.

Election of Officers and Concluding Business.

Votes of thanks were extended to Mr. Wilkinson for his paper, and also to the supply men and the street-railway company.

In executive session the association elected these officers:

President—W. L. Bowers, Davenport.
Vice-president—Austin Burt, Waterloo.
Secretary—W. S. Porter, Eldora.
Treasurer—Rufus E. Lee, Clarinda.
Executive committee—W. J. Greene, Cedar Rapids; George S. Carson, Iowa City; A. W. Zahm, Mason City.

Dubuque was selected as the place of next year's convention, and the association adjourned to meet in April, 1905.

W. L. Bowers, the new president of the association, has charge of the commercial end of the electric-lighting, gas and steam-heating departments of the Davenport Gas and Electric Company. He was born in Pennsylvania in 1861 and has had a valuable experience in the lighting business, having been connected with gas and electric-lighting companies since 1886. He was with the Laclede company of St. Louis for 12 years, and he has also been engaged in the business in Shreveport, La., and Butte, Mont. For the last four years he has been connected with the Davenport company, where he has put his years of experience and knowledge of machinery to good use. He is a member of the Masonic order, the Knights of Pythias, Elks, Odd Fellows and Sons of Veterans.

Convention Notes.

The "Zion City" yell was given a few times—just for luck.

The Crescent Company of Chicago was represented by Albert Meyer.

"A good convention" was the verdict of both central-station and supply men.

W. P. Cosper energetically represented the Garton-Daniels Company of Keokuk.

The Western Electric Company sent as its representative M. R. Lash of Chicago.

The National Electric Company of Milwaukee was worthily represented by A. P. Peck.

The Western Electric Supply Company was represented by F. S. Wiemeyer of Denver.

The Nungesser Electric Battery Company was present in the person of Duke Trempe.

P. T. Ackerson was on hand as the representative of the American Transformer Company of New York.

Professor Bissell and Professor Spinney of Iowa State College contributed valuable papers, which were appreciated.

The H. W. Johns-Manville Company, manufacturer of asbestos, steam-pipe coverings, insulations, etc., was represented by Frank E. Johnson of Milwaukee.

When the Chicago delegation reached Des Moines an impromptu reception was organized in its honor, and the party, with signs and banners, marched in triumphant procession to the hotel.

I. N. Butterworth of the Tri-city Electric Company boarded the train from Chicago at Davenport at an early hour on Wednesday morning. He was one of the busy men at the convention.

The General Electric Company was represented by W. H. Colman and G. A. Seabury of the Chicago office. It made no exhibit. Mr. Colman was a member of the transportation committee.

Joseph L. Barnard of Minneapolis and J. S. Corby of Chicago exhibited the Imperial Crown lamps of the Bryan-Marsh Company and their own smiling countenances. They made a success of both jobs.

"Meters with rotating parts floated" was the point made by the Stanley Instrument Company of Great Barrington, Mass., which, in the person of F. J. Alderson, received visitors in Parlor D at the Savery.

R. W. Loose, who represented the Star incandescent lamps made by the Standard Electrical Manufacturing Company of Niles, Ohio, was one of the busiest men at the convention. He made many new friends.

Francis Raymond was there with all of his three I's. Mr. Raymond is the fortunate possessor of a personality that wins and retains friends. In representing the G. I. Company at Des Moines he added to his laurels.

A. G. Munro of Omaha was no stranger to many at the convention, and he received a hearty welcome. Mr. Munro is pushing the business of the Nebraska Electric and Fixture Company of Omaha with intelligence and vigor.

J. G. Pomeroy was on hand, of course. "Jim" is the Adams-Bagnall man in Chicago, as everybody knows, and he had a pleasant word for every visitor at the convention. As chairman of the entertainment committee he "done noble."

The Wagner Electric Manufacturing Company was represented at the convention by W. Owens Thomas of Chicago. A paper prepared by General Manager Layman was read by Mr. Thomas. It related to single-phase motors and attracted much attention.

F. F. Skeel, western manager for the Crouse-Hinds Electric Company, was one of the choice spirits of the gathering. He dispensed information about switches and switchboards, Norbitt specialties and such things with the savoir faire of a good fellow and a gentleman.

Quiet, but effective, the work of Julian S. Jackson, Chicago sales agent for Pass & Seymour of Solvay, N. Y., was of the order denominated fine. Mr. Jackson did not let anybody get away from the convention without hearing something new about P. & S. specialties and porcelains.

J. W. Mason of Chicago, C. A. Felker of Iowa and J. G. Ball of Wisconsin were the representatives of the Central Electric Company at the Iowa state convention. They did good work for their company. Their Okonite-Central Electric fob souvenir was much sought after.

Perry R. Boole, chief engineer and general sales manager of the Electric Appliance Company of Chicago, was strictly "in it" at Des Moines. His efforts helped everybody to have a good time, and he made many new friends. Leon Bly was the other representative of the Appliance company.

Through President A. C. Garrison the Columbia Incandescent Lamp Company of St. Louis invited the members of the association to inspect its factory when visiting the exposition this summer. John G. Boyd, sometimes referred to as "the Rev. John G. Boyd of Texas," represented the company at the convention.

Although Des Moines was his first western convention, John A. White of the Chicago office of the Electric Storage Battery Company got "in the push" with the ease of a veteran. Mr. White knows a lot about batteries and he contributed sensibly to the storage-battery discussion of Wednesday, when Mr. Reavy read a paper describing the plant of Chloride cells at Davenport.

E. L. Draffen, the gentlemanly representative of the Gould Storage Battery Company in Chicago, attended the convention. Mr. Draffen addressed the association on Wednesday afternoon, when the subject of storage batteries in central stations was under discussion. His clear presentation of the subject made a favorable impression, and it is said that Mr. Draffen got on the trail of some big business.

On Thursday there was a pleasant interlude to the labors of the association. The Des Moines City Railway Company placed two large special cars at the service of the visitors, who enjoyed a trolley ride about the city, with a short stop to inspect the power house. This excursion was taken at noon to avoid interference with the business sessions. Luncheon was served on the cars, so that no time was lost. The association later formally thanked the street-railway company for its courtesy.

Ervin Dryer was present, of course, for Iowa is familiar territory to him. But he was not in attendance as a Westinghouse man, but as representing the Allis-Chalmers Company. For many years Mr. Dryer was connected with the Chicago office of the Westinghouse Electric and Manufacturing Company, but he resigned on April 1st. He is one of the best-known electrical salesmen in the West, and many friends at Des Moines learned with interest of his new connection.

Busy, ingenious, trying to help everybody else, "Tom" Grier was a central figure at Des Moines. He was chairman of the transportation committee, which took 19 men out of Chicago, and in its zeal tried to sell hammocks on the rear platform of the car as "lower berths." He was toastmaster at the smoker and between times did much clever advertising for the American Circular Loom Company. At the smoker his company gave away an acceptable souvenir in the shape of a box containing a pipe, bag of tobacco and packet of matches. All told, Mr. Grier made a new and shining record at the Iowa convention.

Calvin Flexduct Roulet and I. A. Bennett did an unusual "stunt" in properly bringing before the convention the name Flexduct. Evidently with the thought of long-delayed spring, they presented each member with an emblem in the shape of a carnation

attached to a neat blue ribbon bearing the word "Flexduct." A "skedoodle" for everyone was Mr. Bennett's insistence when presenting each member with one of the Phelps Company's latest inventions, the "skedoodle" plug. This company was well represented by numerous neat and attractive advertising displays in self-flashing "Hylo" lamps, turn-down lamps and long-distance lamps.

The Fort Wayne Electric Works was represented by Walter S. Goll, manager Chicago office, Frank McMaster, representative in the Iowa territory, and A. H. Savage of the St. Paul office. These gentlemen exhibited a number of the company's specialties, including Type-A oil transformers, Type-K integrating wattmeters, form-C arc lamps for series direct-current and alternating-current service and revolving-desk type and telephone-booth fan motors. They also distributed literature descriptive of the well-known Fort Wayne line of direct-current arc and alternating-current machinery for lighting and power purposes. Mr. Goll was a member of the transportation committee, and one of the most energetic of that unique bunch of hustlers.

The principal social feature of the convention was the informal smoker tendered to the members of the association on Wednesday evening, April 20th, by a large number of electrical manufacturers and dealers. The affair was held in Turner Hall and was greatly enjoyed. A "Dutch lunch" was served to about a hundred men, and there were a number of informal speeches, Thomas G. Grier performing creditably the arduous duties of toastmaster. A minstrel performance by local talent wound up the affair. The committee in charge of the smoker consisted of J. G. Pomeroy, Adams-Bagnall company; J. W. Mason, Central Electric Company; P. R. Boole, Electric Appliance Company, and N. G. Harvey, Illinois Electric Company. Credit should be given to it, and particularly to Chairman Pomeroy, for hustling work in "pulling off" the affair on short notice. The association passed a vote of thanks for its entertainment.

The Westinghouse interests had the largest delegation at the convention. It consisted of W. R. Pinckard, Arthur Huntington, H. G. Peticolas and A. M. Miller of the Electric Company, J. B. Wilkinson and A. H. Charles Dalley of the Machine company, and C. A. Ross of the Sawyer-Man Company. Mr. Wilkinson specialized on the Westinghouse-Parsons steam turbine, on which he read a paper which received a formal vote of thanks from the association. Mr. Dalley talked with delegates about Roney stokers, and with good success if rumor be true. Mr. Ross, of course, could tell everybody about incandescent lamps. Mr. Pinckard was there on general principles, because he is needed at any electrical convention held in the West. Messrs. Miller, Peticolas and Huntington are sharps on the local needs of Iowa. All told, the Westinghouse bunch was a strong one.

Delegates and Visitors.

Ackerson, P. T., American Transformer Co.....New York
Alderson, F. J., Stanley Instrument Co.....Great Barrington, Mass.
Ashby, A. J., Humboldt Electric Light and Power Co.....Humboldt
Ball, J. G., Central Electric Co.....Chicago
Barnard, Jos. L., Bryan-Marsh Co.....Minneapolis
Bellamy, Paul E., Knoxville Electric Co.....Knoxville
Bly, Leon, Electric Appliance Co.....Chicago
Boole, P. R., Electric Appliance Co.....Chicago
Bonebright, F. A.....Webster City
Bowers, W. L.....Davenport
Boyd, John G., Columbia Incandescent Lamp Co..St. Louis
Branson, D. C.....Clear Lake
Burt, Austin, Waterloo and Cedar Falls Gas and Electric Co.....Waterloo
Butterworth, I. N., Tri-City Electric Co.....Davenport
Colman, W. H., General Electric Co.....Chicago
Corby, J. S., Bryan-Marsh Co.....Chicago
Cosper, W. P., Garton-Daniels Co.....Chicago
Coulson, F. E., Grinnell Electric and Heat Co.....Grinnell
Cravath, J. R., Electrical World and Engineer.....Chicago
Croan, B. F., City Light and Water Co.....Estherville
Cummings, C. R., Webster City Electric Light and Water Works.....Webster City
Dalley, A. H. Charles, Westinghouse Machine Co..Chicago
Draffen, E. L., Gould Storage Battery Co.....Chicago
Dryer, E., Allis-Chalmers Co.....Chicago
Edgecomb, A.....Missouri Valley
Emery, E. A. Sorge, Jr., Co.....Chicago
Etzel, John L., Clear Lake Electric Light and Power Co.....Clear Lake
Felker, C. A., Central Electric Co.....Oskaloosa
Ferris, Robert, Eldora Electric Light Co.....Eldora
Gray, Perry, Jefferson Light, Heat, Power and Water Co.....Jefferson
Greene, W. J., Cedar Rapids Electric Light and Power Co.....Cedar Rapids
Grover, W. H., Cherokee Electric Co.....Cherokee
Hardy, J. W.....Des Moines
Harris, James H., Heine Safety Boiler Co.....Chicago
Harrison, M. A., Osceola Electric Light Co.....Osceola
Harvey, N. G., Illinois Electric Co.....Chicago
Healey, H. R., Healey Electric Light Co.....Waverly
Hindert, A. L., Perry Electric Light, Power and Heat Co.....Perry
Hopkins, L. G., Waterloo Electric Supply Co....Waterloo
Hornung, J. C., W. H. Schott.....Chicago
Hovey, S. B.....Independence
Hovey, M. W., Marshalltown Light, Power and Railway Co.....Marshalltown
Hoyer, G. C., Nashua Electric Light Co.....Nashua
Huntington, Arthur, Westinghouse Electric and Manufacturing Co.....Omaha, Neb.
Innes, J. A.....Eagle Grove
Jackson, Julian S., Pass & Seymour.....Chicago
Johnson, Frank E., H. W. Johns-Manville Co..Milwaukee
Johnson, O. J., Sac City Electric Co.....Sac City
Keily, W. E., Western Electrician.....Chicago
Keiser, W. N., Des Moines Edison Light Co....Des Moines
Lash, M. R., Western Electric Co.....Chicago
Lee, Rufus E., Lee Electric Light Co.....Clarinda
Lever, A. J.....Tama
Lindsay, J. R., Union Electric Co.....Dubuque
Logan, O. E., Sheldon Electric Co.....Sheldon
Loose, R. W., Standard Electrical Manufacturing Co..Elkhart, Ind.
Madson, L. F., Northwood Electric Light Plant..Northwood
Mason, J. W., Central Electric Co.....Chicago
Mathes, L. D., Union Electric Co.....Dubuque
Michel, F. W., Orange City Electric Light Co..Orange City
McCain, P. L.....Des Moines
McGee, D. F., Red Oak Electric Co.....Red Oak
Miller, A. M., Westinghouse Electric and Manufacturing Co.....Chicago
Meyer, Albert, Crescent Co.....Chicago
Morse, R. W., Shenandoah Electric Light and Power Co.....Shenandoah
Munro, A. G., Nebraska Electric and Fixture Co.....Omaha, Neb.
Myers, Paul P., Grinnell Electric and Heat Co.....Grinnell
Payne, Robert P., Nernst Lamp Co.....Chicago
Peck, A. P., National Electric Co.....Milwaukee, Wis.
Pinckard, W. R., Westinghouse Elec. and Mfg. Co...Chicago
Pine, P. R., Tipton Light and Heat Co.....Tipton
Peticolas, H. G., Westinghouse Electric and Manufacturing Co.....Waterloo
Pomeroy, J. G., Adams Bagnall Electric Co.....Chicago
Porter, W. S., Eldora Electric Light Co.....Eldora
Raymond, Francis, G. I. Arc Light Co.....Chicago
Reavy, Edw., People's Light Co.....Davenport
Ross, C. A., Sawyer-Man Electric Co.....Chicago
Roulet, C. B., Osburn Flexible Conduit Co.....New York
Sawyer, Paul B., Des Moines Edison Light Co..Des Moines
Seabury, G. A., General Electric Co.....Omaha, Neb.
Skeel, F. F., Crouse-Hinds Electric Co.....Chicago
Smith, D. J., Ackley Electric Light, Power and Heat Co.....Ackley
Spinney, P. B., Iowa State College.....Ames
Springer, M. E., Practical Gas Construction Co..Des Moines
Switzer, F. B., National Conduit and Cable Co....Muscatine
Thomas, W. Owen, Wagner Electric Manufacturing Co.....Chicago
Trempe, A. D., Nungesser Electric Battery Co.....Chicago
Walters, W. C.....Toledo, Iowa
Westerberg, A. R., Madrid Electric Light and Power Co.....Madrid
Wheeler, M. J., Denison Electric Light and Power Co.....Denison
White, F. L., Traer Electric Co.....Traer
White, John A., Electric Storage Battery Co.....Chicago
Wiemeyer, F. S.....Denver, Colo.
Wilkinson, J. B., Westinghouse Machine Co.....Chicago
Zahm, A. W., Mason City Gas and Electric Co...Mason City

DELEGATES AND VISITORS AT IOWA ELECTRICAL CONVENTION IN DES MOINES.

Iowa Street-railway Association Formed.

At a meeting of representative street-railway men in the state of Iowa held in Des Moines on April 21st the Iowa Street and Interurban Railway Association was formed. The object of the association is the exchange of ideas and the diffusion of knowledge, and the discussion of all practical questions in connection with the operation, construction and maintenance of electric and interurban railways in the state of Iowa. Both companies and individuals are eligible to membership. The admission fee is $10. Annual dues are fixed at the same sum.

Officers were elected as follows:

President—G. B. Hippee, Des Moines.
Vice-president—J. F. Lardner, Davenport.
Secretary and treasurer—L. D. Mathes, Dubuque.

In addition to these gentlemen, there were present Isaac B. Smith of Cedar Rapids, J. R. Lindsay of Dubuque, Mr. West of Tabor, Mr. Leussler of Council Bluffs, Mr. Springfield of Ottumwa, M. W. Hovey of Marshalltown, S. B. Hovey of Independence, Mr. Hamlin of Mason City, Mr. Walters of Tama, H. H. Polk of Des Moines, A. G. Munro of Des Moines and others.

The next meeting will probably be held in Dubuque on the same date as that of the Iowa Electrical Association. Several gentlemen are members of both associations, and fraternal relations will exist between the two bodies, which are, however, distinct organizations.

The Iowa street-railway convention is the first

of its kind in the West, although several similar organizations exist in eastern states. The officers of the Des Moines City Railway Company and of the Des Moines-Colfax interurban railway entertained the members of the new association at lunch at the Kirkwood and later a ride was taken through the city and to Colfax, via the Interurban railway.

The first president of the society, G. B. Hippee, is general manager of the Des Moines City Railway Company, and the secretary, L. D. Mathes, is general manager of the Union Electric Company of Dubuque.

The Combustion of Iowa Coal.[1]

By G. W. Bissell.

That Iowa coals are difficult to burn satisfactorily —that is, economically, easily and with minimum attendant expense in repairs of grates and settings—has been long understood and acknowledged; but their low cost to the majority of steam users in Iowa, as compared with imported coals, creates a demand for them and also establishes a need for study to bring to the help of their users information which will enable the overcoming of some of the difficulties in the way of better results than are now generally obtained in their combustion.

It is the object of this paper to endeavor to state the problem, and, if possible, to offer suggestions for its solution. The problem is best stated by study, first, of the chemical composition and physical properties of the coal; second, of the means ordinarily used for burning it, and, third, of the results of practice in its use.

Chemical tests made by the Iowa Geological Survey and by the Iowa State College[2] show that the average proximate composition of Iowa coal is as follows:

2. The Iowa Engineer, June, 1902.

	Per Cent.
Moisture	8.1
Volatile matter	38.1
Fixed carbon	45.6
Ash	8.2
	100.0
Sulphur	[illegible]

Or

	Per Cent.
Total combustibles	83.7
Moisture	8.1
Ash	8.2
	100.0
Sulphur	[illegible]

On the basis of moisture excluded.

	Per Cent.
Volatile matter	41.5
Fixed carbon	49.6
Ash	8.9
	100.0
Sulphur	[illegible]

Many coals are worse and some are better than the above average. The writer recently had a sample which analyzed:

	Per Cent.
Moisture	8.07
Volatile matter	37.88
Fixed carbon	38.90
Ash	15.15
	100.00
Sulphur	[illegible]

The average heating value of one pound of Iowa coal is about 11,500 British thermal units (B. T. U.), and some Iowa coals give as high as 13,200 B. T. U. per pound of moisture free coal. A good West Virginia soft coal recently examined at the college gave over 15,000 B. T. U. per pound, and contained less than two per cent. of either ash or moisture and no sulphur.

Omitting from consideration the comparatively few plants in which boilers have been especially selected and set to meet the conditions suggested by the properties of the fuel to be handled and omitting locomotive boilers, the writer is of the opinion that the typical boiler and furnace in which Iowa coal is used is of the horizontal return tubular type set in brickwork and proportioned in nearly all respects in accordance with the practice of eastern boilers for which hard coal is mostly used.

The average Iowa coal, with 11,500 B. T. U., is theoretically capable of evaporating 11.9 pounds of water into steam from and at 212 degrees.

Some boiler tests made under the direction of the writer give results of evaporation from and at 212 degrees per pound of combustible as follows:

Marquisville lump	[illegible]
Boone lump	[illegible]
Summit lump	[illegible]
Marquisville nut	[illegible]
Marquisville steam	[illegible]
Marquisville slack	[illegible]
Average of above	7.39
[illegible]	[illegible]
Hard nut coal	[illegible]

1. The Iowa Engineer, September, [illegible]

The tests were made in an internally fired boiler of the marine type.

The Iowa coals, with an average of 7.39 pounds evaporation, were being burned with an efficiency of 62 per cent. under test conditions. Under ordinary operative conditions, and with brick-set boilers the efficiency is much lower, and it is safe to say that the majority of steam users in Iowa do not get from their coal more than 50 per cent. of the heat. Good practice demands 70 per cent. The question in its new form, then, is, How can the efficiency be raised? or, How can the fuel cost of generating steam be reduced?

To the user of lump coal, whether Iowa or imported, a considerable saving can be effected by substituting steam or slack coal, the fuel cost of generating steam with coal from a given locality, where freights are not excessive, being almost proportional to the cost of the coal per ton.

The following figures from tests at Ames in 1901 confirm this statement:

Kind of Coal.	Cost Per Ton.	Cost Per 1,000 Lbs. of Steam Pressure. Cents.
Marquisville lump	$2.85	24.0
Marquisville nut	2.54	21.5
Marquisville steam	2.35	21.2
Marquisville slack	1.43	14.0

Freight and cartage included.

The change from lump to slack may demand larger grates and increased draft, but will be a paying change. But the change above suggested is merely begging the real question, which is, How can we burn a given Iowa coal so as to get the maximum efficiency?

In answering this question, there are two things to be considered: First, the design of the boiler and furnace; second, the handling of the fuel.

Authorities agree that boilers depend largely upon their furnaces for their efficiency. The requirements of a furnace suitable for burning soft coals are:

1. Grates of sufficient area to give the rate of combustion suited to the coal and the draft. Slack coal with a draft of three-eighths of an inch can be burned with good rocking or shaking grates at a rate of 20 to 25 pounds per square foot of grate per hour. Lump coal, under the same conditions, can be burned at 30 to 40 pounds per square foot of grate per hour.

2. Rocking grates. The design depends upon the degree of clinkering peculiar to the coal.

3. Draft sufficient to burn the coal when fired in a bed of such thickness as can be readily maintained without "holes." Three-eighths of an inch should be sufficient for natural draft. Any more means useless waste of heat in the chimney gases, which must be heated to produce the draft.

4. A coking arch or other form of firebrick roof over the fire to prevent the chilling of the volatile matter of the fuel and of the air supply before they shall have been thoroughly united in combustion. The "Dutch oven" or extended furnace is the best construction for this purpose. The coking arch over the fire in an ordinary setting is the next best thing.

Frequently, however, owing to the eastern design of setting in general use in the West, there is not sufficient height between grates and boiler shell for an arch.

A boiler shell hung 24 inches or less above the grate is sure to give poor results, because of its chilling effect on the air and volatile matter of the fuel at the time when they should unite in perfect combustion, with the evolution of 14,500 B. T. U. per pound of carbon, and will inevitably result in the evolution of only 4,000 B. T. U. per pound from a large percentage of the carbon in the fuel.

In fact, the secret of success or the reverse in burning soft coal lies in the provisions which are made in this one particular. The "Dutch oven" is a good investment.

5. Hollow walls with enclosed air spaces to reduce radiation losses.

The requirements of the boiler, so far as its design is concerned, are:

1. Heating surface 40 to 50 times the grate surface, arranged to compel the gases to reach every part without undue resistance. Horizontal return tubular boilers will meet this requirement with four-inch flues 18 feet long or longer, with as few horizontal rows as possible, and having a draft area of one-seventh of the grate surface.

2. Accessibility of heating surface for cleaning on both sides.

For the successful handling of soft coal, the following requirements exist:

1. Alternate firing.

2. Sufficient thickness and evenness of fire to compel the air to become intimately mixed with the fuel and, at the same time, without reducing the air supply below the proper amount.

3. Keeping the top air supply properly adjusted.

The intelligent fireman can judge whether these requirements are being met, by watching his fire at various points in the boiler setting, through peepholes provided for the purpose, by watching the top of the stack, etc.

1. A paper read before the Iowa Electrical Association at Des Moines on April [illegible]. The author is professor of mechanical engineering in Iowa State College.

To Form Electrical Jobbers' Association.

A meeting of electrical jobbers was held in Buffalo, N. Y., on April 15th to 17th and was attended by representatives from the principal cities of the United States. The attendance was made up largely of electrical jobbers and supply dealers, but not a few prominent manufacturers and contractors were present. The result of the three-day session was the appointment of a number of committees, which are to formulate plans for a National Supply Dealers' Association and report at a future meeting. The main subject discussed was standardization, and the sentiment prevailed among jobbers, manufacturers and contractors alike that the interests of the electrical business would profit by an immediate standardization of material and methods.

Transportation Arrangements for Boston Convention.

This year the National Electric Light Association will hold its annual meeting at the Hotel Vendome in Boston on May 24th, 25th, 26th and 27th. With a view of providing the best accommodations and all the advantages of a convention train for the exclusive use of members, supply men and their friends who will attend the Boston meeting, the Lake Shore and Michigan Southern Railway in conjunction with the New York Central and Hudson River Railroad will provide special sleeping cars, which, with dining and buffet library cars, it is proposed to run as the first section of the "New England express," leaving Chicago at 2 p. m. Sunday, May 22d, arriving in Boston at 5 p. m. Monday. All electrical people going to Boston for this event are requested to join this party; and to enable the railroad to provide desirable sleeping-car accommodations it is requested that requisitions for berths or staterooms be sent in as early as possible.

A rate of one-and-one-third fare for the round trip, on the certificate plan, has been authorized for this meeting, which will be available, leaving Chicago as early as May 20th and good returning, leaving Boston not later than May 31st. Applications for sleeping-car reservations (which should be made early) or any additional information, may be addressed to L. F. Vosburgh, general agent passenger department, 180 Clark Street, Chicago, or C. F. Daly, chief assistant general passenger agent, Chicago, of the Lake Shore Railroad, and, "first come first served" in lower berths.

Frank L. Perry, assistant business manager of the Western Electrician, has been appointed by the association to have charge of transportation matters for Chicago and vicinity.

For further information of delegates it should be stated that word has been received from Master of Transportation George F. Porter that the New England Passenger Association, the Trunk Line Association and the Central Passenger Association have made the rate of a fare and a third for the round trip from all points throughout their territory for delegates and visitors.

Chairman Charles H. Hodskinson of the committee on hotel accommodations reports too that "an unusually large number of rooms have already been assigned to members." It is believed that the placing of this matter in the hands of a committee to which all applications for rooms can be referred will undoubtedly result in better satisfaction, for members of the association will be cared for first and will not be obliged, should they be a little late in deciding to attend, to make the best of such accommodations as will be left after non-members have been provided for, as has happened at former meetings.

Alternating-current Generators.

At the meeting of the American Institute of Electrical Engineers in New York on April 22d two technical papers on alternating-current dynamo design were presented and discussed. These papers were "The Mechanical Construction of Revolving-field Alternators," by David B. Rushmore of Pittsfield, Mass., and a "Contribution to Theory of the Regulation of Alternators," by H. M. Hobart of London and Franklin Punga. Vice-president C. W. Rice presided. Mr. Rushmore was present and gave some of the points in his own paper. Gano S. Dunn of Ampere, N. J., made a resume of the Hobart-Punga paper. Those taking part in the discussion were Professor C. A. Adams, Jr., of Cambridge, Mass., B. A. Behrend of Cincinnati, W. L. Walters of Milwaukee (communicated), Mr. Dunn, Mr. Rushmore, Dr. F. A. C. Perrine of Pittsfield, Mass., and H. G. Stott of New York (communicated). Abstracts of the papers and discussion may appear in a future issue of the Western Electrician.

Appleyard Traction Interests Consolidate.

Plans for the consolidation of the Appleyard interests in Ohio under the control of the Ohio Union Traction Company, recently incorporated, have been announced. The bonded indebtedness is not to exceed $30,000 a mile single track outside of cities and $10,000 additional for double track. Within cities $60,000 a mile single track, and $40,000 additional for double track is the limit. The lines affected are the Dayton, Springfield and Urbana; Columbus, London and Springfield; Columbus, Grove City and Southwestern; Central Market Street Railway in Columbus; Urbana, Bellefontaine and Northern; Kenton and Southern, and Springfield and Western. Holders of bonds in these companies will exchange their holdings on May 1st for the first and consolidated 5's of the new company, based upon their market value. All these properties are reported to be in good condition and their value on the market would indicate that they are making good profits.

The Trent Power Company, with a capital of half a million dollars, has been incorporated, with head office in Trenton, Ont. The principal director is Hon. S. H. Blake of Toronto.

Use of Space Telegraphy by War Correspondents.

There are signs of a difference of opinion between the civil and military branches of the United States government respecting the Russian decree against the use of space telegraphy by newspaper correspondents. The disposition of the service branches is distinctly in favor of governmental control, which is toward the support of the Russian position. It is even argued that no civilian should be allowed to erect a wireless mast without executive permission, because its use might interfere with that of some military mast. While the State Department opinion is not crystallized, it is known that the department is disposed to move slowly and cautiously in laying any sweeping prohibitions on private enterprises, either newspaper or commercial.

The London Times puts its case, and the wireless case, strongly: "Any correspondent is allowed, subject to censorship, to send a telegram from Tokio, Nagasaki or any point at which he may be, and any correspondent may post a telegram to a neutral port, such as Wei-Hai-Wei, and have it dispatched from there. At what point is the line to be drawn? Is it wrong to send telegrams by steamer to Wei-Hai-Wei? Is it wrong to shorten the journey by telegraphing it from the steamer? The entire misconception is revealed by a suggestion in Le Temps [of Paris] that the Japanese might intercept the news sent by our correspondent to London. Whether this is technically possible we do not know. Our correspondent says not. But if it is only news that the Japanese could obtain from our correspondents, which he has obtained either from them or from personal observation while with them, in his case, therefore, the whole basis of the Russian circular, namely, that information may be communicated to the enemy falls to pieces. We can hardly believe that arbitrary enactments, such as the Russian circular contains, will commend themselves to the judgment of neutral countries, especially when they involve sudden and entirely unexplained reversal in the practice hitherto adopted by the belligerent who issues them."

The Russian government seems to have receded from its original position, as both the American and English foreign offices are said to have received notes saying that Russia does not contemplate any immediate action in the matter. It is explained that the notice served by Russia is a measure of self-protection against possible communication with the enemy.

Earnings of Chicago Edison and Commonwealth Companies.

The annual report of the Chicago Edison Company to be submitted to the stockholders for the year ended March 31, 1904, will show an increase of $428,083 in gross earnings over the preceding year. The income account for the last two years follows:

	1904.	1903.	Increase.
Gross earnings	$1,837,650	$1,409,576	$428,083
Expenses, renewals, etc	2,515,040	2,195,647	319,393
Net earnings	$1,322,610	$1,213,926	$108,690
Bond interest	307,088	300,990	6,098
Balance for stock	$1,015,531	$ 912,939	$102,592
Dividend paid	720,526	593,346	127,180
Year's surplus	$ 295,005	$ 319,593	*$ 24,588

*Decrease.

The Commonwealth Electric Company for the same period will show an increase in gross earnings of 34 per cent. Comparisons for the last few years are as follows:

	1904	1903.	1902	1901.
Gross earnings	$1,150,999	$1,002,085	$760,666	$629,047
Expenses and renewals	834,735	623,264	407,097	410,176
Net	$ 516,264	$ 378,821	$271,563	$218,871
Bond interest	275,737	220,704	167,261	137,770
Balance	$ 240,527	$ 158,117	$104,302	$ 81,101

Fourteen members of the senior class of Lehigh University, South Bethlehem, Pa., will receive the degree of electrical engineer next June.

Single-phase Railway Motor.

Thoughtful engineers have long recognized that an alternating-current system of electric traction, which would permit the use of a high transmission-line potential but avoid the transformation to direct current by means of the rotary converter, would give an impetus to the electrical solution of transportation problems greater even than that which followed the introduction of the rotary converter some few years ago. In no other department of electrical application has the necessity of a variable-speed motor been so important a factor. The series-wound direct-current motor has met these conditions with considerable success, and made possible the tremendous growth of electrical railways in this country. This type of motor has practically superseded all others in traction service, and has become generally regarded as the only type applicable, possessing, as it does, the essential characteristics of a torque which increases as the speed decreases, and a speed variation over a wide range which is under sufficient control. The direct-current motor, however, in many respects is not entirely satisfactory; especially is this true in the matter of speed control and in current distribution.

An alternating-current motor possessing the characteristics of a direct-current series motor is believed by many to be the future railway motor. The one illustrated herewith is built by the Westinghouse Electric and Manufacturing Company, and is known as its No. 91 railway motor.

As seen by Fig. 1, in general appearance this motor does not differ greatly from the direct-current type, now standard. A laminated core built up of circular punchings of soft steel, securely bolted together, is rigidly held within a cylindrical frame of cast steel. End brackets, accurately fitted and bolted to the frame, complete the motor casing. Lugs are provided on the casting for "nose" suspension, and for the support of the gear case.

A drum type of armature core with open slots is wound with machine-formed coils of copper strap connected in multiple. The coils are held in place by retaining wedges of hard fiber which fit in grooves punched in the armature teeth. There are no band wires over the core. Numerous ventilating spaces in the core permit free circulation of air and insure cool operation. The commutator is built up of cold-rolled copper segments. The brush holders are of the sliding-shunt type with carbon brushes. The motor is wound for a potential of 225 volts, and a frequency of 25 cycles or less. At normal voltage and full load the armature speed is approximately 700 revolutions per minute.

An auto-transformer is provided to reduce the trolley potential to that desired at the motors. It is of the shell type, with single coil, and of standard construction throughout. A two-coil transformer may be used in place of the auto-transformer, sometimes with advantage. It is desirable with motors connected in multiple and a lower secondary voltage, of a smaller size than would otherwise be possible. The regulator is operated by an air motor, connected to the shaft by a worm gear, and controlled by magnet valves.

The master controllers are located one at each end of the car. They permit the control by a single motorman of a single car or of a train made up of several cars. Each consists, as shown in Fig. 2, essentially of a skeleton brass drum, mounted upon an insulated shaft, and stationary contact fingers which make contact with points upon the drum. The drum is made in one casting, with contact points so spaced as to give the proper combinations. These controllers are connected only with the low-voltage circuits from the storage battery, which operate the magnetic valves.

A diagram of connections of a four-motor equipment is presented in Fig. 3. The four motors are arranged in pairs, each consisting of two armatures in series, and two fields in series. The two pairs are connected in parallel. This equipment is designed for operation at a trolley potential of from 1,000 to 1,200 volts reduced by the auto-transformer on the car to approximately 300 volts.

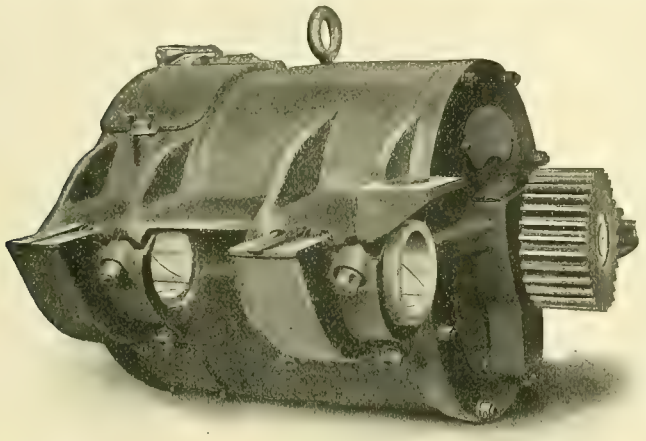


Fig. 1. General Appearance of Machine

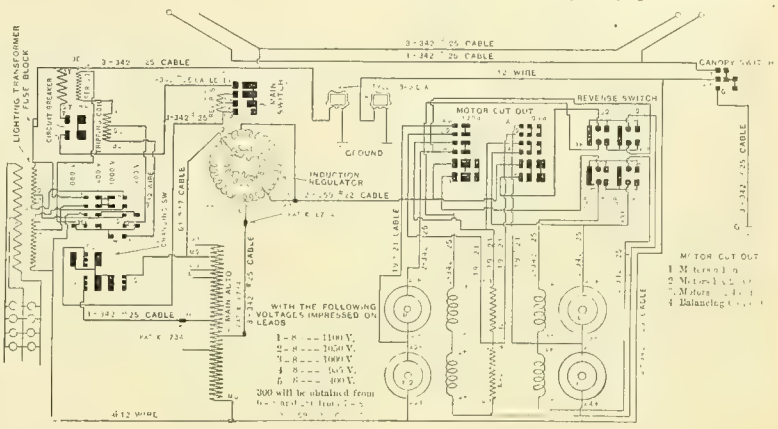


Fig. 3. Diagram of Connections.

SINGLE-PHASE RAILWAY MOTOR.

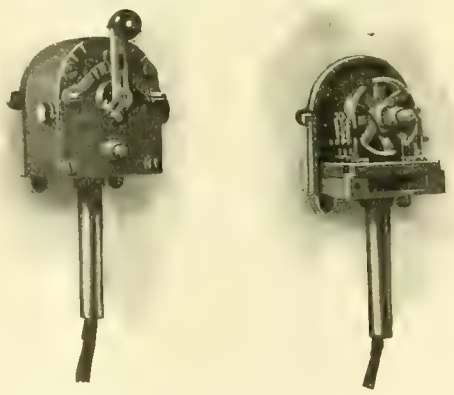


FIG. 2. SINGLE-PHASE RAILWAY MOTOR.—MASTER CONTROLLER.

Chicago Street-railway Situation.

Although the franchise of the Chicago Passenger Railway Company expired on April 21st at midnight, nothing was done at the last meeting of the Chicago City Council which might indicate what will become of these lines. The road is an important link in the Chicago Union Traction Company's system and carries with it the right to Adams Street, west of Clark, the Adams and Harrison Street bridges and the Washington Street tunnel. Municipal-ownership advocates demand that the city prepare at once to take over these lines as they do not come under the provisions of the 99-year act, and no further right to the streets, it is argued, can therefore be claimed by the traction company.

The passage of the Mann bill ordering the city of Chicago to remove or lower the tunnels under the river has further complicated the traction situation, as the Chicago Union Traction Company has rights covered by its franchises to the use of the tunnels. The new local transportation committee has been ordered by the council to report out at once an ordinance providing for the lowering of the tunnels. The council also passed an order directing the transportation committee to report at the next meeting the ordinance creating a Local Transportation Department, for the establishing of which $7,000 has been appropriated. Some dissatisfaction was expressed by members of the council at the delay of some of the city officials in arriving at something definite in the way of franchise extension, and it is probable that the next meeting of the council will produce some developments. In the meantime the Chicago Passenger Railway Company is operating without a franchise, having simply been informed that the franchise has expired and [illegible] remove the tracks at once [illegible] any concession on the [illegible] any company.

Ohio Telephone Notes.

From present prospects the right of the Cuyahoga Telephone Company to charge more for service than the maximum rates stated in the franchise will be tested in the courts. It is said that an ordinance will be introduced in the City Council at an early date looking to that end. It seems that the franchise of the Cuyahoga Telephone Company fixes rates for business telephones at $48 a year and residence service at $36, and where both are used by the same person the rate is to be $72 a year. The Cuyahoga Telephone Company showed a reduction in its March earnings, owing to losses and confusion incident to transferring to a new switchboard and other things that came up in connection therewith.

In a statement in a Cleveland paper President Dickson of the Federal Telephone Company sets out the condition of the various subsidiary companies in such a manner as to make it plain that they are now in shape to make good profits. The companies still under control of the Federal are as follows: Columbiana, Cuyahoga, Findlay, Fostoria, Lancaster, Massillon, Stark County, Youngstown, Zanesville and the United States.

The Central Union Telephone Company has secured a franchise to operate a plant at Ashland after two years of legal warfare. The Star Telephone Company is operated by local capital and has the united support of the business men of the place. Most of them have signed an agreement not to use another system, even if it is put in free.

Judge Nippert of Cincinnati has decided that the interests of the various Independent companies seeking franchises in Cincinnati are not identical and their hearing should be separate. He has, therefore, set a date for the hearing of the Queen City Telephone Company, all the others having been heard. The Bell people seem to control the situation so far as the city authorities are concerned, but with the fight the Independents are putting up with the courts there is liable to be a change.

The earnings of the People's Telephone Company of Akron for the first quarter of this year were $21,830, as compared with $20,201 for the corresponding time last year. The net profits for stock are $5,897 and the first three months last year they were $4,980. At this rate the stock is earning six-per cent. dividends. The company has 3,800 subscribers.

The Pure Oil Company has been granted a franchise to build telegraph and telephone lines through the streets and alleys in Marietta.

The Johnstown and Croton Telephone Company has been granted a franchise by the Village Council of Alexandria. The lines will connect with the long-distance lines at Newark.

E. L. Barber, J. S. Brailey, Jr., James E. Brailey, Herbert A. Barber and James C. King are the incorporators of the Central Telephone Construction Company of Toledo, with a capital stock of $100,000. The company will engage in the construction of telephone exchanges, lines and plants. C.

Southeastern Telephone Developments.

The Automatic Electric Company of Chicago has installed an experimental set of telephone instruments at Greensboro, N. C., which is working with precision. The citizens' committee having in charge the investigation looking to the establishment of an Independent system is making a careful examination of this improvement, and unless the friction with the Bell company is adjusted the automatic service will be used in the new system.

The work of overhauling the Reidsville (N. C.) telephone exchange has been completed and the system is in fine working order. There are about 150 telephones connected with the switchboard. Metallic lines are being built to Wentworth, Leaksville and Stoneville. Connection is being made with Greensboro and Lynchburg, Va. This gives three wires north and south of Reidsville, which not only improves the local but the long-distance service.

A new telephone company has been chartered under the name of the Graniteville (S. C.) Telephone Company. W. A. Giles is president and C. B. Willis secretary. The capital is $2,500.

The Piedmont Telephone and Telegraph Company of Gastonia, N. C., has acquired the exchanges at Mt. Holly, Stanly, Lowell, McAdensville and Davidson, N. C., owned by Dr. C. L. Hunter and others. The combining of these with the properties already owned by the Piedmont company will secure uniformity and vastly improve the service of the system.

The Southern Bell Telephone Company will soon dismantle the plant of the Gordon company which it recently purchased. The property will be wrecked and sold as junk, as the two systems are entirely different and the material of the Gordon cannot be used in the Bell service. The plant is located at Charleston, S. C. L.

The Telephone on the Pacific Slope.

The Sunset Telephone Company of San Francisco is making active preparation to establish a service in East Reno, Cal.

Robert Reading, T. D. Goodman, L. D. Cheeney and E. G. Carter will erect a private telephone line from Balls Ferry to Cottonwood, Cal.

The Mark West and Santa Rosa Telephone Company of Santa Rosa, Cal., is the name of the proposed rural telephone system that will connect many residences along Mark West and Santa Rosa Creeks.

The Home Telephone Company of San Diego, Cal., is contemplating putting in a local telephone system at Burbank, Cal.

It is rumored that the Home Telephone Company of San Diego will succeed in getting a franchise for Colton, Cal. This company has also applied for a franchise for a telephone service in the city of Santa Paula, Cal. A.

Indiana Telephone Items.

The Hazleton Telephone Company of Hazleton has filed articles of incorporation. The company's capital stock is $2,000.

The Cairo telephone plant at Battle Ground has been sold to E. T. Roadruck of Brookston, one of the original stockholders. Mr. Roadruck will put in a new switchboard and otherwise extend and improve the plant.

The secretary of the Delaware and Madison Counties Telephone Company reports that 65 more farmers on the rural lines were connected with the Elwood exchange during the week and 130 applications are waiting to be approved by the company. Over 300 farm residences are already connected with the Elwood exchange.

The Cadiz Telephone Company stockholders, at a meeting last week adopted a resolution that all business in the future will be done with Independent companies. The company is composed of nearly 30 rural lines with from 20 to 50 patrons each, and has connection with all towns of the county by direct lines.

The leases on the property and equipment of the New Telephone Company of Indianapolis have been signed over to the Indianapolis Telephone Company, which was organized recently to take the property of the New company and extend and improve the service.

G. S. Akers of Ambia, Ind., has purchased the Thomas-McCoombs telephone plant of Royal Center. Mr. Akers announces that he will at once install a new switchboard and make many other needed improvements.

A combination of Independent telephone companies was effected at Delphi last week to include Flora, Frankfort, Lafayette, Logansport, Kokomo and Delphi. The purpose of the combination is for mutual protection against the alarming invasion of the co-operative telephone systems in this part of the state.

An exchange is being put in at St. Joseph by the Home Telephone Company of German Township. The plant has been constructed by 65 wealthy farmers.

The Providence Telephone Company of Providence has announced that it will extend its lines to Banta and Trafalgar. F.

Michigan Telephone Matters.

The Clayton Telephone Company has been incorporated in Lenawee County with a capital of $5,000.

Brighton, Mich., will soon have an Independent telephone exchange. It will be installed by the Livingston County Mutual Telephone Company.

The Lake Shore Telephone Company of Hart is in a prosperous condition. Its new directory shows over 743 telephones in Oceana and Muskegon Counties. A large percentage of these are residence telephones. The demand for telephones throughout Oceana County is so great that the company has had difficulty to obtain instruments to fill the orders.

The Detroit council has adopted resolutions declaring the rights of the People's Telephone Company to the ownership of the poles and conduits in the city streets and alleys forfeited for non-fulfillment of the terms of its franchise. The commissioner has been instructed to take possession of the same in the name of the city. The question of leasing this property to the Co-operative Telephone Company will be taken up later. The streets of Detroit are now so full of conduits that there is no room for a new company, the People's company having used up the only remaining space. The Michigan Telephone Company, it is said, now wishes to control the People's Telephone Company's as well as the other company's conduits, thus shutting out all competition. W.

Telephone News from the Northwest.

The Farmers and Merchants' Telephone Company of Arlington, Minn., has been incorporated with a capital of $10,000 by A. C. Buck and others.

C. H. Kopp, C. T. Buchanan and George H. Reis were granted a franchise at Shakopee, Minn., for a telephone exchange.

Farmers near Glenwood, Minn., have formed the White Bear Lake Telephone Company to build rural lines.

The trouble at Wheaton, Minn., with the Minnesota Central Telephone Company has been settled by concessions. The company did not restore free service with Ortonville, as demanded, however.

The Southern Minnesota Telephone Company has been absorbed by the Central Dakota Telephone Company.

The St. Croix Mutual Telephone Company has been organized at Swiss, Wis. The new company will build a line from Grantsburg to Gordon.

The Farmers' Mutual Telephone Company is planning large extensions to its lines at New Hartford, Iowa. A new switchboard will also be installed.

The E. H. Martin Telephone Company of Webster City, Iowa, will reorganize with a capital stock of $300,000.

The Paint Creek (Iowa) Farmers' Telephone Company has been incorporated with a capital of $15,000.

The Eldon (Iowa) Independent Telephone Company has been sold to C. A. Mann of Sioux City for $30,000.

The Rogers Telephone Company has been formed at West Union, Iowa, with a capital of $25,000.

A new telephone exchange will be established at Solon, Iowa.

The Clear Creek (Iowa) Mutual Telephone Company has been incorporated with a capital of $5,000. E. S. Allen is president and F. C. Greer secretary.

The Iowa Mutual Telephone Company may build a line into Dougherty and establish an exchange there. R.

GENERAL TELEPHONE NEWS.

The San Antonio Telephone Company is preparing to make improvements to its local system at San Antonio, Texas, to the amount of $100,000. D. A. Walker of Columbus, Ohio, is president of the company.

The city of Decatur, Neb., has voted, almost unanimously, to vote $20,000 of bonds to the Omaha, Decatur and Northern Electric railway, the bonds to be delivered upon completion of the line into Decatur.

The Southern Utah Telephone Company of Salt Lake, Utah, has incorporated with a capital stock of $5,000. The directors are R. C. Lund, James Andrus, E. H. Snow and others. The place of business will be at St. George.

The Michigan State Telephone Company, organized recently to take over the properties of the Michigan Telephone Company will fell into the hands of the bondholders under foreclosure proceedings, has declared its first quarterly dividend on preferred stock. On June 1st 1½ per cent. will be paid to stockholders of record May 1st.

The Chicago Telephone Company has secured from the Lake County board of supervisors a 20-year franchise covering all of the lake shore towns in the county, and also a new franchise for the towns of Cuba, Ela, Grant and Antioch, which the company asked for some time ago. The franchise does not prevent the county giving franchises to other companies.

Alluding to the telephone service in New York city, the New York Times has a complaint to make. "The constant buzz of the system, the frequent small explosions which sound like pistol shots, and the variety of odd sounds which the wire brings to one who obeys the injunction to 'hold' it subject to the convenience of another, cause the average person to leave the instrument with the unalterable conviction that his hearing on the left side has been permanently impaired. It is sometimes an hour before the disagreeable sensation of rifle practice inside one's head passes."

The Salt Lake correspondent of the Western Electrician writes that the threatened friction between the Rocky Mountain Bell Telephone Company and the Utah Independent Telephone Company, which latter company now has most of its cables laid and is about ready to begin operations in Ogden and Salt Lake City, has already occurred by the issuance of a circular letter from the office of the new company stating that it would use the same numbers given by the Bell company. Manager Murray has sent out a circular letter, in answer, stating that the numbers are copyrighted and will be protected.

Siemens & Halske of Berlin have recently patented a telephone which is intended for use exclusively in situations where cross-connections may occur between the telephone conductors and high-tension circuits. The feature of the instrument is that there are no metal parts outside the case which can be touched. Instead, everything is made from either hard or soft rubber, and all the metallic parts of the instrument are contained in a walnut case. The instrument is also provided with high-tension fuses suitable for 3,000, 5,000 or 10,000 volts, depending on the voltage used in the station or district in question.

The United States Circuit Court of Appeals has decided that Spanish war taxes to the amount of $21,492, paid upon messages by the New York Telephone Company, are not to be refunded. The company sued on the ground that the fees for messages, at 15 cents each, were based on the cost of maintaining wires and other expenses. It was held that the government, in taxing messages, should not have levied its tax upon the full amount which the company collected from subscribers. The court ruled that the company, by altering the phraseology of its contracts, might have escaped the tax, but had not done so and was clearly liable.

The Kineon interests have obtained a majority of the stock of the Merchants' Police and District Telegraph Company of Covington, Ky., and it is claimed, under the franchise held by that company, will now have the right to string their wires all over the city. The Kineon interests have an independent system extending through Harrison, Pendleton, Kenton, Cynthiana, Falmouth, Butler and Covington. Connections will be made with the Independent lines in the South and East, as well as with those in Ohio. Bayard L. Kilgour, manager of the Bell interests in Cincinnati, says that his company will make a legal contest against the right to build a new system in Covington.

Collection of Information on Radium.

The United States Geological Survey is collecting information concerning the occurrence of radio-active minerals in the United States. Radio-activity has been observed in many minerals and also in many other substances, such as slags, tailings from concentrators, slimes, chemical wastes, water from mineral springs, deep-well waters, and petroleums, and it is possible that the number of known radio-active minerals may be greatly increased. Anyone who has found such minerals or has observed radio-activity in any other substances is urged to give the Survey full details regarding them, and any advice which the Survey may be able to give in return will be cheerfully furnished.

For the guidance of those who believe that they possess specimens of minerals containing radio-active elements it may be said that the simplest means of detecting radio-activity in a suspected substance is by the use of a photographic plate—the more sensitive the better. The plate should not be removed from its enclosing black paper. The specimen to be tested should be laid upon this black paper in a dark room and left there from two to 15 hours, a small metal object having first been placed between the specimen and the black paper on the plate. After thus remaining in the dark room the plate should be developed in the usual manner. If the specimen tested has radio-active powers, a photograph of the metal object will be produced on the plate exactly as if the plate had been exposed to the sun's rays. The test should be made, if possible, with from half a pound to a pound of the material. To those desiring them the Survey will mail postal franks, which will enable anyone to send free of postage a box of specimens weighing not more than four pounds.

Interesting specimens are especially desired for the Survey's two exhibits at the Louisiana Purchase Exposition. These exhibits will be general and varied in character. They will include specimens of every known radio-active substance, whether obtained from minerals or ores, from mineral waters or from petroleum wells. Authentic specimens of radium compounds will also be shown. Everything relating to the source, manufacture and application of radium will be exhibited, including all chemicals obtained from the separation of various radium compounds and all instruments and devices by which it is proposed to apply radio-activity in medicine, science, and the arts. An interesting feature will be the portraits and the publications of celebrated radium discoverers and investigators, together with photographs of their laboratories and apparatus, and autograph letters from some of them.

Two convenient halls will be set aside for demonstration of the wonders of radium. In one will be grouped the specimens of ores and minerals containing radium, and careful note will be made of their effects upon various substances. In the other hall illustrated lectures will be given twice daily on a variety of subjects relating to the history of the discovery of radium, its nature, and its possibilities. Its mode of occurrence, the methods used in separating it from radium ores, the concentration of its activities, and the manifold uses to which these remarkable radio-active substances may be put will all be described. Cinematograph Hall will be so arranged that it can be easily darkened and different highly active specimens of radium compounds will be exhibited in it as affecting the diamond, willemite, kunzite, and other radio-responsive substances.

George F. Kunz, 40 East Twenty-fifth Street, New York city, has been appointed radium commissioner at the exposition, and all communications regarding the collection and examination of radio-active specimens should be addressed to him.

In a recent bulletin the United States Geological Survey says: "Apropos of the bill before Congress asking for an appropriation of $1,000,000 to be used in the erection of a building for the United States Geological Survey, some ill-informed newspaper correspondent has been lamenting the extravagance of Director Walcott in appointing Mr. George F. Kunz to be 'radium commissioner' at the Louisiana Purchase Exposition. His lamentations have so reverberated through the country press that it seems only fair to Director Walcott, Mr. Kunz and the public to explain that Mr. Kunz is giving his services as a radium expert to the Survey and the nation without any expectation of reward except that which may come to him with the consciousness of good citizenship."

Transmission Lines.

At the meeting of the Chicago branch of the American Institute of Electrical Engineers on Tuesday evening last the subject of discussion was "High and Moderate-voltage Lines." H. H. Wait presided, in the absence of Mr. Junkersfeld. George H. Lukes presented his paper on "Overhead High-tension Distributing Systems in Suburban Districts" and also abstracted W. C. L. Eglin's paper on "Safeguards and Regulations in Operation of Overhead Distributing System." Professor Nies made an abstract of Professor Ryan's paper on "The Conductivity of the Atmosphere at High Voltages," and W. A. Blanck did a like service for Mr. Semenza's paper on "European Practice." Mr. Blanck and L. A. Sanford contributed interesting written discussions, and Messrs. Gear, Warner, Carlton and others participated in the discussion.

CORRESPONDENCE.

Great Britain.

London, April 16.—A brief reference has been made in my notes to the first half year's working with electric traction upon the Mersey railway. Some fuller details are now available. The receipts show an increase of $40,000 and the number of passengers from 2,750,000 to 4,225,000. The effect of giving better accommodation in the third-class carriages has been that the first-class passengers have not increased materially, and it has been decided to reduce the first-class fares. Under steam working the lowest cost of maintenance of permanent way has been 3.9d per train-mile, but under electrical conditions this has been reduced to 1.6d. The present cost of locomotive and generating power is 5.4d per train-mile against 11.3d per train-mile with steam; the traffic expenses are now 7.3d per train-mile as against 13.5d; and the cost of ventilation 0.2d as against 3.4d. The total working expenses have been reduced from 41.2d to 18.2d. The patronage accorded to the line has increased with increasing months, and the company therefore has some justification for its hope that as the line becomes more widely known the receipts will considerably increase.

The Birmingham corporation which has for many years been in the hands of private enterprise for both its lighting and tramway enterprises is gradually assuming control of these undertakings, and consequently has been exercised to consider the advisability of considerably extending the generating plant now at its disposal. A few years ago the corporation acquired the undertaking of the City of Birmingham Electric Supply Company, but the mains were so loaded that when last year the first section of municipal electric tramway line was opened for service current had to be purchased from a neighboring local authority. It is not surprising therefore that a huge extension is contemplated, and a report has been made recommending additional plants being put down to the extent of 22,000 kilowatts, the first installment to consist of 8,500 kilowatts. The tramway system in Birmingham for many years has eclipsed any in the country for its nondescript character. Horse, steam, cable and electric cars in the hands of various companies have all been running simultaneously, but the corporation last year decided that as the leases expired it would take over the lines and convert them all into a standard system of electrical working.

An interesting item in connection with the large three-phase station at Dublin, which has been erected by the corporation, is the fact that the consulting engineer has seen fit to refuse to finally take over the engines for the reason that they do not comply with all the conditions of the contract. The contractors have agreed to make good the shortcomings.

The conversion to electric traction of the horse tramways in the northern suburbs of London, just beyond the London County Council's area, is being pushed forward with great speed. The whole of the road equipment is practically complete, and it is expected that the cars will be running by June. Unfortunately a change of cars will be necessary at the county boundary by reason of the fact that the County Council has decided to equip the northern lines within London upon the conduit system.

A note has been circularized by the Postoffice Telephone Department urging that all telephone transmitters and receivers be wiped every morning with a cloth, apparently for hygienic preasons.

The Newcastle-upon-Tyne corporation has been much disturbed because a committee of the House of Lords granted the Tyneside Tramways Company, which owns tramways running to the Newcastle boundary, compulsory running powers over the municipal lines. The bill has yet to be passed by the House of Commons, and the corporation intends to take the opportunity for again opposing by all legitimate means the proposal in question. G.

New York.

New York, April 23.—A curious fire occurred on the Second Avenue elevated line at Allen Street last Sunday night. As a five-car train was passing that point a fuse blew out and ignited a quantity of paper and other rubbish that happened to be lying on the track. A gentle breeze was blowing and the fire extended to the woodwork of the elevated structure. The passengers on the train were much perturbed, but the current was shut off and the fire department speedily extinguished the flames. The rubbish was on the track on account of the domestic habits of the dwellers on Second Avenue at that point, for the tracks are laid very close to the second-floor windows and cannot be kept entirely clean in spite of the utmost vigilance of the railway company.

The plan and scope committee of the rapid transit commission has considered the rival Metropolitan and Interborough schemes in their bearing on each other and the commissioners have planned a new route which, it is thought, embodies the best points of both, so that it is hoped that the two great traction corporations may be induced to bid against each other for the franchise.

Alderman Goodman was defeated on Tuesday by a vote of 43 to 8 in an attempt to resurrect the Port Chester electric-railway application. His resolution asked for terms to be fixed for the privilege of crossing certain streets in the Bronx. Meanwhile the rival scheme of the Westchester company is progressing.

It is stated that Mr. Clarence H. Mackay is now practically in sole control of the Commercial Cable Building at 20 Broad Street, Jefferson M. Levy having disposed of his interest therein. This property is valued at $3,000,000 and is actually assessed at $1,850,000.

Among the charters granted at Albany this week was that of the Caldwell and Osterhoudt corporation of New York with a capital of $5,000. The new concern will deal in electrical supplies. The directors are R. L. Caldwell of Summit, N. J., and H. B. Osterhoudt and P. A. Overbaugh, both of Brooklyn.

For reasons not thoroughly intelligible to the outsider the stock of the Metropolitan Street Railway Company declined from 114¼ to 110½ on the Stock Exchange on Tuesday afternoon, and closed with a net loss of 2½ points. A sale of 5,500 shares at 113½ began the break, and then the stock traders, who have a means unknown to the general public of ascertaining exactly what "stop orders" are current on speculative accounts, sold the stock down a full three points. Several other securities declined in sympathy.

New rules relating to smoking have been introduced this week on the surface cars. While there is no obligation on the part of the company to provide special facilities for smokers, the innovation is irritating to a degree of exasperation. Hitherto smoking has been permitted on the last four seats of open cars, and notices to this effect have been visible to all, but in future special smoking cars are to be provided on most of the street lines and the smoking of tobacco will be prohibited on all other cars whether open or closed.

The Williamsburg Bridge will soon be equipped with adequate car service, while in the future some intelligent scheme will be put into operation for connecting the bridge with the present Brooklyn Bridge—a plan which involves a suitable terminal structure in the neighborhood of the City Hall.

D. W. W.

Dominion of Canada.

Winnipeg, Man., April 23.—Messrs. Ahearn and Soper of Ottawa have been awarded the contract for lighting the Welland Canal. It will require over 400 arc lamps. Electricity will also be the motive power for operating the gates, valves, bridges and sluiceways. The electric power will be furnished by the Cataract Power Company.

The American Power Company is making ready to begin work on the mill site and power dam at Fort Francis, Ont. The plans show a fine structure, with two power houses, and a complete system of sluices and gates, with long chute and openings.

The city of Kingston, Ont., has passed, by a large majority, a law to purchase the local electric plant for lighting purposes.

Samuel Ickes, Walter R. Turnbull, Charles Waterous and Henry H. Powel of Brantford, Ont., and James Wallace of Woodstock are seeking a charter for the Brantford and Hamilton electric railway. The capital stock of the company is $500,000 and the head office will be located in Brantford.

A. E. Welch, general manager of the Southwestern Traction Company, has just returned from England, where he has been successful in his negotiations with an English syndicate to float the bonds of the company. A radial railway between Hamilton and Strathroy is therefore assured. The road will run through Woodstock and Brantford, and a line will be built from London to Port Stanley, via Delaware and St. Thomas. The company has the right-of-way over most of the roads and requires now chiefly the right of entrance to the cities of London and St. Thomas.

The Niagara, St. Catharines and Toronto railway has won in its suit against the Grand railway, for intersection with the Grand Trunk at Stamford, near Niagara Falls, for the purpose of establishing a competitive route between St. Catharines and Niagara for fruit and other shipments. The application was opposed by the Grand Trunk, on the ground that it would interfere with its running arrangements with the Wabash railway.

An agreement has been entered into between the Peterboro Radial Railway Company and Robert Stuart of the American Cereal Company by which the latter obtains the charter for a street railway granted to the former by the town some months ago. The new company will immediately put the road into shape for operation.

The private bills committee of the Ontario Legislature has granted the application of the Strathroy and Western Counties Electric Railway Company to extend the line from St. Thomas to Port Stanley.

A company is applying to the federal government for a charter to build an electric road from Ottawa and Hull to Buckingham, skirting the Ottawa River and then going up to Livre River far enough north to connect with the Grand Trunk Pacific road, to be built by the government.

The Bessemer and Barry's Bay Electric Railway Company is seeking power and asking for incorporation, in order to construct and operate a line from L'Amable Station northerly to a point on the Canadian Pacific railway, not further west than Mattawa, passing near Barry's Bay on the Canada Atlantic.

The British Columbia Electric Railway Company has declared a dividend of three per cent. for

the last half year ended December 31st last. The gross receipts of the company for the half year were $425,000, the working expenses $230,000, leaving net receipts of $190,000, as compared with $145,000 a year previous. The company operates the electric street-railway systems of Vancouver, Victoria and New Westminster.

The Toronto Street Railway Company is doubling its power capacity by a new installation which will bring this total up to 10,000 horsepower, with a reserve storage-battery capacity of 3,000 horsepower in addition. The company is taking out 12 boilers of an old type and replacing them by eight 800-horsepower water-tube boilers of the most modern type.

The Winnipeg street railway has arranged to create a new belt line in the north end of the city. The new line, which will be opened on the completion of the Main Street subway, will take in Higgins, Sutherland and Euclid Avenue and Main Street.

The town of Perth, Ont., now owns and is conducting the plant of the Perth Electric Light Company. Mr. John Code is in charge of the plant. The lights will be rearranged and placed in the center of the street.

The big concrete dam supplying power for Orillia's municipal electric plant at Ragged Rapids on the Severn River, gave way recently. The dam is about 180 feet wide, with a head of about 30 feet. It will take three months to rebuild it. H.

New England.

Boston, April 23.—The legislative committee on street railways has reported favorably upon the petition of E. Moody Boynton for the revival and extension of the powers heretofore granted to him for the construction of his so-called bicycle railway, although not without a large dissenting minority. Mr. Boynton has been trying for a number of years to interest enough people in his company, known as the Boston, Quincy and Fall River Bicycle Railway Company, to enable him to get it into working operation, and successive legislatures have granted him extensions of time for that purpose, but last year his petition to that end was refused favorable consideration. He asks now to be given until December 31, 1905, to have the road in operation.

The Boston and Albany railroad has recently put into commission, for the use of the roadmaster of one of its divisions, an autocar which is intended to supplant the special train heretofore used for inspection on the line. The adoption of such a car, it is calculated, may eventually cause the old-time handcar also to be superseded by some such type of vehicle for the workmen.

In pursuance of the plans of the New York, New Haven and Hartford Railroad Company relative to its recent purchase of the Fair Haven and Westville Electric Railway Company, material has been ordered and construction work will begin on the seven-mile link to connect the line with the Meriden Electric Railway Company by means of the Wallingford Tramway Company, which is understood to be controlled by the steam corporation.

Among the propositions which have begun to attract some attention from observers of railway legislation in Massachusetts is the bill, rather quietly pushed forward by promoters in the western part of the state, and providing for the granting of very advantageous powers to the Western Massachusetts Street Railway Company, so-called, which seeks a special charter. It is surmised that the people back of the scheme intend to bring about a consolidation of western trolley roads, with their new company as a nucleus for the absorptions contemplated, and the bill is likely to encounter close scrutiny from many interested parties.

Steps have been taken looking to the consolidation on May 1st of two Maine trolley systems—the Lewiston, Brunswick and Bath Street Railway Company and the Portland and Brunswick Street Railway Company. The former has about 62 miles of track and the latter 15 miles. The Portland company is capitalized for $300,000 and bonded for $225,000. The Lewiston road is capitalized for $627,100 and bonded for $1,000,000, including bonds of dependent companies. B.

Michigan.

Detroit, April 23.—The advocates of a city commercial lighting plant in Bay City will introduce resolutions ordering the issuing of bonds for $50,000 to start the plant. This will meet with opposition by some of the aldermen.

Mayor Maybury of Detroit, who made quite an effort to induce other mayors of Michigan to join him in a request on the governor for a special session of the Legislature in the interest of the three-cent street-car-fare campaign has found a lack of interest exhibited by mayors of the different cities and probably nothing will now be done until the next session of the Legislature.

The estimators have cut down the appropriation for the Detroit Lighting Commission for sub-stations to the amount of $6,000. The sub-stations of the municipal lighting plant are now located in the schools.

The stock and business of the Michigan Electric Company of Detroit has been turned over to Frank C. Teal of Detroit, who has combined it with his own stock. This ends the receivership of the Union Trust Company. It is understood that Mr. Teal is acting as agent for the John A. Roebling's Sons Company of Trenton, N. J. C. G. W.

Ohio.

Cleveland, April 23.—Columbus merchants have planned to have a series of trade excursions on the electric lines centering there this summer. They will advertise the city and the excursions, offering very low fares on certain dates that people may visit the city on shopping tours. The experiment will doubtless prove interesting to electric-railway men all over the country.

The Heinlein bill giving street-railway companies the right of eminent domain so far as necessity requires in straightening and improving tracks is concerned has become a law, notwithstanding the delay of Governor Herrick in signing it.

The LeFever bill creating a state franchise commission is destined not to become a law, it seems, as its friends failed to put in an appearance when it came up for hearing in the house committee on cities a few days ago.

Cincinnati bondholders of the Miami and Erie Canal Transportation Company are making an effort to pool the bondholders and make an assessment sufficient to take the business out of the hands of a receiver.

The Dayton City Council has passed the electric-light ordinance over the mayor's head. The ordinance giving the local light company a franchise was vetoed on the grounds that the company had not lived up to its agreement in regard to commercial lights and was getting too much for street lighting.

Plans are being discussed by the officers of the Cincinnati Traction Company for the erection of large fireproof car barns on Walnut Hills to take the place of those destroyed by fire some time ago. It is probable that something like $500,000 will be spent in improvements on the system this year.

On May 1st the Columbus, London and Springfield Railway Company will put into regular service several observation parlor cars equipped with 125-horsepower motors and capable of maintaining a steady speed of 60 miles an hour. A regular schedule will be fixed.

The Godfrey bill, exempting the stock of Ohio corporations and those which have two-thirds of their property in Ohio from taxation, has passed both houses of the General Assembly and will become a law as soon as it is signed by the governor. Hereafter a corporation will not be taxed both on its tangible property and on its capital stock.

The House of Representatives has passed the Lawrence bill placing city and interurban electric railways under the taxation laws governing steam roads.

The Williams bill, providing that where the City Council fixes a minimum price for street lights and the company accepts, council shall not change the price for a period of 10 years unless upon mutual agreement, has been passed by the Senate. That body has also passed the bill allowing electric-light and gas companies to engage in each other's line of business.

The National Carbon Company of Cleveland has let a contract for the construction of a plant at Clarksburg, W. Va., where a specialty will be manufactured. It is probable that no plant will be built at Chicago as previously anticipated. A quarterly dividend of 1¾ per cent. will be paid on May 14th.

The Cincinnati, Hamilton and Dayton Railroad Company has reduced its rates to meet the figures made by the Western Ohio Railway Company, which recently inaugurated a fast-car service between Lima and Dayton. The management of the steam road threatens to put on more trains and make the fight lively unless the fast service on the electric line is taken off. It is believed the electric line will be able to sustain its ground, because it has the cars and power and will not be at any great additional expense.

The Akron City Council has reconsidered the ordinance granted to Thomas L. Childs to build a line through the city, and before it is again voted upon several amendments will be made. Mr. Childs had already accepted the ordinance.

The Chillicothe, Bainbridge and Aberdeen Electric Railway Company is planning to build a line from Chillicothe through Bainbridge, Sinking Springs and West Union to Aberdeen. The capital stock is $50,000, and G. F. Horn, A. A. Luther and others are interested in the enterprise.

The Banner Electric Company of Youngstown has been incorporated with a capital stock of $100,000 for the purpose of securing more money to conduct the rapidly growing business which has heretofore been handled by a firm. Additions will probably be made to the plant, and some other improvements are said to be in contemplation. N. L. Norris, Thomas Carr, C. S. Crook, F. C. Kirschner and O. U. Cassidy are the incorporators. O. M. C.

Indiana.

Indianapolis, April 25.—The franchise of the Oil Belt Traction Company has been purchased by A. Norvale, president of the Municipal Bond and Security Company of Cincinnati. The company is preparing to build a line from Hartford City to Alexandria. J. P. McGrath, principal promoter of the line, retains one-third of the stock and is to be president of the company.

The Dayton and Muncie traction line is completed into Winchester and the overhead construction is practically finished to the city limits. The car barns in Winchester are filled with rolling stock and the power house, which is equipped with duplicate machinery, is ready for running as soon as the track is connected. The power house and equipment are said to be among the best in the state.

Service was resumed to-day between Indianapolis and Columbus by the Indianapolis and Southern Traction Company. No through cars have been run on this line since the flood. The two new bridges necessary were completed on the 24th. The road has been ballasted during the interim and is now in excellent condition.

Material is being placed on the ground for the construction of another electric line from Jeffersonville to New Albany. Captain E. J. Howard of Howard's shipyards is back of the enterprise.

Efforts are being made by the citizens of Russiaville and Young America to change the proposed Indianapolis, Logansport and Chicago steam road to an electric line. The right-of-way for the road has already been secured.

Work of constructing the Wabash and Rochester electric railway will be begun to-day by Superintendent Wyke. The company has offered to erect the car barns and power house in Rochester if the citizens succeed in placing bonds to the amount of $50,000. A similar offer has been made to the citizens of Akron.

The Indianapolis and Northwestern Traction Company will begin running its limited cars on May 1st. The running time between Indianapolis and Lafayette will be two hours and 20 minutes for the 68 miles.

The argument of the case of the Consolidated Traction Company against the Northwestern Traction Company involving the contention as to which company has the better right to the possession of certain streets in Crawfordsville was had before Judge Baker Saturday. The indications are that both companies will be admitted to the city on similar terms.

A fight is on in Marion involving the granting of a franchise to an electric-light and heat company and the disposition of the municipal electric-light plant. The city apparently wishes to sell the plant. F.

Southeastern States.

Charlotte, N. C., April 23.—The Greenwood (Miss.) Electric Railway Company has been organized, with $12,000 capital stock paid in. The officers are: President, Monroe McClurg; vice-presidents, Samuel J. Stein and R. T. Jones; secretary and treasurer, R. Thayer. Two interurban lines will be surveyed at once, one to Ittabena, the other to Black Hawk. The lines are expected to be open by the first of next year.

Anderson, S. C., is to have a city electric railway. J. A. Brock, R. S. Ligon and others are the promoters. The lines will traverse the principal streets and be extended to the mill villages about the city.

It is proposed to build an electric car line from Easley to Anderson, S. C., and the proposition is meeting with much encouragement by the citizens along the line, who propose to give the right-of-way and $1,000 per mile. If the line is built to Easley it will be extended to Pickens, S. C.

Dr. W. K. Sharpe is the promoter of a trolley line from Townville, S. C., to Anderson. The leading business men and the citizens generally are taking an active interest in the matter, with fine prospects of making the enterprise a success.

The Salisbury (N. C.) Gas and Electric Light Company has been transferred to the Salisbury and Spencer Street Railway Company, all the securities having been purchased by N. B. McCanless and T. H. Vanderford, president and secretary, respectively, of the street-railway company. Fifty thousand dollars is the amount involved, the stock being taken at practically the par value. Pending the merger there will be no change of corporate name or management.

The Catawba Power Company has purchased from the Southern Bell Telephone Company 3½ miles of standing poles in the city of Charlotte, over which to distribute the 5,000 horsepower it will bring to the city. The purchase will save the power company several weeks' work, and it is expected that the company will reach Charlotte about August 1st.

The citizens of Greenwood, Miss., will vote on the proposition of issuing bonds to the amount of $125,000 for the purchase of the electric lights, waterworks and sewerage. A two-thirds majority is required to issue bonds, and it is believed that 90 per cent. of the voters favor municipal ownership of these public utilities. L.

Northwestern States.

Minneapolis, April 23.—The electric-light franchise of the Union Manufacturing Company at St. Paul has been extended to include all territory west of Rice Street.

A municipal electric-light plant has been voted at Fennimore, Wis.

Bids for the construction of an electric-light plant at Wittenburg, Wis., will be received by John Englund, clerk, until May 9th.

A new dynamo will be installed at the government fog station at Two Harbors, Minn.

Thomas Lennon, a lineman in the employ of the Winnebago Traction Company was instantly killed by a live wire at Oshkosh, Wis.

A trolley line may be built from Waterloo, Iowa, to Westfield by way of Red Cedar Park.

Bayless & Eagal are succeeded at Davenport, Iowa, by the Black Hawk Electric Company, which is

incorporated with a capital of $10,000. W. A. Fuller is president and J. H. Eagal, secretary.

The Wisconsin Traction, Heat, Light and Power Company has begun work on its new lighting plant at Menasha, Wis.

The Western Union Telegraph Company's office at Devils Lake, N. D., has been destroyed by fire.

The contract for the construction of the car barn for the Fargo (N. D.) and Moorhead (Minn.) Street Railway Company has been awarded to S. Wilson for $11,295. Material for the new line is arriving, and the work of tracklaying will begin at once. R.

Pacific Slope.

San Francisco, April 21.—The Pacific Power Company, of which J. E. Green is president, is to sell the equipment of its power plant at 23 Stevenson Street. This consists of four boilers, two engines and three generators.

The Big Creek Power Company of Santa Cruz has purchased five acres of land in that city and will use it as a site for a power plant. About $100,000 will be expended in bringing the lighting system up to date.

The Northern California Power Company is soon to install a large steam-generating plant at Red Bluff, to be used in case of emergencies.

Fred C. Finkle, chief hydraulic engineer of the Edison Electric Company of Los Angeles, is in San Francisco on his way to Seattle.

Work is being rushed on the Central California Electric Light and Power Comapny's extension of its line from Wolf Creek to Deadman's Flat. Superintendent of Construction Alexander is now at Grass Valley.

C. A. Barrett of the Oregon and Washington Electric Power Company of Milton, Ore., states that contracts for machinery, labor, etc., have been let for the plant. The estimated cost of the plant is $250,000.

The engineers for the power plant of the Washington and Oregon Power Company are now at work on the site for the proposed power station on the south fork of the Walla Walla River, near Milton. It is the intention to have the plant in operation by the first of October.

The Central Light and Power Company of San Francisco has extended its underground electric conduits along Stockton, Geary and other streets. It is said that as low a rate as three cents per kilowatt has been accepted in some cases in territory covered by both the Central Light and Power Company and the San Francisco Gas and Electric Company.

The Madera Electric Light Works of Madera, Cal., are to be rebuilt and refitted. Larger boilers and engines will be installed. A 100-horsepower boiler and a triple-expansion 150-horsepower engine will be put in. The company's lines will be extended to parts of the town not before lighted.

The Los Angeles Gas Company and the Los Angeles Electric Company have been merged under the management of W. B. Cline. It is announced that a bonded indebtedness of $4,000,000 will be created for the purpose of making improvements.

Sealed bids will be received by E. Tedford, city clerk of Santa Ana, Cal., up to May 2d, for the installation of a fire-alarm system in that town.

The San Diego Gas and Electric Light Company is extending its system from San Diego to National City. The transmission line is now being put in.

The Ione and Eastern Railroad Company has been incorporated at Ione, Cal., by J. Dennis, W. Dennis, J. J. Fagan, W. Pardy and others, with a capital stock of $1,000,000. The company will construct an electric railroad connecting Ione, Jackson and Sutter Creek, in Amador County, Cal. The line will have a total length of about 14 miles. A.

PERSONAL.

It is now stated that Marconi will make no exhibit of his space-telegraph inventions at the Louisiana Purchase Exposition.

Joseph Rothgary, chief electrician of the Cleveland Fire Department, has resigned. He had been with the department for 30 years.

John B. Allan, general manager of sales of the Allis-Chalmers Company, has resigned his position and expresses his intention of taking a vacation for a couple of months, in order to recuperate.

J. E. Hawks, president of the Detroit, Ypsilanti, Ann Arbor and Jackson electric railway, who has returned from a trip to New York, says that the financial feeling in eastern circles is one of confidence and a good year may be looked for.

C. E. Brown has just returned from Europe after having completed work in the field as electrical engineer of the Canadian electrothermic steel and iron commission. Mr. Brown is now busily engaged at Ottawa preparing a report of the investigation which has been made.

Arthur West, assistant chief engineer of the Allis-Chalmers Company, has resigned his position, and will go to the Mediterranean for a holiday trip. In his letter of resignation he states that "for the last couple of years I have been regularly overworked, and my most urgent need is rest."

James M. Jones, for nearly four years assistant general manager of the Indianapolis Street Railway Company, has resigned. Mr. Jones' resignation is due to pressing private business demanding his attention. During his official connection with the company he made many friends. Mr. Jones was formerly mayor of Kansas City.

L. C. Bradley, for some time connected with the Seattle and Tacoma electric road, has been chosen superintendent of the Scioto Valley Traction Company, whose road will be in operation within a short time between Columbus and Lancaster, Ohio. The Seattle road is a third-rail line and is operated very much the same as the new Ohio road will be.

Frederick Nelson, for a number of years a salesman in the Chicago office of the Westinghouse Electric and Manufacturing Company, has resigned his position with that company. Mr. Nelson has a wide acquaintance among electrical men and users of electrical apparatus in Chicago, and his friends will wish him success in any new relation that he may undertake.

John H. Raymond of Chicago, traveling salesman for the Fort Wayne Electric Works, was struck by a train near Galva, Ill., on April 25th and seriously injured. One leg was fractured in three places, and as it could not be given the proper attention immediately his condition is critical. The train ran upon a side track, where Mr. Raymond stood expecting it to pass on the main track.

J. T. P. Kenyon has become associated with the New York Central and Hudson River Railroad as chief draughtsman of the electrical department, with headquarters at the Grand Central Station, New York city. Mr. Kenyon assumes the responsibilities of his new position after much experience in the engineering department of the New York Edison Company, with which concern he has been connected for some time.

The death occurred early this month of Mr. James S. Forbes, who made himself famous in London as chairman of the National Telephone Company and also as chairman of the District Railway Company previously to Charles T. Yerkes assuming control of that concern. He was the first to support the preliminary experiments which were made by Sir John Wolfe Barry and Sir William Preece, with the object of determining the financial and other possibilities of electric traction upon such a line as that owned by the District company in London.

Frederick W. Nolker, president of the Missouri-Edison Electric Company, died at his home, 4440 Lindell Boulevard, St. Louis, on April 17th. He had lately returned from Palm Beach, Fla., and contracted a severe cold which developed into the grip, causing his death after a three weeks illness. Mr. Nolker was only 29 years of age and one of the prominent young society men of the city. Besides being president of the Edison-Missouri Company, Mr. Nolker was interested in the Gilsonite Construction Company. He was a graduate of St. Louis University. His wife survives him.

James W. Hinkley, president of the Walker Electric Company and of the Consolidated Electric Light and Power Company and the Consolidated Light, Heat and Power Company of Poughkeepsie, N. Y., died at his home, Elm Hill, Syracuse, N. Y., early this month. At the time of his death Mr. Hinkley was also president of the United States Casualty Company of New York, and was identified, either as president or a director, in many other industries and banking and trust institutions. He graduated from the United States Military Academy at West Point and then engaged in newspaper work, in which he became quite prominent.

Frank W. Sabold, one of the well-known telephone and telegraph men of his day, died in Albany, N. Y., on April 16th at the age of 47 years. When the American-Union Telegraph Company was organized he was made manager of the Indianapolis (Ind.) office. The Western Union Telegraph Company absorbed the American-Union in 1882, and Mr. Sabold was made manager of the Albany office. In 1890 he became manager of the Westchester Telephone Company. After its absorption by the New York Telephone Company he became superintendent of the Westchester division. Since 1902 he had been contract agent for the Hudson River Telephone Company.

At the most recent meeting of the American Institute of Electrical Engineers in New York, Vice-president Calvin W. Rice occupied the chair in the absence of President B. J. Arnold, and he took advantage of the president's absence to pay him a well-merited compliment. Mr. Rice said: "Your president has been here to-night and has been obliged to leave to attend a meeting of the joint committee on the Union Engineering Building. There is a great deal of work, as you are aware, in connection with the preparation of all the plans for this Union Engineering Building, and Mr. Arnold makes frequent trips from Chicago to New York to carry out his duties as president. I think you will rarely find a man who will make such sacrifices of time as he has done in connection with his duties as president of the Institute."

Ervin Dryer has resigned his position in connection with the Westinghouse Electric and Manufacturing Company and has accepted an appointment with the Allis-Chalmers Company. Mr. Dryer's connection with the Westinghouse company extended over a period of 16 years. He is one of the most competent salesmen in the electrical and mechanical field and his wide acquaintance throughout the western part of the United States will be of great service to the Allis-Chalmers Company in the extensive new developments it has undertaken. Mr. Dryer has already entered upon his new duties with the Allis-Chalmers Company and his headquarters will be at the offices of that company in the New York Life Building, Chicago. He will give his attention to engine work as well as to the sale of Bullock electrical apparatus, which the Allis-Chalmers Company now controls.

Richard H. Pierce, the well-known electrical engineer, has been appointed chief engineer to take charge of the power plant at the St. Louis Exposition. Mr. Pierce for the last year has resided in Boston, for many years previous having lived in Chicago, where he was actively engaged as a member of the engineering firm of Pierce, Richardson & Neiler. He is very popular in the engineering fraternity and his technical ability is of a high order. Born in Woonsocket, R. I., in 1860, Mr. Pierce graduated from Yale in the class of '82 with the degree of A. B. In 1885 he graduated from the Massachusetts Institute of Technology with the degree of B. S., being a member of the first class in electrical engineering sent out from that institution. Coming to Chicago soon after completing his education, Mr. Pierce was identified with the development of electric lighting in the West. During the World's Columbian Exposition of 1893 he became electrical engineer in charge of electrical construction and operation, and he, with Frederick Sargent and the late Luther Stieringer, is entitled to the credit of solving the many problems incident to the use of electricity on a large scale for a great exposition—problems at that time entirely without precedent. In May, 1903, Mr. Pierce removed to Boston to open a branch of the firm above mentioned and to attend to private interests in the East. Mr. Pierce's interesting article in the World's Fair number of the Western Electrician of April 16th, comparing, electrically, the Chicago and St. Louis expositions, will be recalled with interest by readers of this journal. At the time the article was written it is probable that Mr. Pierce had not the slightest conception that he would himself become connected with the St. Louis Exposition. But the exposition people have displayed great sagacity in persuading him to take the appointment, for which he is pre-eminently fitted.

ELECTRIC LIGHTING.

The electric-light plant at Rottineau, N. D., was destroyed by fire recently.

Fire recently destroyed the electric-light plant at Hooper, Neb., causing a loss of $1,500. The plant was owned by W. T. Martin, who will probably rebuild.

The City Council of Traverse City, Mich., will receive sealed bids until May 31st for the lighting of the streets of the city for a period of five years, dating from May 1, 1905.

The following companies have recently joined the National Electric Light Association: South Manchester Light, Power and Tramway Company, South Manchester, Conn.; Marion Light and Heating Company, Marion, Ind.; Rawson Light and Power Company, Leicester, Mass.; Monterey Light and Power Company, Monterey, Mex.; Herkimer County Light and Power Company, Little Falls, N. Y.; Lockport Gas and Electric Light Company, Lockport, N. Y.; Olympia Light and Power Company, Olympia, Wash.; East River Electric Company, Bluefields, W. Va.

Fergus A. Dennie of Princeton, N. J., has applied for the appointment of a receiver for the Princeton Light and Power Company. John W. Griggs, representing the North American Trust Company of New York, asked that the trust officer of the North American Company be named as receiver for the Princeton company. Bayard Stockton, representing the John A. Roebling's Sons Company, a creditor of the Princeton concern to the amount of about $5,000, asked for the appointment of Richard Stockton. The assets of the Princeton company are placed at about $400,000 and its liabilities at about $600,000.

ELECTRIC RAILWAYS.

Work on the power house of the Rochester, Syracuse and Eastern Railroad Company of Rochester, N. Y., will be begun within a short time. It will cost something like $600,000.

The Metropolitan Street Railway Company of Kansas City, Mo., has granted its motormen the right to remain seated on certain parts of their run, in accordance with the request of the men a few weeks ago.

The Village Council of Oakdale, a suburb of Louisville, Ky., will sell at auction a franchise for an electric road within a short time. The proposed line will connect with the city line at South Louisville and give closer connection with the city.

The Chicago-Oak Park Railway Company, with a capital of $9,200,000, was incorporated in Trenton, N. J., last week, the registered offices of the company being in Jersey City. The company is chartered to take over the properties and franchises of the Chicago and Oak Park Railroad Company (until recently the Lake Street Elevated Railroad Com-

pany). Of the $9,200,000 capital stock, $6,000,000 is common and $3,200,000 preferred. The incorporators are C. D. Boston of West Orange, N. J., W. R. Sainsbury of Bath Beach, N. Y., and J. G. Quimby of Bronxville, N. Y.

An effort is being made to construct and operate an electric street railway in the city of Victoria, B. C. Mr. Charles Bsandeis, representing Montreal capitalists, is negotiating with the council of Victoria looking to the carrying out of the project and is investigating available waterpowers that might be used for generating the power.

The construction of a railway from Dyersville to New Vienna, Iowa, is under consideration. Considerable stock has been subscribed, it is said. The promoter is G. H. Hesselmann, a well-known business man of New Vienna. It is proposed to run the road by steam the first year, after which it is to be extended and electricity introduced as a motive power.

The Royal Prussian State Railroads Commission has now under advisement two projects for the building of a high-speed electric railroad between Hamburg and Berlin. Should it be decided to build such a road or equip the present tracks in the required way the journey of 149.04 miles between these two cities, which is now made in from three to five hours, could, it is said, be traveled in one and one-half hours.

The organization of the Springfield, Bloomington, Lincoln and Peoria (Ill.) interurban railroad has been completed by the election of nine directors and the following-named officers: President, Lafayette Funk, Bloomington; vice-president, S. E. Prather, Springfield; secretary and treasurer, Frank W. Aldrich, Bloomington. The company will float bonds to the amount of $2,500,000 and will construct a trolley line from Bloomington to Springfield and from Peoria to Lincoln. The stockholders include prominent capitalists of the four cities to be connected.

President E. B. Overshiner of the Swedish-American Telephone Manufacturing Company has become interested in a new Kansas enterprise. A charter was recently issued in Topeka for the Kansas City and Topeka Railway Company, which proposes to build a trolley line from Topeka to Kansas City. The capital stock of the company is $2,500,000, and its directors state that the work on the line will be rushed as fast as men and money can push it. It is expected to have cars running between the two cities by fall. Among the names of the directors appear that of E. B. Overshiner and also A. V. Overshiner. E. B. Overshiner is vice-president of the new railway company.

POWER TRANSMISSION.

President Warren of the Lake Superior Power Company states that the head office of the company, as reorganized, will be in Toronto, and that the government will guarantee a loan of $2,000,000.

The Pecatonica River Power Company of Freeport, Ill., with a capital stock of $5,000, has been incorporated to operate electric-lighting, railway and power plants. The incorporators are H. B. Whitte, J. H. Vincent and C. B. Courtney.

Governor Odell has intimated his intention to veto the bill of the Lockport and Ontario Power Company on the ground that it gives the company almost unlimited power to engage in almost any kind of business and to acquire the right of eminent domain throughout the state.

TELEGRAPH.

The charter of the United States Telegraph and Telephone Company has been filed with the Cook County recorder. The company is composed of Henry E. Weaver, G. Watson French, Henry L. Turner, Harry D. Critchfield and Harry Rubens. The object is "to construct and operate lines of electric telephone and telegraph in any state or country, and to acquire and own everything pertaining thereto." The scheme includes the merging of other companies in Chicago, Milwaukee and St. Louis for the purpose of establishing an independent commericial service between these cities. Lines also will be constructed between Omaha and Minneapolis, it is said.

SOCIETIES AND SCHOOLS.

The American Cotton Manufacturers' Association announces its eighth annual convention, which will be held at the Arlington Hotel, Washington, D. C., on May 11th and 12th. Among the practical subjects to be discussed will be an address on "Forests and Waterpowers," by F. H. Newell, chief engineer United States Geological Survey, and one on "The Cost of Power," by Professor R. C. Carpenter of Sibley College, Cornell University.

At a meeting of the executive committee of the Canadian Electrical Association held on April 21st it was decided to hold the next annual convention in the city of Hamilton on June 15th, 16th and 17th. Committees were appointed to make the necessary arrangements.

The Southern Hardware Jobbers' Association announces an old-fashioned barbecue during its annual convention, to be held at Atlanta the latter part of next month. Secretary C. B. Carter of Knoxville, Tenn., is sending out information concerning the convention.

PUBLICATIONS.

Kinsman specialties, manufactured by McLeod Ward & Co. of New York city, are brought to the notice of the trade through a leaflet illustrating and describing the No. 2 A lamp fixture and shade for roll-top desks. An adjustable arm makes it possible to throw the light forward or back as desired, illuminating any part of the desk.

Supplement No. 11 to catalogue No. 10, issued by the H. T. Paiste Company of Philadelphia, contains a price list of "P-K" electrical specialties. The supplement illustrates and describes those new specialties that have been added since the last general catalogue was issued, consisting principally of small knife switches, attachment plugs, fuseless rosettes and the like.

The new catalogue of "Corliss Engines" issued by the Minneapolis Steel and Machinery Company of Minneapolis is artistic in design and well adapted to show the company's products, which consist of numerous types of Corliss engines for heavy duty. The catalogue is profusely illustrated and contains some fine pictures of installations. To Joseph Garbett, M. E., is due much of the credit for developing the Twin City Corliss engine.

Telephone manufacturers are noted for the complete and handsome advertising literature which they issue, and the Kellogg Switchboard and Supply Company of Chicago by its latest bulletin upon "Magneto Switchboards" does much to keep up the standard of excellence. This type of switchboard is described from start to finish, including circuits, diagrams and dimensions of the boards themselves and details of all the pieces of apparatus, however small. Information is also contained concerning transfer circuits, cut-in station apparatus, two and four-party-line selective systems and express-board installing. Of special interest to practical men are a number of pages given over to switchboardcable forming and the methods of handling lead-covered cables for outside work. The bulletin is well illustrated and contains 103 pages.

MISCELLANEOUS.

The New York office of the Lehigh Valley Railroad Company has been moved from 26 Cortlandt Street to 143 Liberty Street, where President E. B. Thomas and the general manager, chief engineer, superintendent of the New York division and other officers are located.

The General Electric Company says that a person calling himself George E. McCants and describing himself on his card as chief electrician of the General Electric Company, Schenectady, N. Y., is traveling in Texas and representing that he is connected with that company. There is no person of the name given on the payroll of the General Electric Company. It is almost unnecessary to add that there never was any person of that name chief electrician of the company.

The report that the formation of the Mackay Companies has brought the controlling interests of the Commercial Cable Company and the American Telephone and Telegraph Company into such close affiliation as to result in a practical consolidation of the two systems is denied by officials of both companies. Recent transactions involving the Manhattan Trust Company and incidentally the cable and telephone companies and in which the names of John I. Waterbury, T. J. Coolidge, Jr., Clarence H. Mackay and Murry Crane are mentioned have been interpreted as tending toward a consolidation of the control of the cable and telephone companies. It is not known that the Mackay Companies have actually acquired any telephone stock. An official of the Postal Telegraph-Cable Company remarked that so long as there is a Mackay living the Postal company will not lose its identity.

TRADE NEWS.

After May 1st the office of the Calumet Machine and Engineering Company, at present in the Monadnock Building, Chicago, will be located at 1422 Marquette Building.

The William Rahr Sons Company of Manitowoc, Wis., is asking for bids for furnishing two generators of 250 and 100-kilowatt capacity, respectively, and 25 motors ranging from one to 50 horsepower to be installed in its malting plant in Manitowoc.

The Pacific Electric Company of La Crosse, Wis., made a voluntary assignment on April 11th. Creditors must file their claims within three months with C. S. Van Auken, assignee, or George D. Wright, clerk of the Circuit Court of La Crosse County, who may be addressed at La Crosse.

The Gould Storage Battery Company, the well-known maker of complete storage-battery plants for central stations, electric railways and other purposes, announces that after May 1st it will occupy the entire eighth floor of the new Century Building, No. 1 West Thirty-fourth Street, New York. The company has been located at 25 West Thirty-third Street.

Sealed bids will be received on May 14th at noon for the complete installation of a power plant upon the Cannon River, near the village of Cannon Falls, Minn. Approximately 10,000 cubic yards of concrete, three horizontal directly connected waterwheels operating under 46-foot head and generating 1,575 kilowatts at 30,000 volts, with three generators, step-up transformers, switchboards, oil switches, etc., will be required. G. S. Edmondstone, 518 Globe Building, St. Paul, Minn., is the chief engineer.

The annual meeting of the Joseph Dixon Crucible Company was held at the company's main office, Jersey City, N. J., on April 18th, and the old board, consisting of Edward F. C. Young, John A. Walker, William Murray, George T. Smith, Edward L. Young, George E. Long and Joseph D. Bedle, was re-elected. President, E. F. C. Young; vice-president and treasurer, John A. Walker, and secretary, George E. Long, were re-elected by the directors. Judge Joseph D. Bedle was also re-elected as counsel.

BUSINESS.

Sales Manager John W. Brooks of Pass & Seymour, Solvay, N. Y., was a visitor in Chicago last week. Mr. Brooks reports the factory at Solvay as exceedingly busy. He was given a warm reception by his numerous friends in the Electrical Building, Chicago.

The National India Rubber Company of New York city, whose offices were recently removed to the 12th floor of the building at No. 42 Broadway, is represented as follows: Rubber-insulated wire, Henry D. Stanley; hose belting and packing, Albert B. Pratt; druggists' sundries, Henry D. Archer.

Smith's marlin cable hangers, manufactured by Milton M. Smith of Evanston, Ill., consist of a hook, uniform in size and shape, fastened to a marlin cut to accurate length and knotted by machine. These hangers are put up 50 in a bunch of uniform size. The size is marked on each package for the convenience of construction men. The product is handled by the John A. Roebling's Sons Company.

A recent bulletin from Charles R. Pratt and Edward Van Winkle, consulting engineers of New York, testifies to the merits of the Pratt elevator safety device, which grips the guide rails beneath the elevator platform and brings the car to a gradual stop in case of an accident. The clutch is operated by a spring which is released by a speed governor. The maximum pressure is applied as the car continues to travel by a rope governor wound upon a drum.

"The contract method every time," says the Electric Appliance Company, Chicago, to people who are going to purchase lamps. "Whether a consumer's requirements call for 1,000, 10,000 or 100,000 lamps, he should buy them on contract and so be assured of the best price and best service." The company has just closed contracts with two of the largest consumers in the West for the Packard high-grade lamps and recommends all its customers to secure lamps on the contract basis.

The Mica Insulator Company of New York and Chicago is now placing on the market a new product under the trade name Bias Linotape. This material is a tape cut on the true bias and coated with a film of Empire oxidized linseed oil. It is extremely flexible and can be wrapped around sharp corners and turns where straight tape cannot be used. It is designed especially for use in insulating armatures, field-magnet coils, cables, switchboards and high-tension work. The company is distributing small samples of this tape and announces its willingnes to mail these samples upon application.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) April 19, 1904.

757,436. Electrical Generating System. William A. Bole, Pittsburg, Pa., assignor to the Westinghouse Machine Company, Pittsburg, Pa. Application filed July 12, 1901.

A form of flexible coupling to be placed between the engines and generators of alternating-current system to help maintain synchronous operation, is described

757,439. Prepayment Electrical Measuring Instrument. Frank Conrad, Edgewood Park, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed June 24, 1903.

A switch for making and breaking the main circuit of the instrument and two electromagnets for respectively and positively moving the switch to its circuit-opening and its circuit-closing positions are associated with a counting train and a coin-actuated member and a device for closing the circuit of each magnet and for opening that of the other.

757,441. Cluster Socket. John H. Dale, New York, N. Y. Application filed February 18, 1904.

A socket for holding several incandescent lamps is described, which is provided with one set of main leads.

757,495. Electric Sole Shoe. Adam Reed, St. Joseph, Mo. Application filed February 4, 1904.

A cushion arranged on an insole contains a vertical slot in its rear portion, and a galvanic couple made up of elements having flat disks disposed above and below the cushion and connected together by means extending through the vertical slot.

757,503. Telegraph System. Harry O. Rugh, Chicago, Ill., assignor to the Western Telegraphone Company, Chicago, Ill. Application filed August 31, 1903.

Associated with the regular Morse system is a device for impressing alternating-current impulses on the line consisting of a line relay including a vibratory contact element actuated by the magnet of the relay and a traveling contact element possessing inertia and normally resting against the vibratory contact element, but separable therefrom through the agency of wave-form current impressed upon the relay.

757,504. Telegraph System. Harry O. Rugh, Chicago, Ill., assignor to the Western Telegraphone Company, Chicago, Ill. Application filed August 31, 1903.

Alternating current is sent out over the line which does not affect the Morse instruments on account of their high impedance. The receiver for the impulses is an ordinary telephone receiver which with each series of impulses gives a sharp buzzing sound.

757,505. Telegraphy. Harry O. Rugh, Chicago, Ill., assignor to the Western Telegraphone Company, Chicago, Ill. Application filed August 31, 1903.

A condenser in series with an alternating-current telegraphing device intended for use on regular telegraph lines prevents the regular Morse direct current from affecting the apparatus.

757,515. Phase Regulation. Egbert M. Tingley, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed May 9, 1896.

In a wattmeter an induction-motor device has two energizing coils supplied from a single source of alternating current and a closed circuited armature, one of the coils being in shunt to the translating devices, the other being in series. At least one of the coils is shunted by a local circuit of different time constant than that of the coil.

757,516. Phase Angle-adjusting Means. Egbert M. Tingley, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company. Original application filed May 9, 1896. Divided and this application filed April 24, 1900.

In an alternating-current circuit are a field coil connected in series in the circuit, a second field coil in shunt upon the circuit, an inductive resistance in series with the second field coil and a non-inductive resistance in shunt thereto.

757,517. Method of Phase-angle Adjustment. Egbert M. Tingley, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Original application filed May 9, 1896. Divided and this application filed April 24, 1900.

Measuring the electrical energy of a single-phase circuit is accomplished by establishing, by means of currents from the single source supplying the energy to be measured, two periodic magnetic fluxes, one proportional to the electromotive force of the supply circuit and the other proportional to the current flowing to the translating devices. The fluxes have a phase difference equal to an angle differing from 90 degrees by the angle of lag in the work circuit and acting inductively upon a closed circuited armature. They maintain the phase difference of the fluxes by the action of currents shunted around part or all of the energizing coils and outside their magnetic fields. (See cut on next page.)

757,518. Method of Phase-angle Adjustment. Egbert M. Tingley, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Original application filed May 9, 1896. Divided and this application filed February 4, 1901.

Increasing the phase angle between the currents in two independent field coils is done by shunting one of the coils by a resistance having a lesser time constant than the coil.

757,523. Induction Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company, Providence, R. I. Application filed December 14, 1903.

Combined with a secondary winding divided into sections, the inside ends of which are electrically connected, is a sleeve of insulating material surrounding the sections and having a flange extending between them.

757,524. Induction Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company, Providence, R. I. Application filed December 30, 1903.

A cup of insulating material is supplied into which one end of the core and primary coil projects. A secondary coil is divided into a number of sections, a portion of which surrounds the cup, while the remainder surrounds that portion of the core and primary coil not covered by the cup.

757,525. Induction Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company, Providence, R. I. Application filed January 12, 1904.

Several induction coils and armature levers have a single circuit-controlling lever common to all of the armature levers and adapted to be actuated successively thereby.

757,527. Vibrator for Induction Coils. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company, Providence, R. I. Application filed January 20, 1904.

Two contact points have a normal relative movement into and out of contact with each other, and co-operate with means for swinging one contact out of the path of the other and into position for inspection.

757,537. Method of Signaling for Electric Railways. Samuel M. Young, New York, N. Y. Application filed November 6, 1903.

Operating signals upon an electric railway are adapted to be controlled by the movement of the cars in the system and is accomplished by impressing an alternating current upon the conductors which separately form return paths for the power circuit, normally transmitting such alternating current through the signaling devices employed and shunting the alternating current around successive signaling devices.

757,541. Push-button Switch. Walter A. Church, Binghamton, N. Y. Application filed June 17, 1903.

The details of the shifting arrangement are described

757,559. Wireless-telegraph System. Guglielmo Marconi, London, England, assignor to the Marconi Wireless Telegraph Company, London, England. Application filed November 19, 1901.

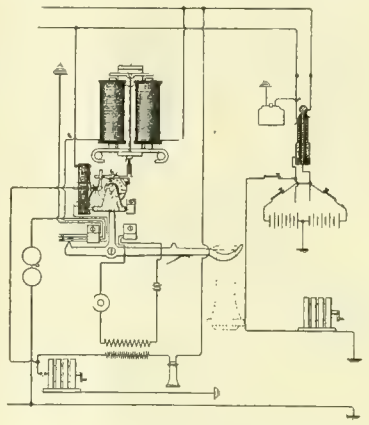
At a station are a conductor, a number of open circuits electrically connected with the conductor, a corresponding number of instruments, one electrically connected with each open circuit, and means whereby the time periods of the open circuits are caused to differ from each other.

757,564. Electric Headlight. William H. Northall, Elwood, Ind. Application filed March 20, 1903.

A carbon arc fed by solenoids furnishes the light for the apparatus.

757,609. Electrical Telephone Apparatus. Pliny H. Fisk, Clay, Iowa. Application filed June 13, 1903.

Telephones are connected on a single circuit or line. Electrically controlled means are associated with the telephones, whereby a number of quickly successive impulses are caused to pass over the line. Means operated by the impulses lock out all the instruments in the series except the ones at the transmitting and receiving stations. The action of the locking-out means is retarded to permit the action of the cutting-in device of the receiving station.



NO. 757,826.—SELECTIVE TELEPHONE SYSTEM.

757,617. Process of Producing Carbide. William S. Horry, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed March 29, 1902.

Terminals of a source of electric current are placed in contact with different parts of a charge of carbide-forming materials. Different quantities of electric current are passed through different portions of the charge, and the current density increased along the path of the current in the charge to a point where the heat generated by the resistance of the charge causes the materials to react to form carbide. (See cut on next page.)

757,618. Process of Electric Heating. Wiillam S. Horry, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed April 5, 1902.

Heating a circular body of conducting material is done by placing the active terminals of a source of polyphase current substantially in contact with the body at various points around its periphery, and causing different phases of the current to simultaneously flow between several of the terminals and along paths which cross each other through the body.

757,619. Process of Electric Heating. William S. Horry, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed April 28, 1902.

Different phases of a polyphase current are caused to flow along paths which converge to a common point within the furnace.

757,620. Method of Electric Heating. William S. Horry, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed June 6, 1902.

Superposed electric currents are passed through a pool of conductive material and thereby maintaining in the pool a region of maximum current density. A suitable charge is fed into the pool.

757,621. Electric Furnace. William S. Horry and Edgar F. Price, Niagara Falls, N. Y., assignors to the Union Carbide Company, Niagara Falls, N. Y. Application filed October 11, 1902.

The furnace charge is heated by means of electrodes, which produce in a certain region a zone of maximum current density.

757,626. Electrically Driven Machine for Sawing Logs, etc. Kaspar Kottmann, Zurich, Switzerland. Application filed May 1, 1903.

A saw and its carriage are driven by an electric motor.

757,629. Sewing-machine Motor. Jacob H. Macon, Jr., Tampa, Fla. Application filed December 24, 1902.

A small electric motor is mounted to run a sewing machine by means of a belt.

757,630. Safety Device for Trolley Poles. Phelam McCullough, Thomas Blaney and Robert Baron, Liverpool, England. Application filed January 22, 1901.

The device is so arranged that a sudden pull on the trolley cord actuates a centrifugal device, which locks the drum which pays out the slack on the cord.

757,633. Electric Heating. Edgar F. Price, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed April 5, 1902.

Material is fed in proximity to a stable resistance conductor. Superposed electric currents are passed through the conductor, thereby increasing the current density along the path of the current through a portion of the conductor in proximity to the material.

757,634. Electric Resistance Furnace. Edgar F. Price, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed April 30, 1903.

A stable resistance conductor is placed in position to heat the charge, and means for passing through the conductor electric currents superposed in such order that the current density increases through the conductor, thereby heating it ununiformly.

757,659. Electric Arc Lamp. Robert Hopfelt, Berlin, Germany. Application filed May 13, 1902.

Electrodes partly composed of metal are specified and the negative electrode is above the positive one. The lower or positive electrode contains at least five per cent and the upper or negative one less than five per cent of metal for the purpose of lessening the formation of slag on the negative electrode and preventing the dropping of slag on the positive. An annular refractory reflector closely surrounding the negative electrode immediately at the arc is essentially composed of carbon, carborundum or of magnesia, lime or other refractory material, for the purpose of attaining a high degree of durability.

757,670. Electrically Heated Soldering Iron. Alfred C. McCloskey, Philadelphia, Pa. Application filed May 6, 1903.

A soldering head heated by a resistance coil is provided with a hollowed-out lower end. A partition of metal separates the space formed in the lower end of the soldering iron from the lower end of the heating iron, and means are supplied for connecting the heating iron and the soldering iron together. (See cut on next page.)

757,687. Rheostat. Imle E. Storey, Amsterdam, N. Y. Application filed September 2, 1903.

A resistance element consists of a tube of graphite or similar material with metallic heads. A rod passes through the tube and engages with the heads to clamp them against the ends of the tube.

757,692. Block-system Emergency Apparatus. Frederick V. Thompson, Philadelphia, Pa., assignor of one-half to Frank Baker, Philadelphia, Pa. Application filed January 10, 1903.

An emergency circuit controlled by relays connected to a third rail operates a solenoid in the locomotive cab which closes the throttle and applies the air brakes.

757,695. Electric-lighting and Power System. William A. Turbayne, Buffalo, N. Y., assignor to Charles M. Gould, New York, N. Y. Application filed January 13, 1902. Renewed September 29, 1903.

Together with a generator and electric circuit are an exciter for the field winding of the generator, an electric motor actuating the exciter and having its armature supplied from a practically constant source, and means for varying the field magnetism of the motor in correspondence with variations in the speed of the armature of the generator and irrespective of variations of current in the main circuit.

757,715. Propulsion of Electric Automobiles. Jonas W. Aylsworth, East Orange, N. J. Application filed June 24, 1903.

An electric motor whose field magnets and armature are independently rotatable in opposite directions is connected by a releasable clutch to the drive wheels. Means for locking against rotation the rotatable element connected with the clutch are a part of the invention.

757,722. Electric Semaphore. Dona Boisvert, Providence, R. I. Application filed October 13, 1902.

An electric motor is attached to an axle which operates the semaphore signal.

757,736. Multiplex Telegraphy. John J. Ghegan, Newark, N. J. Application filed July 3, 1902.

Two receiving differentially wound relays embody means for switching one winding of each of the relays into and out of the main line alternately, with an "artificial" line. A relay switches the "artificial" line into the second winding of each of the relays alternately, the "artificial" line being statically balanced to counteract discharges from the main line.

757,765. Insulator. John W. Osborne, Winchester, Ill. Application filed August 15, 1903.

A shank which is externally threaded has a flat rectangular plate arranged at the outer end, pins project at right angles from the plate. The pins are arranged alternately adjacent the opposite edges of the plate, each pin having a notch made in the outer side. The pins, plate and shank are covered with non-conducting material.

757,768. Signal Apparatus. Jonathan D. Price, Aurora, Ill., assignor to the Miller Signal Company, Chicago, Ill. Application filed January 21, 1902.

The track is divided up in[illegible] each other, energized by batteries. Each train carries a signal circuit adapted to be energized from the track circuit.

757,773. Electric Fan. Frank N. Roehrich, Brooklyn, N. Y. Application filed December 10, 1901.

An electrically driven fan is described, which by its reactive force is caused to revolve on its base.

757,774. Fan. Frank N. Roehrich, New York, N. Y. Application filed April 16, 1903.

The fan is made so that its shaft is simultaneously rotated and operated.

757,782. Electric Arc-rupturing Device. Sidney H. Short, London, England, assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed February 11, 1902.

Contact pieces between which an arc is likely to be formed are supplied with an electromagnet having a pole piece in proximity to the arcing point to magnetically blow out the arc.

757,785. Spring Jack for Telegraph Switchboards. John F. Skirrow, East Orange, N. J. Application filed December 16, 1903.

Details are described.

757,789. Elevator Brake Mechanism. August Sundh, Yonkers, N. Y., assignor to the Otis Elevator Company. Application filed August 5, 1903.

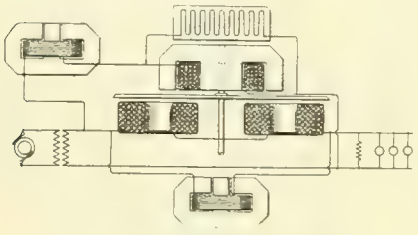
An electric elevator brake is operated by a circuit which is made at the same time that the main circuit is broken.

757,792. Circuit-controller for Induction Coils. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company, Providence, R. I. Application filed January 20, 1904.

An induction coil co-operates with a vibratory circuit controller having a number of sets of contacts and means whereby any one set can be thrown into operative position and the other set or sets thrown out of operative position.

757,799. Telephone Transmitter. Walter L. Wilhelm, Buffalo, N. Y., assignor to the Wilhelm Telephone Manufacturing Company, Buffalo, N. Y. Application filed January 23, 1902.

A tubular holder for the microphone is located within the telephone casing. A mouthpiece outside of the casing, and a single detachable connection joining the mouthpiece and the tubular holder together and to the casing make up the invention.



NO. 757,517.—METHOD OF PHASE-ANGLE ADJUSTMENT.

757,802. Wave-responsive Device. Albert E. Woodward, Nashua, N. H., and Harry Shoemaker, Philadelphia, Pa., assignors to Marie V. Gehring, Philadelphia, Pa. Application filed July 9, 1903.

Wave-responsive devices comprise disks of aluminum in contact with conductors in series with the disks and a mass of rubber for exerting pressure at the contacts.

757,817. Process of Electrolytically Extracting Copper and Zinc from Ores. Stanislaw Laszczynski, Kielce, Russia. Application filed October 10, 1902.

Tightly wrapped insoluble anodes are contained in a porous and perfectly permeable envelope of fabric or other suitable material, the thickness of which is in inverse proportion to the applied density of current, for the purpose of preventing anodic oxidation of the cations.

757,826. Telephony. Albert Meinema, Chicago, Ill. Application filed January 16, 1904.

In a selective signaling telephone system is a bodily movable switch-actuating appliance at a sub-station of the telephone line with electromagnetic mechanism for operating the switch-actuating appliance. The switch-actuating appliance includes a rotating member carrying two pins of unequal effective length, circuit-controlling springs or elements included in the signal-receiver circuit at the sub-station and adapted to be closed by one of the pins and a telephone contact element, the other of the pins serving to connect the three contact elements. (See cut on previous page.)

757,830. Means for Protecting Live Parts of Electric Switches or the Like. William McDevitt, Philadelphia, Pa., assignor of two-thirds to Washington Devereux and William W. Hollingsworth, Philadelphia, Pa. Application filed September 26, 1903.

Insulating means for protecting the switches are described.

757,847. Electric Arc Lamp. Frederik Sindingchristensen; New York, N. Y., assignor to the Commercial Construction Company, New York, N. Y., and William H. Locke, Jr. Application filed May 4, 1903.

Embodied in the arc-feeding mechanism is an electromagnet in which the variations of current are adapted to operate directly the feeding mechanism. Connections independent of the feeding mechanism are placed between the magnet and the arc-forming mechanism.

757,853. Electric Switch. George H. Whittingham, New York, N. Y., assignor to the Automatic Switch Company of Baltimore City, Md. Application filed October 29, 1903.

Armature-circuit terminals and contacts therefor consist of rocking arms provided with central pivoted bowed portions and a blade at each end. A shaft provided with tappets is designed to rock the arms so as to move their blades into and out of contact with the terminals, the bowed portions providing clearances whereby the tappets may pass their points of operative contact with the arms.

757,880. Electric Rheostat. Roy W. Brown, Amsterdam, N. Y. Application filed April 21, 1903.

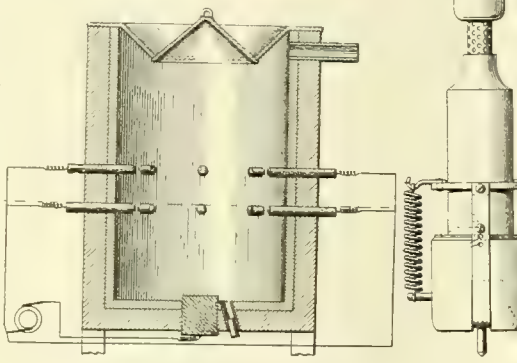
Combined with a resistance body is a movable contact piece. Contact pieces located and supported on the resistance body are arranged so that, as the movable contact piece is moved along the resistance body, parts of the resistance body will be cut out of the circuit, first a part at one end and then a part at the other end.

757,884. Terminal Cut-out. Henry P. Clausen, Chicago, Ill., assignor to P. C. Burns and J. G. Ihmsen, Chicago, Ill. Application filed July 18, 1903.

A thermal cut-out comprises a heat-concentrating member, a body of softenable material, and means including relatively sliding members and a spring for shearing the material upon the passage of an abnormally strong current and the consequent softening of the material.

757,898. Electric Controller. Arthur C. Eastwood, Cleveland, Ohio. Application filed January 30, 1904.

Resistance bodies bearing contact fingers co-operate with a metallic cylinder having contact buttons in electrical connection therewith and placed to be engaged by the fingers. A spindle supports the cylinder, metallic pieces are carried by but insulated from the spindle, and other contact fingers are supplied for engagement with the pieces.



NO. 757,617.—PROCESS OF PRODUCING CARBIDE.

NO 757,670.—ELECTRIC SOLDERING IRON.

757,906. Electric Railway. George H. Fretts, Springfield, Mass. Application filed July 14, 1903.

Combined with a switch plate having depending flanges is a switch tongue supported for swinging movement between the flanges. A solenoid is supported by the switch plate, also a rock shaft having arms. A link connects one of the arms with the core of the solenoid, and a second link connects with the other arm, the switch plate having a slot and the switch tongue having a lug passing through the slot and connected with the second link.

757,925. Electric Switch. Charles F. Hopewell, Cambridge, Mass., assignor to the Uni Signal Company. Application filed October 7, 1903.

A circuit-controlling device, an operating device, an actuator for the operating device, a locking arm for the movable contact member of the circuit-controlling device, and a projection on the operating device, which is adapted to engage the locking arm are specified by the inventor in the construction of the switch.

757,942. Automatic Commutator. Julien H. Mercadier, Louvres, France. Application filed October 16, 1903.

Terminals on the main line are connected by a fuse wire. A shunt line is situated between the terminals, and a liquid rheostat in the shunt line comprises a U-shaped tube to contain the resistance liquid. Adjustable electrodes in the arms of the tube, and means for securing the electrodes in their adjusted position are the other necessary parts.

757,943. Storage Battery. Abraham V. Meserole, New York, N. Y. Application filed July 13, 1903.

A battery element consists of a supporting bar provided with depending tubular members. Bolts are threaded through the tubular members, a stirrup plate is mounted upon the bolts, and tablets of active material encircle the tubular members and rest upon the stirrup plate.

757,958. Electric Arc Lamp. Isaac W. Percival, St. Louis, Mo., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed January 23, 1899.

Fixed electrodes co-operate with a number of movable electrodes. A single small light-emitting globe incloses the arcs. A cap or cover for the globe is provided with openings for the approximately air-tight passage of the movable electrodes. Connections join all of the electrodes in series, with a single magnetic control mechanism.

757,971. Thermal Cut-out. Michael Setter, Chicago, Ill., assignor to P. C. Burns and J. G. Ihmsen, Chicago, Ill. Application filed August 5, 1903.

A cut-out for electrical circuits is described which operates to open the circuit upon the passage of an abnormal current, by the melting of a piece of solder.

757,972. Thermal Cut-out. Michael Setter, Chicago, Ill., assignor to P. C. Burns and J. G. Ihmsen, Chicago, Ill. Application filed August 5, 1903.

A spring normally holds the two members of the cut-out apart but upon the melting of a piece of solder, the spring is released, opening the circuit.

757,991. Reciprocating Electric Motor. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Application filed March 16, 1903.

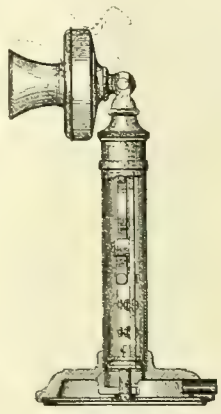
A reciprocating electric motor adapted for alternating currents comprises a magnet and a reciprocating armature co-operating with the magnet. Non-synchronous means for breaking the magnet circuit at the moment of greatest self-induction of the current are supplied.

758,004. Device for Wireless Telegraphy. John A. Fleming, London, England, assignor to the Marconi Wireless Telegraph Company, London, England. Application filed April 8, 1901.

The essential features of the invention are a transformer, the primary circuit of which is permanently closed; means for producing an alternating current in the primary; a coil in the primary circuit; a signaling key and connections for short-circuiting the coil; a producer of electrical oscillations in the secondary circuit of the transformer, and a radiating conductor for the apparatus.

758,005. Apparatus Employed in Wireless Telegraphy. John A. Fleming, London, England, assignor to the Marconi Wireless Telegraph Company, London, England. Original application filed April 8, 1901. Divided and this application filed November 9, 1901.

A transformer having a constantly closed primary circuit is associated with an oscillation producer having a spark gap in the secondary circuit of the transformer with means adjacent to and independent of the spark terminals for extinguishing electrical arcs at the spark gap of the producer. A signal key controls the extinguishing means.



NO. 758,031.—TELEPHONE DESK SET.

758,006. Wireless Telegraphy. Francis J. Green, Detroit, Mich., assignor to the American Engineering Company, Detroit, Mich. Application filed January 9, 1903.

In connection with the receivers is an electrical circuit. Relay circuits are actuated, respectively, by the corresponding receiving circuits. A signal circuit, a danger signal in the signal circuit actuated by each of the relay circuits, and metal screens to electrically segregate and shield each of the receivers are further specified.

758,031. Telephone Desk Set. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed May 26, 1902.

The desk set comprises a base recessed to accommodate the telephone wires or cords, the base being also provided on its top with a socket, a tubular standard mounted in the socket, a mounting inclosed by the tubular standard and having its lower end provided with a threaded opening, and a clamping screw extending upwardly through the bottom of the base and engaging the threaded opening. (See cut.)

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on April 26, 1904:

361,676. Electrical Conductor. Leo Daft, Plainfield, N. J.
361,705. Binding Device for Electric Apparatus. Isaac W. Litchfield, Warwick, N. Y.
361,712. Regulator for Dynamo-Electric Machines. Charles G. Perkins, Hartford, Conn.
361,713. Fusible Cut-out. Charles G. Perkins, Hartford, Conn.
361,730. Railway Signaling. Shellman S. Stewart, Montclair, N. J.
361,731. Electric Rope Coupler. Shellman S. Stewart, Montclair, N. J.
361,734. Telegraphy. Francois Van Rysselberghe, Brussels, Belgium.
361,737. Magneto-electric Telephone Call. George A. Wilkins, Philadelphia, Pa.
361,770. Electric Inductive Translator. William Main, Brooklyn, N. Y.
361,778. Electric Valve-operating Mechanism for Elevators. George H. Reynolds, New York, N. Y.
361,779. Means for Electrically Controlling the Operation of Elevators. George H. Reynolds, New York, N. Y.
361,780. Electric Valve-operating Mechanism for Elevators. George H. Reynolds, New York, N. Y.
361,782. Gas and Electric-lamp Fixture. James T. Robb, New York, N. Y.
361,797. Switch and Circuit for Telegraphs. Stanton Weaver, Washington, D. C.
361,829. Electromagnetic Rock Drill. Harry N. Marvin, Syracuse, N. Y.
361,843. Apparatus for Distributing Electrical Power. Elmer A. Sperry, Chicago, Ill.
361,844. Safety Device for Incandescent Lamps. Elmer A. Sperry, Chicago, Ill.
361,896. Armature Core for Dynamo-electric Machines. Albert Schmidt, Pittsburg, Pa.
361,973. Commutator for Dynamo-electric Machines. Ernest P. Warner, Chicago, Ill.
362,005. Electric Bell. Edgar W. Hazazer, New York, N. Y.
362,010. Electric Covering for Indicating Abnormal Conditions. George J. Jewill, Philadelphia, Pa.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, MAY 7, 1904 No. 19

New Testing Car on Berlin Street Railway.

An interesting German electric car for official tests has recently been equipped with measuring instruments and other apparatus for the Grosse Berliner Strassenbahn, or Greater Berlin street-railway system of Berlin, Germany. The accompanying illustration (Fig. 4) is an exterior view of this "bestellter wagen," or testing car, while Figs. 1, 2 and 3 show the interior arrangement of the car, the marble switchboard and the measuring table upon which the instruments are mounted for making various tests. The car is 11 meters long and 2.15 meters wide. It is divided into two compartments, in addition to the motorman's space of 1.3 meters on the platform at each end of the car. The total wheel base is 5.5 meters, that of each truck being 1.3 meters, while the total weight of the car is 14,050 kilograms. The car body was constructed by H. H. Boerker of Gross Lichterfelde in Germany, and the electrical equipment was installed by the Union Electricity Company. There are two controllers, one at each end. They are connected to two street-railway motors of the General Electric type, each having a normal capacity of 23 horsepower, the equipment including the usual automatic circuit-breakers, switches, lightning arresters and fuses. The testing car is provided with three forms of braking apparatus, including the Sperry magnetic brake, the Boerker air brake and the usual hand brake.

The table shown in Fig. 3 is equipped with an ammeter for measuring the current strength employed at the magnetic brake, an ammeter for each motor and a voltmeter for measuring the difference of potential between the brushes of the motors. There is also a combined ammeter and voltmeter for measuring the main running current, and double-scale instruments constructed by the European Weston company. A manometer is also provided on this table for measuring the air pressure for the air brake, which is normally about three atmospheres, as well as a manometer for the air compressor. A chronograph is also provided, with a second-hand stop, and there is also a gradient indicator. The telephone equipment, the desk instrument of which is seen on the measuring table, was installed by Mix & Genest.

The switchboard installed on this German electric testing car is shown in Fig. 1, the testing table mentioned above being shown in the foreground. The switchboard is constructed of marble, four centimeters in thickness, mounted on a metal framework and equipped with the following electrical apparatus: Two wattmeters, supplied by the Union company, are used for measuring the electricity used by the motors, while another wattmeter, made by the Allgemeine Electricity Company, is employed for measuring the electricity used by the electric heaters. In addition to the ammeters and voltmeters, as well as the automatic circuit-breakers, there is also provided a speed indicator, constructed by F. Schuchardt of Berlin. This instrument indicates directly the speed of the car in kilometers per hour and is operated by a small dynamo on the car axle.

A number of registering instruments have also been mounted on this switchboard for giving records of the current, voltage and speed, these instruments being furnished by Siemens & Halske of Berlin. As will be noted by the accompanying illustrations, this car is supplied with a most complete equipment of measuring instruments for making all of the various tests which could be desired, and is of special interest to electrical engineers engaged in railway work.

P.

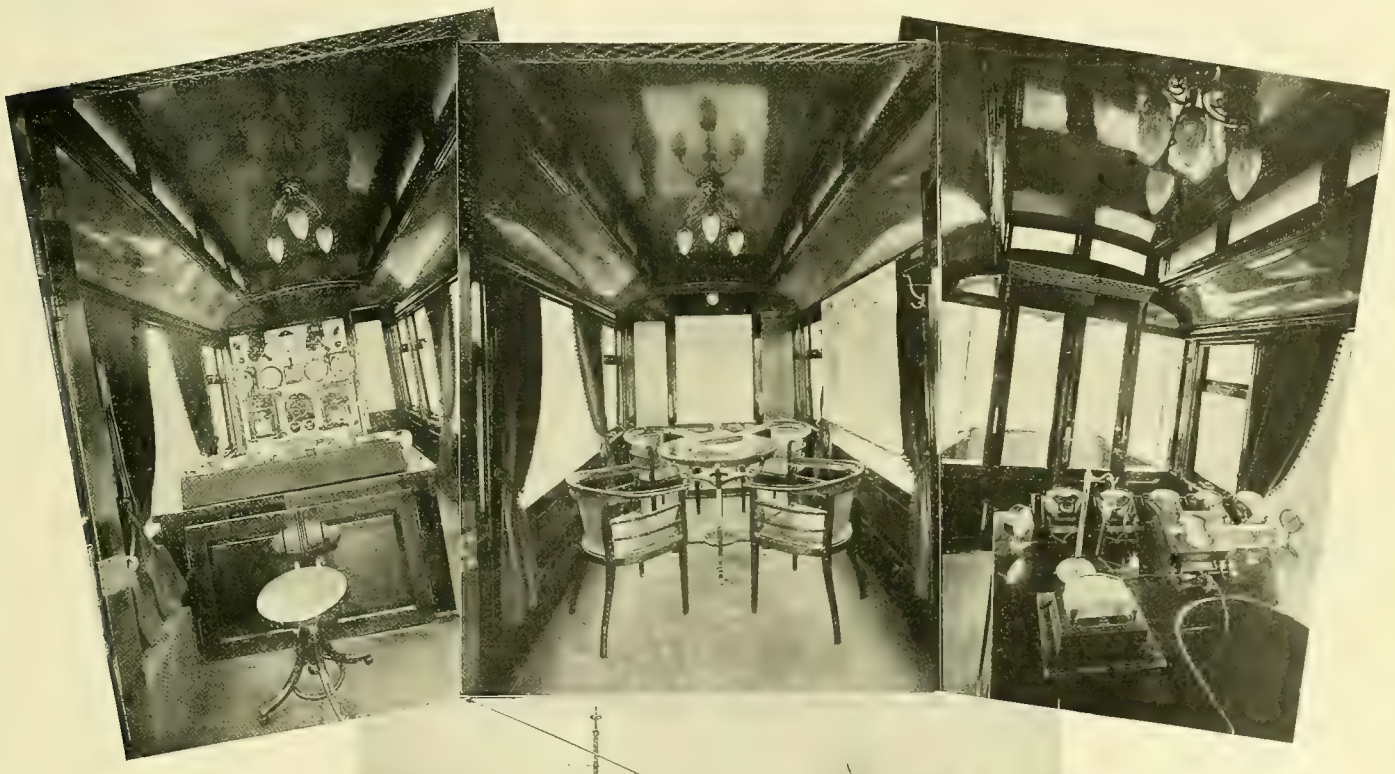


Fig. 1. Interior View Showing Switchboard.

Fig. 3. Measuring Instruments on Table

Fig. 2. An Interior View
Fig. 4. Exterior View.
NEW TESTING CAR ON BERLIN STREET RAILWAY.

The Postal Telegraph-cable Company will expend $125,000 in reconstructing its system in Tennessee and Kentucky. A trunk line will also be constructed between Memphis and Louisville, Ky., and a new plant established in Nashville, Tenn.

Electrical Exports for March.

Electrical exports from the United States for the month of March, 1904, amounted to a total value of $930,297. This amount, compared with $861,878, the amount for the corresponding month in 1903, shows an increase of $68,419 for March of the present year. March also shows an increase of $48,710 over February of this year. Electrical exports are classified by the United States Bureau of Statistics, Department of Commerce and Labor, into two classes—electrical appliances and electrical machinery. The former class, including telegraph and telephone instruments, shows a falling off for March to the amount of $115,134 as compared with last year's figures. Electrical machinery, however, shows a very healthy gain of $183,553. The figures are: Electrical appliances—March, 1903, $449,358; March, 1904, $334,224. Electrical machinery—March, 1903, $412,520; March, 1904, $596,073. Since January 1, 1902, the Western Electrician has kept a monthly record of electrical exports, and within this time no single month has equaled March last in the value of electrical machinery exported. The nearest approach was in March, 1902, when the amount reached $591,078.

Classified according to destination, the following were the principal buyers of electrical machinery from the United States during March last: Japan, $201,617; British North America, $154,083; United Kingdom, $99,389; Mexico, $28,216; British Australasia, $22,853; France, $14,412; British East Indies, $12,001; Brazil, $9,760; Hongkong, $5,418; Chinese Empire, $2,438; Germany, $2,287; Argentina, $1,718.

As stated in these columns last month, Japan for the first time headed the list of importers of American electrical machinery in February, 1904, with a total of $119,856. It will be noted with interest that for March Japan again heads the list, this time with a still larger total, having imported from the United States during the month electrical machinery to the value of $201,617. The United Kingdom, until recently the largest buyer, has dropped to third place, but if all British possessions are taken [illegible] country in the list.

ALTERNATING-CURRENT WORKING.

By W. B. Gump, Asso. Mem. A. I. E. E.

Part IV.

Transformers.

The utility of the alternating-current transformer in modern electrical engineering is so far-reaching that its importance need not be dwelt upon. A complete analysis of the internal working of a transformer could not be contained within these pages, and would not then gain the end sought. The purpose is to explain the practical features, with enough of the theory to give an accurate knowledge of the principles.

The transformer consists of two electric circuits

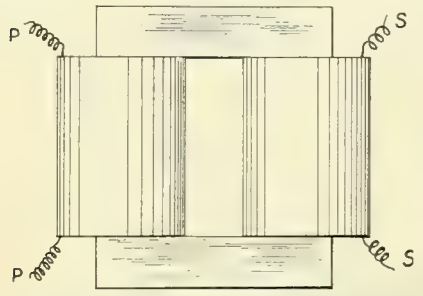


FIG. 31. CORE TYPE TRANSFORMER.

which are interlinked by a common magnetic circuit. The winding of one electric circuit is known as the "primary" and the other the "secondary." The path of the magnetic circuit is led through a soft iron core, which is made up of thin sheets, or "laminated." When the electric circuits are so arranged that their windings surround the core they are known as the "core type." When the magnetic circuit surrounds the electric circuit it is known as the "shell type." The "core type" is represented in Fig. 31 and the shell type in Fig. 32. Since the latter bears some resemblance to a shell, the derivation of its name is at once evident.

The ratio of the number of turns in the secondary coil to the number of turns in the primary is called

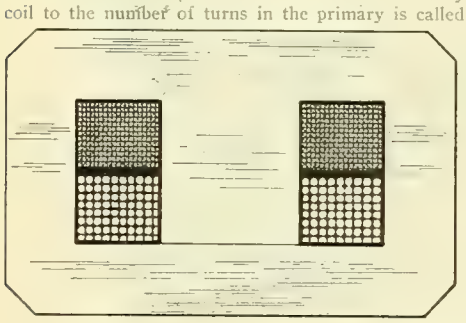


FIG. 32. SHELL-TYPE TRANSFORMER.

the "ratio of transformation." If there were no losses between coils, through leakage, hysteresis and heating, the same ratio would also hold true, for the voltage of secondary to primary; but on account of losses, this ratio is not quite the same for voltage as for the number of turns. A transformer having a ratio greater than unity is known as a "step-up" transformer, the current from the secondary being delivered at a higher voltage than the voltage at which it is received. When the ratio of transformation is less than unity the transformer is a "step-down" transformer.

Step-up transformers are employed chiefly in high-tension stations, where the pressure at the machine is limited. This pressure is received at the primary winding of the transformer and stepped up to a high voltage for transmission purposes, being stepped down at the receiving end for delivery and distribution. Step-down transformers therefore are installed near the points of distribution, receiving a high voltage from the line, and delivering it at a voltage which may be safely and conveniently manipulated. When current is taken from a winding which is used for both primary and secondary, as shown in Fig. 33, the device is known as an auto-transformer.

Theory of the Transformer.

In order to understand the conditions existing in a transformer, consider first Fig. 34, in which (P) is the primary electromotive force, (S) is the secondary and (M) is the iron core. It is best to begin by assuming the secondary circuit to be open. Suppose an alternator (A) to be generating a current in the primary. Since there is no connection to any apparatus from the secondary, the primary will act merely as a choke coil, a large impedance being created, which is almost entirely reactive. The condition resulting is the same as that which was described in a circuit having high self-inductance, and causes a lag between the impressed electromotive force and current of practically 90°. The current flowing is very small, and is only sufficient to magnetize the core. This current is called the "magnetizing current" or "exciting current." The induced electromotive force or counter-electromotive force (as was formerly shown) is 90° behind the current which causes the magnetism. The impressed electromotive force is therefore 180° ahead of the counter electromotive force, or is directly opposed to it, assuming, of course, that no losses occur. The counter-electromotive force is less than the impressed electromotive force by an amount which is necessary to send the exciting current through the circuit. This exciting current is proportional to the ohmic resistance of the primary circuit. The ideal transformer is represented graphically in Fig. 35, in which (OE) is the impressed primary electromotive force, (OC) is the exciting current producing the magnetism (OM), and (OE') is the counter-electromotive force.

Suppose the secondary now be closed through a lighting system which is non-inductive. The flux linked with the primary is also linked with the secondary, and if r equals the ratio of transformation, then the secondary electromotive force (neglecting losses) will be $E' = rE$. The conditions which are brought about with a closed secondary may be stated as follows: On closing the secondary circuit a current is set up in the secondary winding whose am-

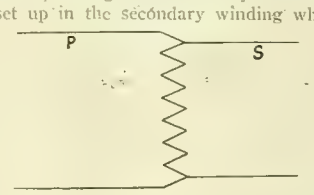


FIG. 33. DIAGRAM OF AUTO-TRANSFORMER.

pere-turns will be directly opposed to the ampere-turns in the primary, the electromotive force in the secondary being directly opposed to the primary impressed electromotive force. By this action a demagnetization of the core results, This in turn reduces the counter-electromotive force and allows more current to flow in the primary circuit. A readjustment follows the flow of more current, by restoring the magnetization of the core. In this way the flux in the core is practically constant, regardless of the load on the secondary.

The pressure relations in a transformer with the secondary closed on a non-inductive load are represented in Fig. 36. Upon the vertical line (YZ) a distance (OC') is laid off, which is the magnitude of the ampere-turns producing the core flux. (OC) is the component of magnetism in the secondary, while (OC") is the resultant or primary ampere-turns. It is now necessary to determine the impressed electromotive force in the primary. A little study will show that the losses due to C^2R, hysteresis

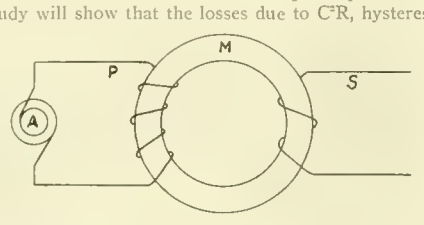


FIG. 34. SIMPLE TRANSFORMER ON OPEN CIRCUIT.

and eddy currents are overcome by the pressure which is the resultant of the counter electromotive force of the primary (OE'), and the pressure (OF) in phase with (OC"). (OE) is therefore the impressed primary electromotive force. In order to show these angles and their relation to the respective pressures, (θ) and (θ') have been greatly exaggerated. In a practical case they would nearly coincide with (OX), and hence would be hard to represent graphically. In the vector diagram just described the relation of the magnetic condition between the primary and secondary was considered in preference to their current relations. The former is more readily understood and is easier to represent than the latter. A clearer insight into the induction motor is also given by a study of the resultant flux rather than the current relations.

The case in which the secondary has an inductive load will now be considered. Observing Fig. 37, (OC) is the ampere-turns in the secondary. Since the secondary is inductive, an angle of lag (a) will exist between the secondary pressure (OP) and (OC), the latter having the same phase relation as the current (OM), which coincides with (OC). As before, (OC") is the resultant flux, and (OE) is the primary electromotive force. It will be seen that the greater the inductance becomes, the greater the angle of lag (θ) will become. Cos. (θ') will therefore decrease, and hence the power factor of the

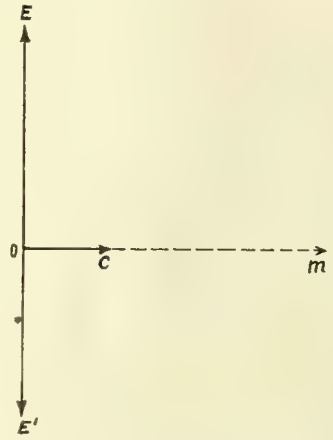


FIG. 35. RELATIONS EXISTING IN IDEAL TRANSFORMER.

circuit will be lowered. A heavily loaded non-inductive secondary, on the other hand, will give a high power factor. If capacity is inserted in the secondary circuit, the effect will be to increase the angle of lag or (if sufficient in amount) to cause a leading current in the secondary. It is evident that this will raise the power factor, and alter the ratio of transformation; that is, the voltage received at the secondary terminals will be greater than that impressed at the terminals of the primary.

The demonstrations given thus far prove that the

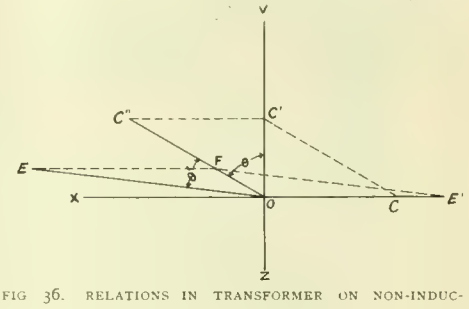


FIG. 36. RELATIONS IN TRANSFORMER ON NON-INDUCTIVE CIRCUIT.

ampere turns of the secondary equal the ampere-turns of the primary (very nearly), or

$$n' A' = nA,$$

from which

$$A' = \frac{n}{n'} A$$

The electromotive force of a transformer, which gives a sine wave, may be expressed by the formula

$$E = \frac{4.44 \phi T f}{10^8}$$

When E = electromotive force of primary (or secondary),

ϕ = useful flux in core (max.),

T = number of turns on coil,

f = frequency of cycles per second.

The factor 4.44 arises from the fact that the flux is created twice, and is twice withdrawn during each cycle; thus the flux is cut four times by the conductors. The form factor being 1.11 for a sine wave results in $4 \times 1.11 = 4.44$ for a complete cycle.

Losses.

The previous demonstrations have not dealt with the losses which actually occur in a commercial trans-

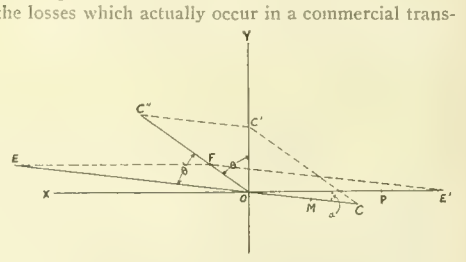


FIG. 37. RELATIONS IN TRANFORMER ON INDUCTIVE CIRCUIT.

former. These losses will now be taken up, and discussed. The losses in a transformer are:

(a) Eddy-current loss,

(b) Hysteresis (or iron) loss,

(c) C^2R loss.

The first is due to eddy currents which circulate in the iron, causing it to heat. This is done away with to a large extent by laminating the core, but

this does not entirely prevent eddy currents from existing. Eddy-current loss is practically independent of the load on the transformer. The power in watts lost by eddy currents may be calculated from the empirical formula:

$$W_e = KVt^2f^2B^2,$$

in which

K = a constant, depending upon the relucivity and resistivity of the iron,
V = volume of iron in cubic centimeters,
t = thickness in centimeters of one lamina,
f = frequency,
B = maximum flux density per square centimeter.

In practice $K = \frac{1.6}{10^{11}} = .000,000,000,016.$

It should be mentioned that in using the above formula the laminæ of the core are supposed to be

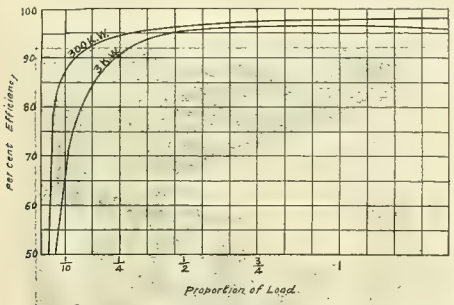


FIG. 38. EFFICIENCY CURVES OF TRANSFORMERS AT DIFFERENT LOADS.

perfectly insulated from each other. The oxide on the sheets is usually sufficient to insulate them; and, in addition they are often japanned, increasing the insulation.

Hysteresis loss is the power in watts lost due to the presence of hysteresis. It is sometimes called iron loss. The latter, however, generally includes eddy-current loss. The formula used in calculating hysteresis loss is derived, according to Steinmetz's law, which is that the watts lost vary directly as the 1.6 power of B (maximum flux density). The formula for hysteresis loss is

$$W_h = \frac{VfK'B^{1.6}}{10^7}$$

in which

V = volume iron in cubic centimeters,
f = frequency,
K' = constant (.002 to .003),
B = flux density.

Both the wave-form and the temperature influence the core loss of a transformer, and when very exact

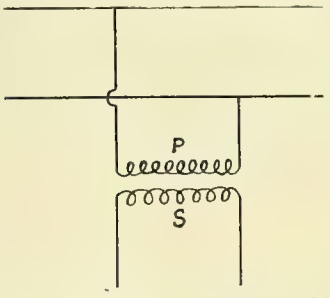


FIG. 39. TRANSFORMER ON SINGLE-PHASE SYSTEM.

calculations are to be made, these must be considered. A rise of 40° C. in the temperature will decrease the core loss between five per cent. and 10 per cent. A peaked wave-form will give less core loss than a sinusoid, or flat top. In consequence of this, it has been found that when transformers which are operated from alternators giving a peaked electromotive-force wave are tested by a sinusoidal current the core loss is considerably higher.

When a transformer has its secondary open the

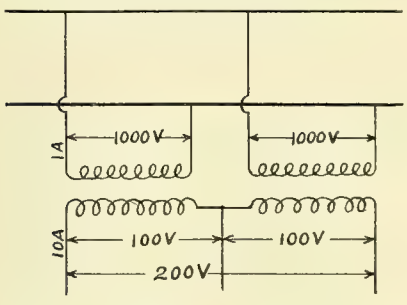


FIG. 40. TRANSFORMER SECONDARIES IN SERIES.

C^2R loss (or copper loss) is due to the exciting current of the primary only, and hence is quite small. When the secondary is loaded normally, the copper loss in watts may be expressed by the equation: $W_c = C^2R + C_1^2R_1$, in which C is the current in primary,

R = resistance in primary,
C_1 = current in secondary,
R_1 = resistance in secondary.

While the core loss is practically constant, the C^2R loss varies as the square of the load.

Efficiency.

It has been stated that wave-form influences hysteresis loss; therefore the efficiency will depend upon wave-form. Transformer calculations are all based upon the sine wave, however, unless otherwise specified. The test for efficiency should be made with a non-inductive load, unless specific conditions make it otherwise. The efficiency of a transformer is the ratio of the output of power to the net input, or it is

output in watts
———————————
input in watts + losses.

Expressing the efficiency algebraically:

$$e = \frac{E'A}{EA + W_e + W_h + W_c}$$

With transformers which are artificially cooled, as is the case with large transformers, the power ex-

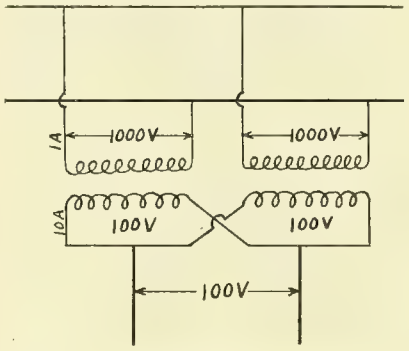


FIG. 41 TRANSFORMER SECONDARIES CONNECTED IN PARALLEL

pended in cooling must be included in the denominator. Since the losses are changed by the temperature, the efficiency is also changed; therefore a definite temperature must be specified in connection with the efficiency.

The ratio of the energy output to the energy input during a run of 24 hours is known as the "all-day efficiency." Under average conditions, a transformer will be fully loaded for about five hours, and will have no load for 19 hours out of the 24. A transformer designed to be loaded but a short time should have a comparatively small amount of iron, and a rather large amount of copper. This will reduce the iron loss during a 24-hour run, and will, of course, increase the copper loss. The latter, however, only

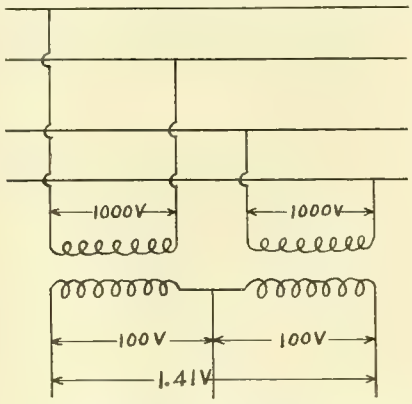


FIG. 42. TRANSFORMERS ON TWO-PHASE CIRCUIT, SECONDARIES IN SERIES.

lasts during the short period in which the transformer has a full load.

Curves giving the efficiency at different loads, of two standard transformers are shown in Fig. 38. The efficiency of the 300-kilowatt transformer is considerably higher than one of four kilowatts, as would naturally be supposed. In very large transformers the efficiency is over 98 per cent. at full load, and closely approaches that figure at less than half load.

Methods of Connecting Transformers.

The way in which transformers are to be connected depends upon the conditions under which they are to operate. The chief methods used will now be described, and those which seem the most important will be explained more in detail. The simplest method is shown in Fig. 39, which is a transformer on a single-phase system. A number of similar transformers may be paralleled on the line, and may have their secondaries independent or otherwise. If the secondaries are connected in series, as in Fig. 40, a three-wire system is the result. It is assumed that the ratio of transformation is one to 10, the primary being 1,000 volts. For simplicity, this ratio will be followed throughout the remaining description. When the same voltage and twice the current is desired, the secondaries may be connected in parallel, as in Fig. 41.

In Fig. 42 a two-phase system is shown having the secondaries of the respective transformers connected

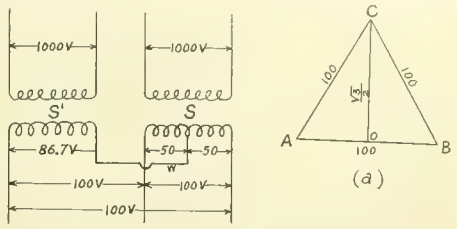


FIG. 43. SCOTT SYSTEM OF TRANSFORMATION

in series. In this case the voltage between the outside wires is not twice the voltage on either leg, but is $\sqrt{2}$ E, since the two voltages are added at 90° from each other. A system devised by Mr. Scott for transforming two-phase four-wire to three-phase three-wire is shown in Fig. 43. The diagram 43a will help to make the voltage relations clear. The secondary of transformer (S) is tapped at its center by the wire (W). This secondary will equal (AB) in the triangle. At 90° from (S) the secondary of transformer (S') is connected. Its direction and magnitude will therefore be measured by the line (CO). Joining the ends will result in an equilateral triangle, forming a three-phase system with its pressures 60° apart.

The most common method of connecting transformers on a three-phase three-wire system is in

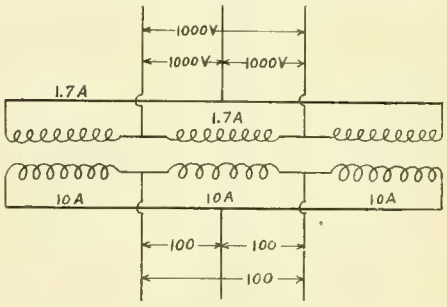


FIG. 44. TRANSFORMERS IN DELTA ON THREE-PHASE SYSTEM.

delta, as shown in Fig. 44. This arrangement is most advantageous when continuous operation is demanded, for one of the transformers may break down, or be cut out, and the remaining two will carry the load. Under such circumstances they will each be overloaded an amount equal to the difference between one-half and one-third full load, which is 16⅔ per cent. overload. Two of them could be cut out, and the remaining one operate the circuit of its own phase.

Transformers are shown in Fig. 45, which are Y-connected. With this arrangement a breakdown of one transformer would result in disabling one line, and a lowering of the pressure between the other two, thus impairing the whole system. There is one great advantage in this method, and that is, that transformers for a given capacity need not contain as much copper for the same line voltage as when

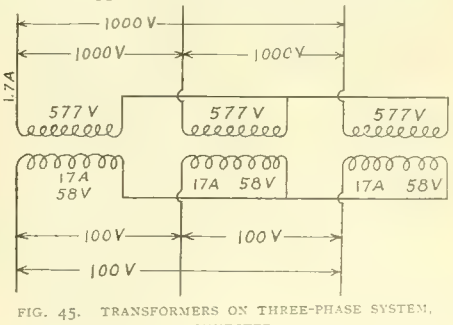


FIG. 45. TRANSFORMERS ON THREE-PHASE SYSTEM, Y-CONNECTED.

"delta"-connected, since the windings need be made for only 57.7 per cent. of the line voltage.

It would be interesting to take up many other arrangements which apply to special cases, but since space is limited, they cannot be taken up here. The diagrams given cover most of the cases which arise in practice, and any further study in this direction must necessarily be pursued through a textbook which completely covers the subject.

Southwestern Gas and Electrical Association.

The members of the Southwestern Electrical Association and the Southwestern Gas, Electric and Street Railway Association met in Dallas, Texas, on April 25th in annual meeting. The most important transaction was the consolidation of the two organizations and the forming of the Southwestern Electrical and Gas Association, embodying both societies and embracing the entire Southwest. The associations met separately for their first session and transacted routine business, after which the organizations joined forces for the discussion of an excellent list of papers and the enjoyment of attractive social features.

The Southwestern Gas, Electric and Street Railway Association was called to order in the rooms of the Dallas Commercial Club at 11 o'clock on the morning of April 25th by President A. E. Judge of Tyler. Routine business was transacted, followed by the president's address, which was well received. A committee was then appointed to confer with a similar committee from the sister organization relative to consolidation. A committee to draft resolutions on the death of President E. H. Jenkins of San Antonio and one on finance was appointed. Letters were read from the Western Gas Association inviting the members to be present at the meeting of the National body at St. Louis in June. A memorial address in honor of the late Joseph B. Crockett, president of the Pacific Coast Gas Association, was read.

President J. W. McLendon of Fayetteville, Ark., called to order the session of the Southwestern Electrical Association, which transacted only routine business. The committee on consolidation was appointed, and it was announced that the committees would confer and turn in a formal report toward the end of the meeting. The members of both organizations then joined.

At two o'clock the joint session was opened and A. E. Judge was made chairman. Addresses of welcome were delivered by Hon. Bryan T. Barry, mayor of the city, and by Captain D. E. Grove, president of the Commercial Club. Replies were made by Mr. Judge and J. L. Ellis. The first paper presented was by H. H. Scott of the San Antonio Gas and Electric Company. His paper was on "Meters and Methods of Selection," and he showed that in choosing meters many more points are to be considered than the item of first cost. Accuracy, losses in meters, maintenance, ease of installation and testing, and cost are five important points to be considered. Mr. Scott said that through the demands of customers, manufacturers are striving for the elimination of constants, the decrease in size and weight of meter, decrease in weight of moving parts and general mechanical improvements. Of late there has arisen a demand that meters register directly in kilowatt-hours, thus doing away with the watt-hour and eliminating a factor for error. Accuracy from a very light load to a considerable overload should be the first point considered, and meters should be provided with an easy adjustment for such loads; also an adjustment for creeping is essential.

Care should be taken, said Mr. Scott, in the selection of the permanent magnets, as past experience has shown that many troubles in old-type meters are due to aging of the magnets. The accuracy of meters within the regulation of each station is a factor that also deserves consideration. A meter showing the least shunt loss and lowest drop across the series coil is the most favorable. The maximum capacity of a meter depends to a large extent upon its ability to dissipate heat, and the resistance of the series coil should therefore be made as low as possible, and a meter easily installed and tested presents an advantage. The questions of accuracy and losses far outweigh the element of first cost.

"Economies of the Meter" was the subject of a paper presented by Superintendent J. R. Cox of the Brush Electric Light and Power Company of Galveston, Texas. In the discussion which followed Mr. Cox's paper it was mentioned that the considerable loss which is often due to the meter bearings, the jewels of which roughen and crack, greatly impairing the accuracy throughout the range, and especially on small loads, is due largely to vibration and atmospheric conditions peculiar to Galveston, New Orleans and one or two other cities.

L. M. Levison, superintendent of the Shreveport Traction Company of Shreveport, La., read a paper on "Motor Service and Sale of Power by Street Railways." He went into considerable detail regarding the development of the motor service in connection with railway work of his company, starting with three or four motors for ceiling fans of 500 volts, and growing to a large and remunerative motor business. Mr. Levison offered to send, upon request, to members of the association and others interested, his schedule of rates, sizes of motors in operation, kinds of motors and fans used, blank contracts and any other information at hand.

A technical paper on the "Operation of Single-phase Motors, from the Central-station Standpoint" was presented by J. R. Cullinane, secretary of the Denison Light and Power Company.

The second day's session was opened in the Commercial Club rooms at 10:30 a. m. The programme included the following papers: "Advantages of Combination of Gas and Electric Plants," by R. R. Stitchter, superintendent construction Cleburne Gas and Electric Company, Cleburne; "Combination of Public Utilities in Small Cities," by E. L. Wells, Jr., manager Arkansas and Texas Ice and Coal Company, Marshall; "Benefits and Evils of Telephone Competition," by J. E. Farnsworth, general manager Southwestern Telegraph and Telephone Company, Dallas. Profitable discussion followed the reading of each paper.

The principal interest in the last day's session centered on the discussion of papers on telephone matters. "Telephone Competition" was the subject and when the matter of Independent companies was brought up a lively discussion was participated in by W. J. Maroney, J. E. Farnsworth and others.

The joint committee on consolidation then made its report and its recommendation to unify the two organizations under the name of the Southwestern Electrical and Gas Association was adopted. Denison, Texas, was named as the next meeting place.

The officers selected for the new organization are as follows:

President—J. F. Strickland, Waxahachie.
Treasurer—A. E. Judge, Tyler.
Secretary—F. E. Scovill, Austin.

The social part of the meeting was especially successful. It consisted of trolley rides, smokers and a vaudeville performance at Hadley Park. A feature was the initiation on Tuesday night of 40 members into the order of the "Sons of Jove." This organization is composed of men over 21 years of age. They must be persons engaged in some branch of the electrical business or its allied industries, including light, power and heat, or who may be engaged in the study or teaching of the electrical science, including savants, philosophers, scientists, inventors, journalists, railroad men, all under certain limitations.

It was the unanimous sentiment of the members that the convention just closed was the most profitable and enjoyable one ever held by either of the old organizations.

Space-telegraph Experience in Chicago.

Chicago has had a discouraging experience in the matter of practical commercial space telegraphy. Readers of the Western Electrician will recall that last year two stations were equipped with space-telegraph apparatus in Chicago, both to form part of a system embodying the principal points on the Great Lakes and to afford a means of communication with boats en voyage. The Marconi Wireless Telegraph Company of America constructed the larger and more elaborate plant of the two and at the same time built a similar one in Milwaukee. The De Forest Company installed its apparatus in the tower of the Montgomery Ward Building, and from here apparently established satisfactory communication with boats equipped with De Forest apparatus at various points on Lake Michigan.

Both these plants have been dismantled. The Marconi plant in Chicago, located at the foot of Oak Street overlooking the lake, was illustrated, and its working described, in the Western Electrician of June 13, 1903. An experienced attendant was put in charge, the apparatus was set in motion, and to all appearances messages were successfully exchanged daily between Chicago and Milwaukee, a distance of 81 miles. A visit to the plant last week, however, revealed the fact that the place had been closed. On further inquiry it was learned that the Chicago manager of the company, Mr. H. W. Beauclerk, had removed to New York, and the apparatus was reported to be for sale. The building and part of the huge mast which elevated the antenna above all surrounding obstacles still remain, but the machinery and conducting wires are gone. Some 40 feet of the large pole lies splintered on the ground, the result of a stroke of lightning during the recent thunderstorms.

At the office of J. W. Thorne, manager of Montgomery Ward & Co., it was stated that soon after the preliminary tests had been made of the De Forest plant in the tower of the Montgomery Ward Building (see Western Electrician of September 19, 1903), the station was abandoned in an incomplete condition.

Street Lighting by Nernst Lamps in Berwyn, Ill.

One of the problems which has hardly received the attention which it deserves is the street lighting of small towns. It is not necessary to travel very far among the villages and smaller cities of the country before having this fact impressed upon the mind. The incandescent lamp, unsatisfactory as it is for street-lighting purposes, will be found in many small towns of from 1,000 to 3,000 inhabitants. Where arc systems are installed they are often of obsolete type and maintained in such a manner as to give dubious satisfaction. With the development of the Nernst lamp an alternative is presented to those towns which find it impracticable to install a thoroughly up-to-date arc system and at the same time are not inclined to use the insufficient incandescent system.

FIG. 1. STREET LIGHTING BY NERNST LAMPS IN BERWYN, ILL.—POWER PLANT.

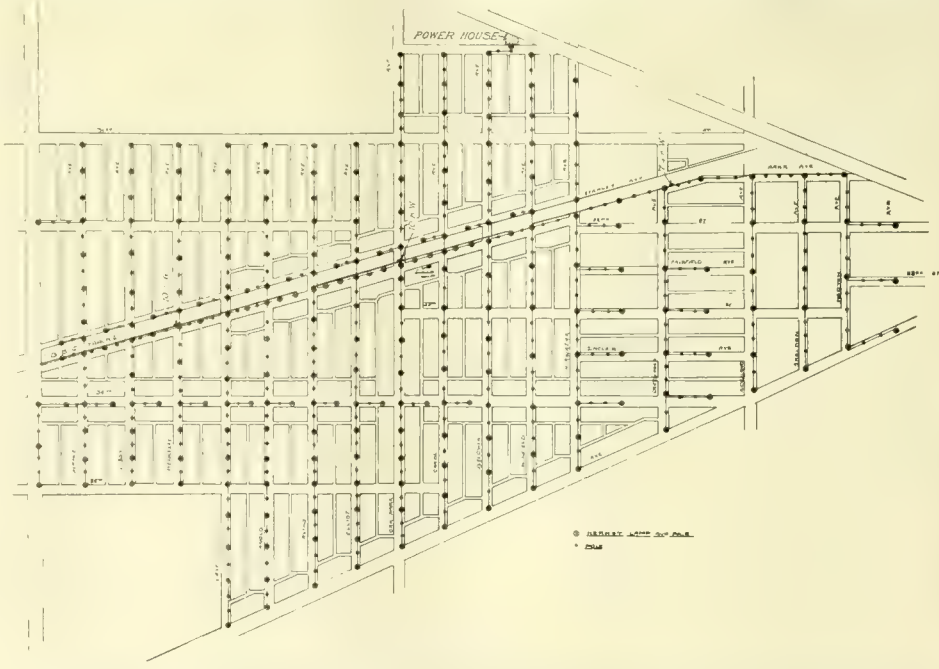


FIG. 2. PLAT OF BERWYN, SHOWING DISTRIBUTION OF NERNST LAMPS FOR STREET LIGHTING.

Berwyn, Ill., a suburb of Chicago, with a population of about 3,000, relies upon a Nernst-lamp system of street lighting which gives satisfaction to its citizens and is economical in operation, so far as results are now available. A description of the installation will be of interest.

Power is developed at a new alternating-current plant built in connection with the city waterworks, at the extreme north edge of town, an interior view of which is shown in Fig. 1. The distribution is shown

in the map, Fig. 2. The generator pressure is 2,300 volts and is transmitted at this pressure to three transformers on a bus-line running a little to one side of the center of the city, along the Chicago, Burlington and Quincy railroad tracks, as shown by the map. The bus-line is divided into three sections, each fed by a transformer, the pressure being reduced to 230 volts for distribution to the lamps. As indicated in Fig. 2, these transformers were originally of 10, 10 and 7½-kilowatt capacity, respectively, but recently the middle transformer has been replaced by one of 12 kilowatts.

From the bus-lines the current is carried along each north and south street to its extremity, in this way securing a minimum drop and at the same time a system of great flexibility. It is said that there is not over three volts drop in pressure to the last lamp.

The lamps are indicated on the map by a dot and circle, and in all there are 250 now in place. They are of the single-glower type, operating at 230 volts and at that pressure give about 60 candlepower each. They are mounted on alternate poles of the line and are carried by specially designed arms, as shown in Figs. 3 and 4. These arms are of conduit tubing and contain the feed wires. The one shown in Fig. 3 is used in the middle of blocks and is not as long as the one pictured in Fig. 4, which is mounted on

Fig. 3. Lamp Suspension in Middle of Block.

Fig. 4. Lamp Suspenstion at Street Intersection

STREET LIGHTING BY NERNST LAMPS IN BERWYN, ILL.

the street corners and hangs so as to cast the light along both the intersecting streets.

Each lamp is protected by a bell-shaped hood, inside of which is a Benjamin socket into which the lamp may be screwed with ease. The globes used are both clear and opal, it being desired to test the two for street lighting. The opal globes give a more diffused light, though it is not as strong as with the clear glass.

In the few weeks that the plant has been running very little trouble has been experienced from burnouts. A 15-year-old boy supplied with one of the Nernst-lamp repair kits easily keeps the lamps in good order.

The power equipment presents no unusual features. The generator (see Fig. 1) is a 60-kilowatt Fort Wayne, eight-pole alternator running at 900 revolutions a minute. Its normal voltage at full load is 2,200 volts, but it is run at 2,300 volts to suit the purpose of the system. The generator is driven by a belt from a 13 by 13-inch, 100-horsepower engine built by the New York Safety Steam Power Company, and is excited by a small two-kilowatt, direct-current generator, shown in the picture. Small though the equipment is, it is asserted that the power necessary is not greatly in excess of one-third of the capacity of the plant.

Two Nernst lamps are mounted in the engine room on the ceiling, a small 25-light transformer, seen on the back wall, reducing the pressure for the Nernst lamps and a few incandescents used about the station and pumping plant.

The switchboard is of neat appearance, as seen in the picture, and contains all the necessary switching and measuring devices.

Being a municipal plant, the City Hall is lighted from the system. No light is sold to private consumers. On the whole this system is an interesting one, the more so from the fact that Berwyn relies entirely on the Nernst lamps for its street illumination. Charles W. Carman, consulting engineer of Chicago, had charge of the design and installation of the plant.

Ohio Interurban Railway Association.

Considerable progress was made in the plans for issuing an interchangeable coupon book at the meeting of the Ohio Interurban Railway Association, held at the Hollenden Hotel, Cleveland, on April 28th. The original plan of the transportation committee was discussed, and another system, more complicated, but perhaps more perfect in detail also, was presented. This plan is to follow the steam roads in the form of agreement between the purchasers of the books and the roads and also the agreement between roads. A coupon bureau as an auxiliary branch in charge of the secretary of the association is suggested, with an auditing committee to look after the settlements between roads on the amount of mileage each sells over the others. The coupon books, as suggested, are to be for the value of $12, must be signed by the buyer and are not transferable. The coupons are to be of the value of five cents each, and not less than two coupons are to be detached for any one ride. The books shall be sold at $10 each and be good for one year. Several members took part in the discussion, and some objections were advanced against both plans. Members were not asked to commit their roads until a thorough understanding of the matter was had. In order to bring it before the directors of each company it was decided to send a copy of both plans to each company, with return postal, asking for an expression as to which is deemed desirable. These answers will be taken up at the next meeting and further discussed.

It is necessary in some way to make arrangements by which travelers may have through transportation in making long trips. Electric roads are now largely used by traveling men and others in making towns over the state, and there is a demand for transportation of this kind. If it can be had at a discount, without the necessity of making a deposit, as is required by the steam roads, there is no question that a great increase in travel will result. For this reason most of the managers are anxious that the plan, whatever it may be, shall be adopted as soon as possible.

Warren S. Bicknell, chairman of the legislative committee, made an interesting report of the work that had been done in the short time after appointment. The committee succeeded in defeating a number of petty bills that would have caused much annoyance and needless expense, such as placing radiators in vestibules, building stations at all stopping places, placing lights at stopping places, and other things of this kind. Among the important bills the committee aided in passing was one which will provide for taxation upon the same basis as steam roads. This will result in the valuation of power houses on a general mileage basis instead of realty. Another enables electric lines to consolidate upon the same terms as steam roads. The right of eminent domain in cities, that dangerous curves and grades may be relieved, is also an important law, as well as that giving police powers to conductors and motormen.

W. H. Abbott of the Roberts & Abbott Company read an instructive paper on turbines in connection with the operation of power plants. He described the DeLaval, Parsons and Curtis turbines and showed the advantages of each. The greatest question to be settled with the turbine is the reduction of speed to a manageable degree, he said, and this has been partially accomplished in various ways. Mr. Abbott said that the turbine is more economical than the steam engine and occupies less space. To secure the same features in a reciprocating engine, a larger machine must be used, as a very large cylinder is required for the use of high superheat. Mr. Abbott is well acquainted with turbines, having installed one in the power house of the Cleveland and Southwestern at Elyria. Another turbine is in operation at the plant of the Sherwin-Williams Company in Cleveland, and still another in a rubber plant at Akron. The address was accompanied by blackboard drawings, illustrating the various points.

F. J. J. Sloat of the Cincinnati, Dayton and Toledo gave a highly interesting discussion of the charges that should be made by a road for the cars of another passing over its line. Mr. Sloat said that some basis should be made for this charge, and he thought it could be arrived at by a consideration of the horsepower of the car, the mileage of track over which it passes and the rate of fare required. So far, wherever charges have been made, it has been done at random. However, it has been largely complimentary service so far. But roads are becoming so numerous and requests are so frequent that it is but just that some reasonable charge should be made at all times. To arrive at a basis upon which the figures may be estimated is a task that must be solved. This paper was discussed freely, but it will require some study thoroughly to understand the plan suggested by Mr. Sloat.

On invitation of the Cleveland and Southwestern company the members of the association took a trolley ride to Elyria in the evening to visit the new power house of that road. From there they went to Avon Beach, where the new power station of the Lake Shore is located, returning to Cleveland late in the evening. On Friday they visited the plants of the Sherwin-Williams Company, the National Carbon Company and other points of interest.

The next meeting will be held at the Chittenden Hotel, Columbus, on the fourth Thursday in May. Following is a list of the names of new applicants for membership:

Thomas F. Clobesey, Cincinnati, representing Stanley Electric Manufacturing Company; J. A. Rutherford, New Philadelphia, O., Tuscarawas Traction Company; J. O. Wilson, Cleveland, Cleveland and Southwestern Traction Company; A. J. Reynolds, Cleveland, National Ticket Company; Daniel Royse, Chicago, Street Railway Review; George S. Davis, Cleveland, Street Railway Journal; E. R. Larter, Tippecanoe City, O.; F. W. Stewart, Chicago, Climax Stock Guard Company; A. R. Dittrick, Cleveland, Dittrick and Jordan Electric Company; William H. Stafford, Indianapolis, Ind., Central Union Telephone Company; W. R. McKown, Greenfield, Ind., Indianapolis and Eastern Railway Company; Milton C. Stern, Dayton, Egry Autographic Register Company; James F. Mahoney, Cleveland, H. W. Johns-Manville Company; E. F. Schnieder, Cleveland, Cleveland and Southwestern Traction Company; A. E. Akins, Cleveland, Cleveland and Southwestern Traction Company; Frank Hoffman, Cleveland, James V. Howell & Co.; L. M. Wolf, Cleveland, Ohio Central Traction Company; Valentine Winters, Dayton, Dayton and Troy Traction Company; Ambrose Petry, Dayton, Ambrose Petry Company; Clinton E. Palmer, Middleton, O., Cincinnati, Dayton and Toledo Traction Company; William Akins, Galion, Ohio Central Traction Company; J. A. Bendure, Lima, O., Lima Electric Railway and Light Company; Frederick V. Green, Cleveland, Westinghouse Traction Brake Company; John McGeorge, Cleveland, McGeorge & Sons; Francis B. Morgan, Cleveland, Eastern Construction Company; George H. Pomeroy, Cleveland, Cleveland and Sharon Traction Company; O. M. Carter, Cleveland, Western Electrician; L. C. Thompson, Cleveland, Taylor Manufacturing Company; F. W. Coen, Cleveland, Lake Shore Electric Railway Company; S. T. Dodd, Pittsfield, Mass., Stanley Electric Manufacturing Company; Edward M. Williams, Cleveland, Sherwin-Williams Company; George B. Dusinberre, Cleveland, Westinghouse Electric and Manufacturing Company; Warren Bicknell, Cleveland, Lake Shore Electric Railway Company; F. W. Bliss, Cleveland, Buckeye Electric Company; W. E. Ludlow, Cleveland, Ludlow Supply Company; R. H. Mickey, Cleveland, National Carbon Company; W. S. Hammond, Jr., Chicago, Consolidated Car Heating Company; Robert K. Fast, Canton, O., Trolley Supply Company.

Plans for New York Central Power House.

The New York Central Railroad Company has filed plans with the Bronx Bureau of Buildings for a large electric power house, which is to supply current to the electric locomotives and electric motor cars of the new electrical equipment to be used on its tracks within a distance of 34 miles of the Grand Central Station. This is the first actual construction work toward the changing of the motive power of the trains that run through the tunnel from the Grand Central Station. The power house will be located on the south side of One-hundred-and-forty-ninth Street, 95 feet from Long Island Sound. It will be a three-story brick structure, being 236.6 by 156.4 feet in size. Thirty electric locomotives have been ordered of the General Electric Company, as previously announced. They will have a capacity of 2,500 horsepower each and are probably the largest ever developed for steam or electric work.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

National Electric Light Association (annual meeting), Hotel Traymore, Atlantic City, N. J., May 11th to 14th.

American Society of Mechanical Engineers and the (British) Institution of Mechanical Engineers (joint meeting), Auditorium Hotel, Chicago, May 31st to June 3d.

Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.

Canadian Electrical Association (annual meeting), Hamilton, Ont., June 15th and 16th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

By the amalgamation of the Southwestern Gas, Electric and Street Railway Association and the Southwestern Electrical Association, a new organization, known as the Southwestern Electrical and Gas Association, has been formed. This step is a sensible one and should result in a strong society. The territory tributary to the association is very large, embracing Kansas, Missouri, Arkansas, Oklahoma, Indian Territory, Louisiana, Texas and Mexico. However, Kansas has an organization of its own, and the principal strength of the association will probably be in Texas, Louisiana, Arkansas, Oklahoma and Indian Territory, although Mexico has had several representatives at conventions of the older of the parent associations, and will continue, it is hoped, to send delegates, making the society international in scope. In view of the marked development of the electrical industries in Mexico and the Southwest there is a great field of usefulness ahead of the consolidated organization, which should have a large and growing membership and accomplish a good work. The convention at Dallas last week was a successful one, and we trust that the future career of the new association will be commensurate with its opportunities.

JAPAN continues to occupy the foremost place among foreign buyers of American electrical machinery, despite the war, or possibly in consequence of it. It was only in February of this year that Japan reached the first place among the nations importing electrical machinery from the United States, and in March it again headed the list, and with a larger amount, the figures being $119,856 out of a total of $510,707 in February, 1904, and $201,617 out of a total of $596,073 in March, 1904. In other words, 23 per cent. of all our exports of electrical machinery went to Japan in the first month of the war and 33 per cent. in the second. These figures are very interesting; they seem to show that the war has increased the demand for electrical machinery, which may very easily be the case; but it may be, too, that ordinary industrial operations happened to culminate in heavily increased imports just at the time of the beginning of the war. Whatever the reason, Japan is just at present our best individual customer for electrical machinery. But if all British possessions are taken together, we send more electrical machinery to the various portions of the British Empire than to the mikado's realm. In March, for instance, our exports of such products to British possessions amounted in value to $293,743. It is interesting to note that Japan and the British Empire together took $495,360 worth of the $596,073 of exports of electrical machinery from the United States in the month of March. Perhaps statistics such as these may explain in some measure the friendly feeling that exists between the United Kingdom, Japan and the United States.

THE annual report of the General Electric Company, which, somewhat condensed, is given in this issue of the Western Electrician, contains many facts of interest to the electrical public. Passing over the financial statement, which shows a larger output but less profit than last year, some of the references to industrial and technical development are worthy of special attention. One of these is the statement that the electrical equipment of the Manhattan elevated railroad has been completed. This road frequently carries more than a million passengers a day, but "not a single passenger in the elevated trains has met with a fatal accident that in any way, directly or indirectly, could be attributed to the electrical apparatus." Following the experience of Chicago, this was to be expected, but the fact is worthy of emphasis in view of the absurd outcry of the New York daily papers against the "deadly third rail."

Long-distance power transmission plants are steadily increasing in number. Five plants are now under construction by the General Electric Company, in which the voltage of transmission is 60,000. The generators employed have now reached the maximum capacity of 10,000 horsepower, and transformers as large as 2,500 kilowatts are built. Particular reference is made to the interesting transmission plant at Guanajuato, Mexico. The power is transmitted at 60,000 volts over a line 101 miles long, carried on iron towers 48 feet high and 440 feet apart.

During the year covered by the report the New York Central Railroad Company placed an order for 30 electric locomotives to have a capacity of about 2,500 horsepower each. These will be the most powerful locomotives ever built, either steam or electric. It is believed that the order is the forerunner of many others to be placed by steam-railroad companies.

The Curtis steam turbine has been successfully introduced, and a line of turbo-generators varying from 1½ to 7,500 horsepower has been developed. About 35,000 horsepower of steam turbines has been installed and 10 times that amount has been sold.

Brief reference is made to the development of the single-phase alternating-current motor for railroads, and many other important facts and statistical statements are given in this interesting report.

WHENEVER a mysterious fire occurs the daily press is too apt to report, without any knowledge on the subject, that the fire was due to "crossed wires" or a "short-circuit," or was "probably of electrical origin." Thus electricity is given a reputation as a fire hazard which it does not deserve. Defective electrical apparatus does occasionally cause fires, of course; but, with improved methods of construction and inspection, the proportion of such fires to the total amount of electrical installation is constantly growing less. The underwriters—the National Board of Fire Underwriters, to be precise—are greatly interested in this subject, of course, and through Mr. William H. Merrill, Jr., of Chicago, they issue a quarterly fire report primarily "to demonstrate practically by actual illustration specific dangers that lie in a lax enforcement of the National Electrical Code of Rules, and to bring about a greater unanimity of opinion regarding the problems presented by electricity considered as a fire hazard." From the language quoted it will be seen that the report is prepared without the slightest intention of being lenient to electricity in the matter of fires, but rather to state facts as they exist. It will be interesting, therefore, to see what Mr. Merrill says about the number of and loss from alleged electrical fires during the quarter ended April 11, 1904, for which the report has just been received. This is the language of the report:

Reports of 135 electrical fires, losses aggregating over $420,000, have been received during the last quarter. One fire, with a loss of over $3,000,000, has also been reported as probably of electrical origin. Reports have been received of 181 fires, losses aggregating $2,280,000, supposed to have been due to electricity, but they are not included in this report, as the causes could not be definitely proved as electrical, principally because the fires destroyed the conclusive evidences of their origins. Fifty fires, losses aggregating $535,425, reported as due to electricity during the last quarter, have upon further and more reliable investigation been found to have been due to other causes. Of these a $115,000 loss, a $30,000 loss and a $25,000 loss were caused by overheated stoves; a $200,000 loss was occasioned by an overheated furnace; a $20,000 loss was caused by a defective chimney; a $17,000 loss was of incendiary origin. Other fires attributed to electricity were found to have been caused by matches and cigar stubs (seven fires), spontaneous ignition, hot ashes, gas from unlighted burner, steam pipe in contact with wood, etc.

Thus it will be seen that impartial investigation revealed the fact that during this quarter a considerably greater loss was due to alleged electrical fires that turned out not to be electrical at all than to the real electrical fires. In other words, the real causes of alleged electrical fires involving a loss of $955,000 were found. Of this amount $420,000, or 44 per cent., is to be attributed to fires actually of electrical origin, while $535,000, or 56 per cent., was due to fires reported as due to electricity but really due to other causes. This statement excludes all "probably electrical" fires and is confined to fires whose origins have been ascertained. There is no reason to doubt that the proportion would hold good throughout if the "probable" fires could be traced. It is evident, therefore, that newspaper statements in relation to electrically caused fires may be discounted at least 50 per cent.

A further interesting subject for comparison is the proportion of loss due to real electrical fires to the total fire loss. The total fire loss of the United States for the first quarter of 1904 is estimated by a competent authority at $75,000,000. It was abnormally large, owing to the Baltimore and Rochester fires. The total actual electrical fire loss shown in Mr. Merrill's report is $420,000, but of course this is not complete. In ordinary years the fire loss of the country is about $140,000,000, and of this it is safe to say that less than three per cent. is to be attributed to fires of electrical origin.

Opening of the Louisiana Purchase Exposition.

In the presence of the greatest throng ever assembled in St. Louis the Louisiana Purchase Exposition was formally opened by President Roosevelt early in the afternoon of Saturday, April 30th. President David R. Francis stood upon a platform at the base of the Louisiana Purchase Monument, his finger resting upon a gold key which completed a signaling circuit to Washington. A thousand miles away the president of the United States stood with his finger upon a similar key which was to close the circuit setting into motion the machinery of the exposition. When the latter key was pressed President Francis was seen to raise his hands and in a loud voice cried:

"Open ye gates. Swing wide ye portals. Enter herein ye sons of men and behold the achievements of your race. Learn the lessons taught and gather from it inspiration for still greater achievements."

Soon the great fountains burst forth, flags were unfurled and amid the strains of the "Star Spangled Banner" the exposition assumed activity. On the opening day it was estimated that between 150,000 and 200,000 people were present.

In Washington elaborate preparation was made for the event. The handsome mahogany table which supported the telegraph instruments was located in the south end of the East Room in the White House. On it rested a small dais covered with blue and gold plush, to the top of which was attached the gold key with which the president closed the circuit. At the table arranging the preliminaries of the event were Major Montgomery and W. Smithers, the chief operator of the White House. A bell circuit connected the telegraph table with a signal bell on the roof of the White House. As the president pressed the key Major Montgomery pressed a switch he held in his hand, that action ringing a bell on the roof. Instantly a private of the United States Signal Corps, located there, dropped a flag, thus signaling the battery of artillery that the machinery of the fair had been started. The salute followed. Three complete circuits from Washington to St. Louis terminated at the table in the White House. One, it was asserted, released the mechanical power at the exposition; one was for the interchange of messages, and one was held in reserve in case of failure of either of the others.

The opening day at the exposition was fittingly ended by the first regular illumination of the grounds and buildings as a whole. When the official signal was given a flood of white light suddenly burst forth from the thousands of electric bulbs that line the tops of the main buildings, and the colonnade of states surmounting Festival Hall. The main portion of the grounds took on even more of a festival appearance than by daylight. Twilight is the signal for the closing of the main exhibit palaces, and until 11 o'clock visitors enjoy the concessions, the lagoon trips on gondolas and launches, the music from the various bands and promenades. White lights will be used in the illumination for several nights, and then the colored electric lamps will be tested.

Electrical Exhibitors.

Following is the list of electrical exhibitors at the World's Fair, St. Louis, with the exception of the collective exhibits of foreign countries:

Adams-Bagnall Electric Company.....Cleveland
Aloe, A. S.....St. Louis
American Carbon and Battery Company.....St. Louis
American Circular Loom Company.....Chelsea, Mass.
American Electric Fuse Company.....Chicago
American Electrical Heater Company.....Detroit
American Electrical Novelty and Manufacturing Company.....New York
American School of Correspondence.....Chicago
American Telephone and Telegraph Company.....Boston
American Watchman's Time Detector Company....Cleveland
Arnold, Bion J.....Chicago
Association of Edison Illuminating Companies.....Chicago
Armstrong, Martin.....St. Louis
Atlanta Utility Works.....East Point, Ga.
Automatic Electric Company.....Chicago
Automatic Fire Alarm Company.....New York
Baird Manufacturing Company.....Chicago
Bajohr, Carl.....St. Louis
Bario Vacuum Company.....New York
Barlow, M. V.....Chicago
Bashlin, W. M.....Warren, Pa.
Baumgart, Mrs. Alexandra.....New York
Benjamin Electric Manufacturing Company.....Chicago
Bristol Company.....Waterbury, Conn.
Browning Company.....Milwaukee
Bryant Electric Company.....Bridgeport, Conn.
Bullock Electric Manufacturing Company.....Cincinnati
Burdett-Rowntree Manufacturing Company.....Chicago
Burnham-Williams & Company.....Philadelphia
Camo H. B., Company.....Chicago
Carbondale Machine Company.....Carbondale
Carman Projector and Specialty Company.....Chicago
Cassidy & Son Manufacturing Company.....New York
Central Telephone and Electric Company.....St. Louis
Chicago Fuse Wire and Manufacturing Company....Chicago
Chicago Roentgen X-Ray Laboratory.....Chicago
Chicago X-Ray Company.....Chicago
Clark, James, Jr., & Company.....Louisville
Collins, A. Frederick.....New York
Colonial Sign Company.....Akron, Ohio
Commercial Electric Company.....Indianapolis
Controller Company of America.....St. Louis
Cooper Hewitt Electric Company.....New York
Crocker-Wheeler Company.....Ampere, N. J.
Dayton Autoelectric Company.....New York
Dayton Electrical Manufacturing Company....Dayton, Ohio
De Forest Wireless Telegraph Company.....New York
Delaney, Patrick B.....South Orange, N. J.
Dialt Motor Company.....Philadelphia
Dicke Tool Company.....Downers' Grove, Ill.
Dodd & Struthers.....Des Moines, Iowa
Dresser, S. R.....Bradford, Pa.
Economical Electric Lamp Company.....New York
Edison, Thomas A.....Orange, N. J.
Electra Water Purifier Company.....St. Louis
Electric Calculator Company.....Chicago
Electric Contract Company.....New York
Electric Controller and Supply Company.....Cleveland
Electric Railway Equipment Company.....Cincinnati
Electric Storage Battery Company.....Philadelphia
Eureka Tempered Copper Works.....North East, Pa.
Faller Automatic Telephone Exchange Company..New York
Federal Electric Company.....Chicago
Field, C. J.....New York
Fort Wayne Electric Works.....Fort Wayne, Ind.
Gardner Electric Drill and Machinery Company...Cleveland
General Electric Company.....Schenectady, N. Y.
Gervais Manufacturing Company.....Edgewater, N. J.
Gest, G. M.....Cincinnati
Goldsborough, W. E.....Lafayette, Ind.
Gould Coupler Company.....New York
Gould Storage Battery Company.....Depew, N. Y.
Gray National Telautograph Company.....New York
Gray Telephone Pay Station Company.....Hartford, Conn.
Grothwell, A.....San Francisco, Cal.
Hall, C. F.....Chicago
Haward, Robert E.....Kansas City, Mo.
Heinze Electric Company.....Lowell, Mass.
Hellesens, Enke & V. Ludvigsen.....Copenhagen, Denmark
Herrero, y Ruiz F.....Albacete, Spain
Hinton & Tarkington.....Hot Springs, Ark.
Holmes, Booth & Haydens Company.....New York
Holophane Glass Company.....New York
Hunt, C. W.....West New Brighton, N. Y.
Hutchison, Miller Reese.....New York
Hutchison Acoustic Company.....New York
Indiana Novelty Company.....Muncie, Ind.
International Acheson Graphite Company..Niagara Falls, N.Y.
Jackson Electric Drill and Supply Company....Denver, Colo.
Jandus Electric Company.....Cleveland
Kaestner, Charles, & Company.....Chicago
Kellogg Switchboard and Supply Company.....Chicago
Kester Electrical Manufacturing Company.....Chicago
Keystone Electrical Instrument Company.....Philadelphia
King, H. E.....Chicago
Kny-Scheerer Company.....New York
Fusel, D. A., Telephone and Electric Manufacturing Company.....St. Louis
Leclanche Battery Company.....New York
Lincoln Electric Company.....Cleveland
Lionel Manufacturing Company.....New York
Locke Insulator Manufacturing Company.....Victor, N. Y.
McGraw Publishing Company.....New York
McRoy Clay Works.....Chicago
Marshall-Sanders Company.....Boston
Matthews, W. N., & Brother.....St. Louis
Miller Anchor Company.....Norwalk, O.
Moloney Electric Company.....St. Louis
Mystic Electric Gas Lighter Company.....New York
National Carbon Company.....Cleveland
National Battery Company.....New York
National Cash Register Company.....Dayton, Ohio
National Clock Works.....St. Louis
National Electric Company.....Milwaukee
Nernst Lamp Company.....Pittsburg
Northern Electrical Manufacturing Company..Madison, Wis.
Norton Emery Wheel Company.....Worcester, Mass.
Nungesser Electric Battery Company.....Cleveland
Organ Power Company.....Hartford, Conn.
Pawling & Harnischfeger.....Milwaukee
Peerless Electric Company.....Warren, Ohio
Perkins Electric Switch Manufacturing Company.....Bridgeport, Conn.
Phelps Company.....Detroit
Phillips, Walter P.....Bridgeport, Conn.
Pittsburg Blue Print Company.....Pittsburg
Pneumatic Signal Company.....Rochester, N. Y.
Postal Telegraph-cable Company.....St. Louis
Printing Telegraph News Company.....St. Louis
Prometheus Electric Company.....New York
Purdue Research Laboratory.....Lafayette, Ind.
Queen & Company.....Philadelphia
Reynolds Electric Flasher Manufacturing Company..Chicago
Robbins and Myers Company.....Springfield, Ohio
Roth Brothers & Company.....Chicago
St. Louis Brass Manufacturing Company.....St. Louis
Safety Insulated Wire and Cable Company.....New York
Sawyer-Man Electric Company.....New York
Scheidel, W., & Company.....Chicago
Shearer, M.....Akron, Ohio
Shedd Electric and Manufacturing Company.....New York
Standard Underground Cable Company.....Pittsburg
Standard Water Purifying Company.....Cleveland
Sterling Electric Company.....New York
Sterling Electric Motor Company.....Dayton, Ohio
Stilz, William F., & Company.....Philadelphia
Stratton, S. W.....Washington, D. C.
Sumter Telephone Manufacturing Company....Sumter, S. C.
Telephone Hygienic Company.....Los Angeles, Cal.
Thordarson, C. H.....Chicago
Toerring, C. J., Company.....Philadelphia
Triumph Electric Company.....Cincinnati
Underwriters' Laboratories.....Chicago
United States Electric Signal Company..West Newton, Mass.
United States Incandescent Lamp Company.....St. Louis
van Inwagen, I.....Momence, Ill.
Van Nort, E. C., Electric Company.....St. Louis
Wagner Electric Manufacturing Company.....St. Louis
Wagner, R. V., & Company.....Chicago
Waite & Bartlett.....New York
Warren Ball-bearing Fixture Company.....New York
Warren Electric and Specialty Company.....Warren, Ohio
Warren Electric Manufacturing Company...Sandusky, Ohio
Wasson, B. F.....Clinton, Ill.
Western Electric Company.....Chicago
Wesco Supply Company.....St. Louis
Western Electrician.....Chicago
Western Union Telegraph Company.....St. Louis
Weston Electrical Instrument Company.....Newark, N. J.
Westinghouse Electric and Manufacturing Company. Pittsburg
Westinghouse Traction Brake Company.....New York
Wheel Truing Brake Shoe Company.....Detroit
Windsor & Kenfield Publishing Company.....Chicago
Wireless Railway Company.....Philadelphia
Wyckoff Pipe and Creosoting Company....Stamford, Conn.
Yetman, Charles E.....New York

In the above list New York has 37 exhibitors; Chicago, 32; St. Louis, 19; Cleveland, nine; Philadelphia, eight; Boston, four; Cincinnati, four; Pittsburg, four; Detroit, three, and Milwaukee, three. The total number in the list is 175.

A corporation to be called the Rochester (N. Y.), Scottsville and Caledonia Railroad Company is being organized with a capital of $250,000, the greater part of which is already guaranteed. The company is designing to build and operate an electric line to connect the towns enumerated in its title. President Henry C. Brewster has a large real-estate interest at Scottsville. Incidentally, the access to the Caledonia fish hatcheries will be facilitated. The engineer of the corporation is Le Grand Brown.

Electric Freight Transportation in Chicago Tunnels.

Much attention continues to be devoted to the plans of the Illinois Tunnel Company, which has a fine network of concrete tunnels under the streets of the downtown business district of Chicago, in which it is preparing to operate a narrow-gauge electric-railway system for the transportation of freight. The project was quite fully described in an illustrated article in the Western Electrician of February 13th last. Since then the work of preparation has been going on, and many railroad men, engineers and others have visited the tunnels. The most important recent development has been the retaining of Mr. Bion J. Arnold, president of the American Institute of Electrical Engineers, as the consulting electrical and mechanical engineer for the Illinois Tunnel Company. Mr. Arnold is one of the most prominent electric-railway engineers in the country, and he is particularly familiar with the transportation problem of Chicago, of which he has made an exhaustive study, embodying the results of his research in a report which has already become a classic. The tunnel freight-transportation project is a very interesting one, embodying unique questions of railway operation, signaling, interlocking, dispatching and the use of freight elevators connecting the tunnels with buildings. The working out of these features will doubtless serve as precedents, for it is to be supposed that other cities will follow Chicago's example if the tunnel scheme proves as successful as it promises to be.

American and British Mechanical Engineers to Meet in Joint Convention in Chicago.

The American Society of Mechanical Engineers and the Institution of Mechanical Engineers of Great Britain will meet in joint convention in Chicago on May 31st to June 3d, inclusive. The headquarters of the gathering will be at the Auditorium Hotel, and it is expected that about a thousand persons will be in attendance. The morning sessions will be held in the old dining room of the Auditorium Hotel and the evening lectures in Music Hall, Fine Arts Building. The anticipated attendance of members of the English society is about 250, and many of these gentlemen will be accompanied by their wives. Nearly all of the foreign visitors and many of the Americans expect to extend their trip to include the St. Louis Exposition. An elaborate programme of papers and entertainment features has been prepared. The chairmen of the Chicago committees are the following-named gentlemen: Finance, Louis Mohr of John Mohr & Sons; entertainment and excursions, George M. Brill, 1134 Marquette Building; hotels and reception, W. L. Abbott of the Chicago Edison Company; printing, F. W. Lane of the Railway Age; transportation, W. H. V. Rosing of the Illinois Central Railroad; meetings, Professor P. M. Chamberlain of Lewis Institute. The gentlemen named constitute the executive committee, of which Robert W. Hunt of 1121 The Rookery is chairman.

Electrical Transmission Convention in Chicago.

A meeting of engineers and others interested in electrical-transmission problems will be held in Chicago, probably at the rooms of the Western Society of Engineers, early in June. This convention, to which all interested in the subject are invited, is under the direction of the transmission committee of the American Institute of Electrical Engineers, which is composed of Ralph D. Mershon, 29 Broadway, New York (chairman), F. O. Blackwell of Schenectady, C. C. Chesney of Pittsfield, Mass., A. M. Hunt of San Francisco and P. M. Lincoln of Pittsburg. It is an outgrowth of the work of securing and classifying data of high-voltage transmission outlined by Mr. Mershon's committee, the first results of which were made public at the Niagara Falls convention of the Institute last year. The Chicago transmission committee consists of James Lyman, Monadnock Building (chairman), P. Junkersfeld and George A. Damon. It is expected that over a hundred transmission men will attend the convention.

Jamestown, N. Y., is rapidly becoming the center of a network of electric railways. The Jamestown Railway Company operates six lines within the city and connects it with the suburbs; the Chautauqua Traction Company has under construction a new line extending up the west side of Chautauqua Lake to Chautauqua and Mayville; the Warren and Jamestown Railway Company [illegible] from Jamestown to Warren, Pa., and another trolley line is contemplated from Lake[illegible] to Sugar Grove, Pa.

Annual Report of the General Electric Company.

Last week the General Electric Company issued its twelfth annual report, covering its business for the year ended January 31, 1904. As usual, the report consists of the president's summary and more detailed reports regarding sales, manufacturing and engineering and finances. What follows is taken from the report.

President C. A. Coffin to the Stockholders.

The profits of your company for the last year, including a profit of $138,644.06 upon securities sold and $750,796.69 royalties, dividends, sundry profits, etc. (see accompanying statement of profit and loss account), after deducting all general and miscellaneous expenses and allowances for depreciation, losses and writing off $553,773.01 from patent account, and $2,027,841.52 from factory plants and machinery, were $7,865,376.89
Less interest on debentures 76,007.15

$7,789,369.74

Less net debit to profit and loss in writing off the patents, etc., of the Stanley Electric Manufacturing Company and other acquired interests, and balance due on all turbine patents acquired by the company, and in revaluing stocks and bonds owned $1,470,098.98

$6,319,270.76

The amount of surplus at the end of last fiscal year was 4,482,701.99

$10,801,972.75

Paid in dividends during the year 3,508,284.00

Surplus January 31, 1904 .... $7,293,688.75

The profit from the sale of securities was $835,005.68 less this year than in 1903.

The disturbed financial and other unsatisfactory conditions of the last year have considerably affected your business, and the percentage of profit upon business done is smaller than for the previous year; the increased price of copper, higher priced and less effective labor, large expenses in developing steam turbines, and lower selling prices have all contributed to this result.

Sales (Vice-president Eugene Griffin).

Sales and Orders.—The total sales (amount billed to customers) during the last year were $41,699,617. A comparison with the five previous years is as follows:

Year Ending January 31.	Amount Billed	Orders Received.
1899	$15,679,430	$17,431,327
1900	22,379,463	26,323,626
1901	28,783,273	27,969,541
1902	32,338,036	34,350,840
1903	36,685,598	39,944,454
1904	41,699,617	39,060,038

The orders received during the last year include:

Generators, rotary converters and steam turbines, aggregate capacity about 900,000 horsepower.

Railway motors, more than 7,000, aggregating over 300,000-horsepower capacity.

Transformers, over 650,000-horsepower capacity.

Stationary motors, more than 15,000, aggregating over 200,000-horsepower capacity. (Stationary motors include both alternating and direct-current motors.)

Arc lamps, more than 75,000.

Meters, more than 110,000.

The equipment of the Manhattan Elevated road in New York city has been completed, and has continued to operate with complete success, frequently carrying more than 1,000,000 passengers per day. This road has now been operated electrically for about one year, and despite the early unfamiliarity of the operating men with electrical apparatus, and the enormous increase in traffic, not a single passenger in the elevated trains has met with a fatal accident that in any way, directly or indirectly, could be attributed to the electrical apparatus. This record is not only one of which the operating department may well be proud, but is also a strong testimonial to the reliability of the electrical apparatus. It is worthy of note that the popular apprehension of the "deadly third rail" is without foundation as regards danger to the public. There is not a recorded instance of a passenger being killed by the third rail.

Most of the equipment for the Interborough Rapid Transit Company, New York city, has been delivered, and many of its cars have been operated for months on the lines of the Manhattan division.

Steam-railroad Equipments.—Considerable progress has been made during the year in this important branch of our business. The New York Central Railroad has placed large orders with this company for electrical apparatus to operate its trains south of Croton (a distance of 34 miles from the Grand Central Station).

The officers and engineers of many of the great railway systems are watching closely the progress of electric traction, and express themselves as ready to adopt electricity as soon as its economical operation has been demonstrated by the installations now in progress.

The South Side and Lake Street elevated railways of Chicago and the Manhattan Elevated railway of New York city are three roads which originally operated by steam and have since adopted electric traction. The South Side Elevated and the Manhattan are equipped, respectively, with the Sprague and Sprague-General Electric multiple-unit control system, and all are equipped with General Electric Company's apparatus. A comparison of results obtained with steam and electricity is given below:

Year	Gross Receipts.	Operating Expenses	Net Earnings.	Op. Ex. to Gross Receipts
South Side Elevated, Chicago.				
Steam, 1895	$ 744,167	$ 573,704	$ 230,463	77.1
Electricity, 1899	1,170,381	516,206	654,175	44.1
Lake Street Elevated, Chicago.				
Steam, 1895	517,305	290,000	227,298	56.1
Electricity, 1899	697,513	331,553	365,960	47.5
Manhattan Elevated, New York.				
Steam, 1901	9,416,888	5,253,230	4,163,658	55.8
Electricity, 1903	12,208,337	5,460,703	6,747,544	44.7

The figures in the case of the Manhattan road are made more interesting by the fact that the number of passengers carried in 1903 was 246,587,022, as against 190,045,741 in 1901, while it will be noted that the operating expenses were only $207,564 more in 1903 than in 1901. The 1903 figures given above are for the year ending June 30, 1903. The results since that date are even more favorable to electric traction.

Multiple-unit Control.—The Sprague-General Electric control equipments on the Manhattan Elevated have continued to give satisfaction to its officials and engineers and by prolonged test have proved their strength, reliability and durability. The same is true of the Interborough equipments during the time they have been in operation.

During the last year we have secured the order for the complete equipment of the elevated road in Boston, with the Sprague-General Electric system, and orders for the same type of multiple-unit control have been given by the Yerkes system of underground roads in London to the British Thomson-Houston Company and by the Metropolitan Underground in Paris to the French Thomson-Houston Company. The Central Underground railway of London has also equipped its entire system with the Sprague-General Electric control.

[A list of roads using Sprague-General Electric control gives a total of 53 roads, with 2,595 cars.]

Railway Motors.—Since the organization of the company in 1892 we have sold 92,557 railway motors, having a total capacity of 3,426,537 horsepower. These motors are in operation in all parts of the world.

Power-transmission Plants.—One of the important enterprises completed during the year is a power-transmission plant at Guanajuato, Mexico. The power is transmitted at a continuous pressure of 60,000 volts. The transmission line is 101 miles long, and the wires are carried on iron towers 48 feet high and 440 feet apart, instead of by the usual system of poles, spaced at intervals of 100 feet or 125 feet.

Including steam and waterpower plants, we have installed and under contract today 1,230,270-horsepower capacity in multiphase generators. Of the above, 514,910-horsepower capacity is being operated by waterpower.

Current Orders.—We have received during the year about 176,834 separate orders (not including contracts), an average of 570 a day.

Organization.—There have been no important changes in the sales organization during the year. This organization is distinguished by its strong feeling of esprit de corps, and it would be difficult to find a more loyal and hard-working body of employes. Great credit is due them and the department managers who have directed their operations for the excellent result of last year's business.

Manufacturing and Engineering (Vice-president E. W. Rice, Jr.).

Manufacturing.—Expenditures aggregating $2,500,000, exclusive of the cost of patterns, special tools, etc., have been made during the year for real estate, extensions to existing buildings and the erection of new ones, and for additional machinery.

The following table shows approximately the floor space and the number of employes during the last six years:

	Floor Space	Employes.
1899	1,800,000	8,000
1900	2,000,000	11,000
1901	2,300,000	12,000
1902	2,500,000	15,000
1903	3,000,000	18,000
1904	3,700,000	17,000

Our factory buildings have been overcrowded on account of the rapid increase of business. Space and facilities are now about normal and proportioned for best economy. The increases under way are intended to give us some surplus capacity in anticipation of further increase in business.

Schenectady Works.—The balance of machine shop of 117,000 square feet, mentioned in last report, was completed and the building occupied by July 1st. The new power house is nearly completed, and 4,000 horsepower is now in service. The storehouse and transformer building of 176,000 square feet has been completed. A machine shop of 237,000 square feet for the manufacture of steam turbines was started about six months ago. The foundations are laid and the structural ironwork is erected. Many other minor extensions and additions have been made in different parts of the works.

Lynn Works.—The buildings, of 180,000 square feet, for the manufacture of railway motors, transformers, small motors and accessories, mentioned in the last report, were completed early in the year. A machine shop of 137,000 square feet was begun several months ago, and its construction is well advanced. This building will be used principally for the manufacture of steam turbines.

Harrison Works.—The buildings mentioned in the last report, aggregating 42,000 square feet, have been completed.

Engineering.—Engineering work of the last year has been largely devoted to the extension, improvement and cheapening of our established lines of apparatus.

There has been a continued increase in the number of applications of the electric motor to industrial work.

There has been a steady increase in the number of long-distance transmission plants. The electric pressure used commercially has increased from 10,000 volts in 1893 to 60,000 volts in 1903, and we now have five large plants under construction employing 60,000 volts. The average size of the transformer used in such installations has increased from 100 kilowatts to 1,000 kilowatts, and the maximum size from about 300 to 2,500 kilowatts.

The various installations mentioned in previous reports, in which electricity is transmitted long distances, have continued to be commercially successful, and many have been increased; for example, 5,000-horsepower capacity in generators, with the necessary transformers, have been ordered by the government of Mysore for the Cauvery-Kolar plant. This nearly doubles its original capacity.

The remaining 5,000-horsepower generators for Power Station No. 2, at Niagara Falls, have been completed, and there are now in operation in this station 11 machines of our manufacture, making a total of 55,000 horsepower.

We have also shipped the first of the 10,000-horsepower generators intended for the Canadian development of Niagara Falls power, and the second and third machines of this same size are nearly completed. These generators are the largest in capacity that have yet been constructed.

We have continued to improve the design and

Consolidated Balance Sheet of January 31, 1904.

ASSETS.			LIABILITIES.		
			3½% Gold Coupon Debentures	$2,129,400 00	
			5% " "	2,000 00	
			Accrued Interest on Debentures	683 33	
			Accounts Payable	1,810,664 54	
			Unclaimed Dividends	1,825 12	
Cash		$3,289,445 18			$3,944,572 99
Stocks and Bonds	$14,665,366 27		Deferred Liability on Account of Purchase of Curtis Turbine Patents, Payable in Installments up to February 1, 1906		834,000 00
Real Estate (other than factory plants)	424,082 74		The Patent Investment for which this Liability was incurred has all Been charged to Profit and Loss (see pages 5 and 16)		
Notes and Accounts Receivable	15,207,480 74				
Work in Progress	2,046,468 43				
	32,343,398 18				
Merchandise Inventories					
At Factories $10,488,464 83					
At General and Local Offices 1,247,754 37					
Consignments 69,899 18					
	11,806,118 38	44,149,516 56	Capital Stock (see page 24)		43,866,700 00
Factory Plants	6,500,000 00				
Patents, Franchises and Goodwill	2,000,000 00	8,500,000 00	Surplus		7,293,688 75
		$55,938,961 74			$55,938,961 74

Note. The Company had, at January 31, a contingent liability for customers' notes discounted amounting to $525,632.00 of which there are outstanding at April 30, 1904, $29,033.00.

E. & O. E. HENRY W. DARLING, *Treasurer*. EDWARD CLARK, *General Auditor*.

Consolidated Profit and Loss Account of January 31, 1904.

EXPENSES.		EARNINGS.		
Cost of Sales (including $2,027,841.52 depreciation of Factory Plants)	$34,918,426 81	Sales		$41,699,617 71
		Royalties, Dividends and Interest on Stocks and Bonds and Sundry Profits	750,796 69	
		Interest and Discount	194,745 24	945,541 93
Interest on Debentures	76,007 15			
Profit for the current year	7,789,369 74	Profit on Sales of Stocks and Bonds		138,644 06
	$42,783,803 70			$42,783,803 70
Net amount in writing off the patents, etc., of the Stanley Electric Manufacturing Company and other acquired interests, and all turbine patents acquired by the company, and in revaluing all the stocks and bonds owned	1,470,098 98	**Surplus brought over from last year**		4,482,701 99
Dividends paid in Cash	3,508,284 00	**Profit for the year ending January 31, 1904**		7,789,369 74
Surplus at January 31, 1904, carried forward to next year	7,293,688 75			
	$12,272,071 73			$12,272,071 73

E. & O. E. HENRY W. DARLING, *Treasurer*. EDWARD CLARK, *General Auditor*.

ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

methods of manufacture of our switchboards for the control and regulation of electrical energy, and have received most of the important orders for such work placed during the last year.

We have designed and delivered to the Baltimore and Ohio railroad two large electric locomotives, of the multiple-unit type, to be used in hauling trains through the tunnel under the city of Baltimore. These locomotives are an addition to those originally purchased in 1894, which are still in successful service.

The New York Central and Hudson River Railroad Company has placed with us an order for 30 electric locomotives, which will be used in hauling all trains on that portion of the main line within a radius of 34 miles of the Grand Central Station. Each of these locomotives will have a capacity of about 2,500 horsepower; they are the largest ever developed for steam or electrical work, and are of an original and unique design, produced by our engineers. We believe this order is the forerunner of many others to be placed by steam railroads.

Our engineers have been engaged for several years in developing and perfecting a line of single-phase alternating-current motors suitable for use on railroads and tramways. While this motor and its control are both new, they are based upon patents already owned by this company.

The last year has been marked by the successful introduction of the Curtis steam turbine. We made an arrangement with the inventor of this turbine a number of years ago, and, as a result of his work and of our engineers a type of prime mover has been developed especially adapted for driving electrical generators. The combination of turbine and dynamo is known as a "turbo-generator," is unusually simple, efficient and of low cost. A large line of turbo-generators, varying in size from 1½ horsepower to 7,500 horsepower, has been developed. We have sold about 350,000 horsepower, of which 35,000 horsepower has been installed and is in successful operation. It is believed that the low cost, simplicity, small space and many other advantages of the Curtis turbine will result in a greatly increased sale of electrical apparatus.

Our engineers have devoted much attention to the improvement and development of the various small articles of manufacture, such as meters, instruments, switches, controllers, arc lamps, incandescent lamps, motors etc.

A larger number of letters patent covering new and important designs and devices has been applied for during the last year than in any previous year.

It is a pleasure to testify to the successful, effective and original character of the work of our engineers, and to the energetic and economical work of our factory managers.

FINANCIAL REPORT.

The financial report of Treasurer H. W. Darling is summarized in the balance sheet and statement of profit and loss presented on page 374. During the year there was expended in acquiring sundry patents and in patent litigation $553,773.01. This is in addition to the cost of acquiring patents of the Stanley Electric Manufacturing Company and other interests, and all turbine patents, all of which are separately charged to profit and loss. The above $553,773.01 is also charged to profit and loss, making the company's patents, franchises and good-will stand at $2,000,000, the same as at January 31, 1903.

During the year the stocks and bonds account has increased about $2,000,000, principally due to the acquisition of the capital stock of the Stanley Electric Manufacturing Company and its allied interests.

Securities having a par value of $1,733,920.06 were sold for $1,295,456.55 during the year. They had been carried on the books at $1,156,812.49, so that these sales netted a profit of $138,644.06.

The net amount of sales billed to customers during the year was $41,699,617.71. Of some 15,500 regular customers on the accounts-receivable ledgers, an increase for the year of 1,000, there were debit balances against 6,350 at the close of the fiscal year. During the year the cash collections from notes and accounts receivable exceeded $39,000,000.

The company has no note payable. The total debentures outstanding on January 31st last were $2,131,400. The total capital stock outstanding at that date was $43,866,700; total capital stock authorized on January 31, 1904, $45,000,000.

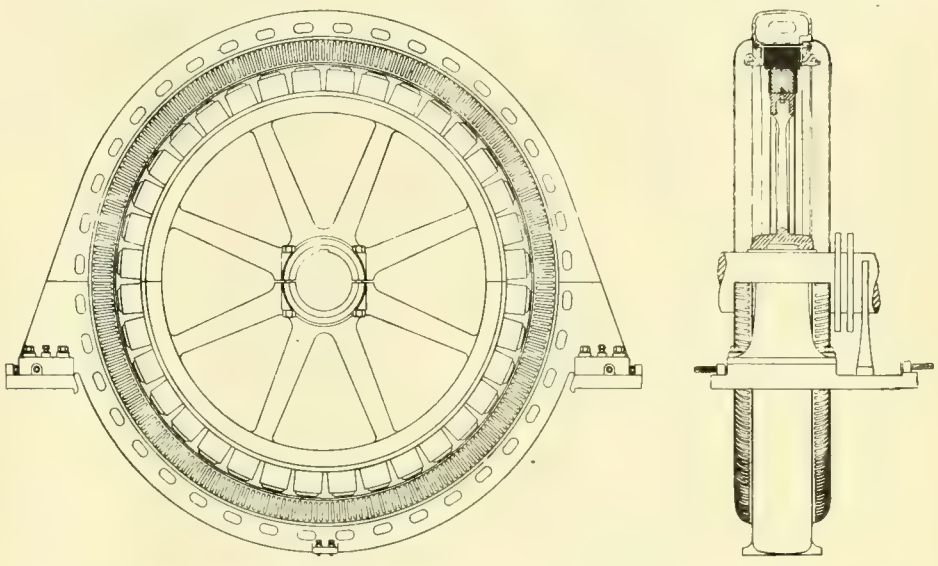
Western Electric Engineers at Dinner.

About 50 engineers and members of the engineering departments of the Western Electric Company of Chicago took dinner together at the Albion Cafe on the evening of April 28th. After dinner the evening was spent socially, and there were a number of informal speeches. Mr. William B. Hale acted as toastmaster, and as it happened to be the last day of Mr. S. G. McMeen with the company, he called on that gentleman to make the first response. Mr. McMeen has served 20 years with Bell telephone operating and manufacturing companies, but has now opened an office as a consulting engineer, with Mr. K. B. Miller, as readers of the Western Electrician are aware. He made a bright speech, expressing his regret at the severance of pleasant relations, and introduced his successor as engineer in charge of telephone-exchange equipments in the person of Mr. T. Dimon. Mr. Dimon, who is from the engineering department of the New York office, made a few remarks. Speeches were also made by Messrs. H. H. Wait, W. H. Warren and several others. The occasion was greatly enjoyed, and Mr. Hale's suggestion that three or four similar social gatherings be held during the next winter season was adopted with enthusiasm.

A 1,500-kilowatt 25-cycle Exposition Alternator.

Following is a description of a three-phase alternating-current generator to be used at the central power station at the St. Louis Exposition. This alternator will be direct connected to a 2,250-horsepower Hamilton-Corliss vertical cross-compound engine. The rated output is 1,500 kilowatts at 25 cycles and 6,600 volts, running at 83 revolutions per minute, and the power generated will be used for various purposes. The machine is furnished by the National Electric Company of Milwaukee.

Like all standard alternators built by this company, the exposition generator is of the revolving-field type, leaving the armature stationary and easily accessible, and the difficulty of properly insulating the armature coils is eliminated, as the windings are not subject to any mechanical strains. The revolving field is of large diameter, giving additional flywheel effect to the engine, and the construction of the field coils makes them practically indestructible. All parts



1,500-KILOWATT ALTERNATOR AT ST. LOUIS EXPOSITION.

are accessible and the method of ventilation insures low temperatures.

The revolving field is made up of cast steel in halves; these are bolted and secured together by shrunk links. The rim of the wheel is in channel cross section, to which the cast-steel pole pieces are bolted. The field coils comprise 65 turns of 1½ by ½-inch copper strap, wound on edge and thoroughly insulated, the outer edge of the coil being exposed to the atmosphere for cooling. Laminated pole shoes are secured to the ends of the pole pieces and serve to hold the field coils in position. These shoes cover a large polar arc, distributing the magnetic flux evenly.

The field coils are insulated from the pole pieces by fuller board, and from the pole shoes and spider ring by heavy fiber. The revolving field is 16 feet in diameter and weighs approximately 50,000 pounds.

The frame is a circular cast-iron housing, into which laminated punchings with inwardly projecting teeth are assembled for the reception of the armature windings. The frame is extremely heavy and stiff, not requiring any external support, and is divided horizontally, the halves being firmly bolted and keyed together. Belts and keys are contained entirely within the cross section, obviating the use of side lugs. Large open spaces are provided in the sides of the frames, allowing a free passage of air from the ventilating ducts in the core.

The armature core is built up of laminated soft steel, punchings being annealed and japanned before assembling; ventilating space-blocks are inserted at suitable intervals, providing openings extending around the circumference and allowing a free passage for the heat generated in the windings. There are six slots per hole, 2½ inches deep by 1½ inches wide, each being wound with 14 conductors of 0.37 by 0.28-inch compressed copper strand. The internal diameter of the armature is 16 feet ¾ inch and the width of the core 16 inches. The diameter of the revolving field is 32 feet; the height over all, 20 feet six inches; length of base, 25 feet; width of base, eight feet four inches, and the width of the frame, two feet four inches.

Cast-iron collector rings and carbon brushes are used, enabling the machine to be operated with a minimum amount of attention and at the same time provides a collector gear, which will carry a heavy temporary overload.

The net weight of this alternator is 135,000 pounds, and following are the guaranties the National Electric Company offer on the machine:

Efficiency—One and one-quarter load, 95.5; full load, 95.5; one-half load, 94.75. The regulation is 5.5 per cent. on power factor 1, and 22 per cent. on power factor zero. The temperature will not exceed 30° on armature and magnets on a continuous run at full load and 40° on the armature and magnets on a continuous run at 25 per cent. overload.

Joplin's Up-to-date Electrical Plant.

The Southwest Missouri Light Company of Joplin, Mo., is planning still further improvements to its already large plant, located at Grand Falls, six miles from Joplin. The main building, of brick and stone, is 245 feet long by 60 feet wide. Three Babcock & Wilcox boilers are installed, each of 500-horsepower capacity, and all connected with one header so that they can be cut out should any trouble arise. Plenty of room is allowed for more boilers whenever they become necessary. The two engines now in place are of 1,000 and 750 horsepower, respectively. Three Brush arc dynamos, each supply a 150-light circuit, while two Stanley alternators carry 12,000 and 9,000 16-candlepower incandescent lamps, respectively.

Besides the steam power a hydraulic plant of 1,200 horsepower at 21 feet head carries part of the load, rope drive being used from the turbines to the generator shaft.

Webb City and Carterville are also supplied with light from this plant. A. M. Barron has recently assumed charge of all the company's interest in Jasper County, acting as manager.

Vandepoele Patents Infringed.

Two decisions, in contested patent-infringement cases, brought by the Thomson-Houston Electric Company against the Ohio Brass Company et al. were rendered by Judge Hale in the United States Circuit Court in Boston on April 28th. The court found that patent No. 394,039, issued to Charles J. Vandepoele in 1888, for an insulated turnbuckle used on electric railways under the suspended-conductor system for tightening the span wire and for furnishing insulation between the trolley wire and the ground, is valid, and that the defendants have infringed thereon. The court found also that claims 4, 5 and 6 of patent No. 393,278, issued to Charles J. Vandepoele in 1888, for a switch for overhead conductors, and claims 1, 2 and 3 of patent No. 396,313, also issued to Vandepoele for an adjustable crossing and switch for overhead conductors, are valid and are infringed by the defendants. A decree for an injunction and an accounting is ordered in each case.

T. J. Johnston for the plaintiff and Mr. Wetmore and MacLeod, Calver & Randall for the defendants were the attorneys.

Elevated railways of Chicago show moderate gains in traffic for April. The South Side elevated carried a daily average of 91,500 passengers during April this year as against 87,553 for the corresponding period last year. The Metropolitan for the same month averaged 121,924 passengers daily against 117,597 for April last year, and the Northwestern shows 74,217 [illegible] April [illegible] April 1903

Independent versus Bell Telephones for Postoffices.

Telephone men will be interested in the following from the Washington correspondent of the Western Electrician on the important subject of the kind of telephone service—whether Bell or Independent, either or both—to be used in postoffices:

Washington, D. C., April 26.—"To be or not to be" seems to be the present status of the case with reference to the question of telephones for the use of the various postoffices throughout the United States, with the present indication of "not to be" gaining the day.

The old ruling with reference to the matter was that none but long-distance service could be employed. This was because the postmaster-general was of the opinion that the various postoffices should be in a position to communicate with the department directly, and, whether intentionally or not, threw the business into the hands of the Bell telephone people.

In discussing the matter today with those interested the opinion was expressed that this ruling was entirely unnecessary for the reason that, with the exception of such offices as Chicago, New York, San Francisco and a few others that might be named, there was no necessity for communication with the department on any matters which could not equally as well be covered by ordinary mail correspondence.

The postoffice appropriation bill, as it passed from the House to the Senate, provided that "no part of this appropriation shall be expended for telephone service in any postoffice where the postmaster is required, by order of the postmaster-general or otherwise, to use no other telephone service than that of the Bell Telephone Company or any of the telephone companies connected with or controlled in whole or in part by said Bell Telephone Company."

This was changed during the passage of the bill through the Senate, so that when the bill came back to the House again it provided "that no part of this appropriation shall be expended for the telephone service required in any postoffice except in cases where the opportunity to furnish such service is afforded to all companies supplying the same in the city where said postoffice is located, and then only to the company proposing to furnish the best service at the lowest rate of compensation."

Speaking of the matter today one of the officials of the Postoffice Department stated that it would take more than an ordinary lawyer to tell just what this clause really did intend; still it was conceded that each postmaster would be allowed to put in whatever system he preferred, provided that in all cases he would be expected to put in that system which would give the best service at the lowest expenditure of money.

This, however, has all been changed by the action of the conference committee which had the bill under consideration last night, and, as the bill stands today, the provision for telephonic service as contemplated by the bill is eliminated entirely, the House agreeing to strike out the provision of the bill as it was originally passed to the Senate, and then further agreeing to strike out in its entirety the amendment proposed by the Senate committee and the Senate committee agreeing to this elimination. This is the present, and, it is to be presumed, the final status of the case so far as the present Congress is concerned. Any further action in the matter will be fully reported. The present action will be a disappointment to those in the Postoffice Department in favor of the Senate amendment providing for the general use of the best service for the lowest cost. A. F. T.

Bell Output for March.

The American Telephone and Telegraph Company raised its output materially during the month of March, and its exhibit shows a marked improvement over the showing for February and the corresponding period for previous years. Following are the figures for the month and the first quarter of the fiscal year with comparisons:

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

The Olathe (Kan.) Citizen's Telephone Company has been sold to Oscar Ayers of Gardner, Kan., for $20,000. This includes the exchange in Olathe, Stanley, Gardner, Bonita and all rural lines in the county. Toll connection will soon be made with the Home Telephone Company of Kansas City.

Ohio Telephone Notes.

A resolution tending toward the repeal of the ordinance granting the Cuyahoga Telephone Company a franchise to operate in the city has been passed by the Cleveland City Council on the grounds that the company did not ask the privilege of the council in changing its rates after the new switchboard was installed. President F. S. Dickson of the Cuyahoga company has addressed an open letter to the mayor, in which he says that holding the company down to the old terms will necessarily limit the capacity of the plant to a point within which some profit can be derived. He holds that people would prefer to pay a fair price for an extended first-class service to a small price for a limited service. President Dickson also asks why it becomes the City Council to allow his competitor to exercise a free rein when a home company owned by the business men of the city is to be restricted to a point where the plant cannot be operated.

On May 1st the telephone operators employed by the Cuyahoga company received an advance in wages of about 8 per cent. President Dickson says this is due them for the good service that has enabled the company to increase business. The co-operative plan remains as it was before.

A temporary injunction has been granted against the Merchants Police and District Telegraph Company of Covington, Ky., to prevent the erection of poles and stringing of wires. The plant of the company was recently purchased by Sol Kineon and others for the purpose of securing an entrance into Cincinnati for their Independent wires from the South, as well as operating local telephones.

The Cleveland Telephone Company has applied for a franchise in Rockport, where there is a demand for service. It is probable that the telephones will be operated from the Ridge exchange if the patronage is not sufficient to install an exchange in the town.

The Pittsburg and Ohio electric railway has been equipped with telephone lines between Conneaut and Jefferson, a distance of 26 miles.

The Central Union will install a new switchboard at Massillon on June 1st.

Exchange connections between the Ohio Valley Telephone Company and the Mutual Telephone Company have been established at Ironton.

The Home Telephone Company of Hamilton has been connected up with the long-distance lines and now communications can be had all over the country except with its nearest neighbor, Cincinnati.

The Baltimore and Ohio Railroad Company has completed a private exchange in Cleveland. It has 50 local lines and 10 trunk lines and is the largest branch office in the city. C.

Telephone News from the Northwest.

The Union Telephone Company of Osage, Minn., is arranging to put in a switchboard to connect with various lines of that vicinity.

The council of Winona, Minn., has an ordinance regulating telephones which meets the approval of the Northwestern Telephone Exchange Company. It imposes police regulations upon the company, but does not include rate regulations.

The Rural Telephone Company of Osseo, Minn., has been incorporated with $50,000 capital stock.

The LeRoy (Minn.) Telephone Company will sell $10,000 of stock this season and will extend its lines and put in many new instruments.

Bids will be received until May 10th for building a telephone line from Brooten, Minn., to Sunberg for the Sunberg and Brooten Telephone Company.

H. A. Miles and others are the incorporators of the Highland Telephone Company at Elmwood, Wis.

The Wisconsin Telephone Company has taken possession of the Wausaukee Telephone Company's line.

The Cedar Falls (Iowa) Mutual Telephone Company has been organized. N. H. Harris was elected president and F. O. Jackson secretary.

J. Dobbs and William Holm have bought the Interurban Telephone Company's system at Beatrice, Neb.

The Plymouth (Iowa) Telephone Company has been incorporated with a capital of $10,000. J. F. Holden was elected president and C. A. Molsberry secretary.

The Iowa Telephone Company has moved into its new Des Moines building at Seventh and Pleasant Streets.

M. H. Spere of Lincoln, Neb., has purchased the Sioux City and Black Hills telephone system. It was bought for the Northwestern Telephone Company. The line is about 200 miles in length. R.

Indiana Telephone Items.

The Leisure Telephone Company of Leisure has been incorporated with a capital stock of $3,500. It will operate a telephone system in Leisure and throughout Madison, Tipton and Grant Counties. A. L. Hiatt and others are interested. Another new company is the Baton Rouge Telephone Company, capitalized at $2,000. It will build in Hamilton County, with chief offices in Noblesville. C. D. Zimmer heads the incorporators.

The Princeton Telephone Company has increased its capital stock from $25,000 to $40,000. The plant will be greatly improved by the installation of modern equipment and the extension of its lines.

The Central Union Telephone Company has been granted permission to lay its conduits in all the streets in Elkhart except Franklin. The company will expend $75,000 in Elkhart improving its plant and will also improve and extend its plant in Goshen and its lines between Goshen and Elkhart.

The Liberty Center Telephone Company is gathering material for the construction of a telephone system in Liberty Center and throughout the county.

The Rushville Co-operative Telephone Company, which advanced its rates a few weeks ago, was forced to readjust them on account of the wholesale "ordering out" by the patrons.

The Domestic News Exchange, with the co-operation of the Central Union Telephone Company, enabled newspaper men and patrons in a number of towns and cities of Indiana to hear the speeches and proceedings of the Republican state convention in Tomlinson Hall last week.

A suit has been brought against the Cumberland Telephone Company at Evansville to recover $10,000 damages on account of the death of Mabel Meckel while working at the company's switchboard during a severe electric storm. The question raised by the action is regarded of vital interest by both telephone men and telephone operators. F.

Michigan Telephone Matters.

The People's Telephone Company of Wayne is making arrangements to extend its line from Carleton to Stony Creek, four miles southwest. Part of the material has already arrived, and construction will follow.

The Detroit Common Council has not yet decided who owns the poles and conduits of the People's Telephone Company. This property had been declared forfeited on account of non-fulfillment of the franchise, but the company asserts that it has fully liquidated by the $5,000 forfeit which it gave as security for the performance of its agreement. The Co-operative Telephone Company is trying to lease these, and the Union Trust Company wishes to lease them to the Edison Illuminating Company. One of the city aldermen proposes that the city establish a municipal telephone plant, and there is also an offer from an Independent company to pay the city a rental of $10,000 a year for the use of this property. The council will ask for legal advice as to the ownership, before proceeding further. The People's Telephone Company will not give up its conduits without a fight, and the attorney for the company will protest against the tax assessment, asserting that it is inconsistent that this property should be taxed by the city after having announced the confiscation of the property for non-fulfillment of the franchise.

The Union Trust Company of Detroit has closed its receivership of the Michigan Telephone Company. It turned over a cash balance of $94,855.70 to the Michigan State Telephone Company, the new owner. The new company has declared its first dividend on preferred stock of 1½ per cent. It is understood that the owners of the old Detroit Telephone Company bonds received $480 in bonds of the new company for each of their $1,000 bonds. The company will consolidate the East and the Gratiot branch offices, and the new exchange will be situated in the new East office on McDougall Avenue. The management also promises new telephone instruments. W.

Cumberland Telephone Company's Charter Attacked.

In a suit brought at the instance of the Independent Telephone Company of Columbia, Ky., through the state of Tennessee, by relation, Chancellor Allison of Tennessee on May 2d ordered that the Cumberland Telephone and Telegraph Company be placed in the hands of a receiver and ousted from the state. Later the chancellor amended his decision, saying that he would decline to appoint a receiver because the company is a Kentucky corporation and therefore, if proceeded against outside the state, suit must be brought in the federal court. The object of the suit was to have declared a forfeiture of the charter of the defendant company upon allegation that it had violated the statutes in attempting to suppress competition.

It is charged that the Cumberland company leased to one of its officers or directors the local exchanges in those towns in which it was confronted with competition, and that it immediately proceeded to break down its rivals by reducing the rates below a paying basis. This resulted in the death or absorption of the smaller concerns, and the rates were restored as soon as competition was stifled. The court held that the statutes forbid the acquisition by one telephone company of another company or exchange in such a manner as was employed by the defendant, and that the company is a quasi public carrier and therefore controlled by the law applicable to railroad and telegraph companies, and cannot, therefore, exercise rights and powers denied to railroads.

An appeal was entered in the ouster proceedings, and thus the order of expulsion is stayed.

The Bell Telephone Company of Canada is stringing a long-distance telephone line between Calgary and Edmonton. The work is expected to be finished in a week or so.

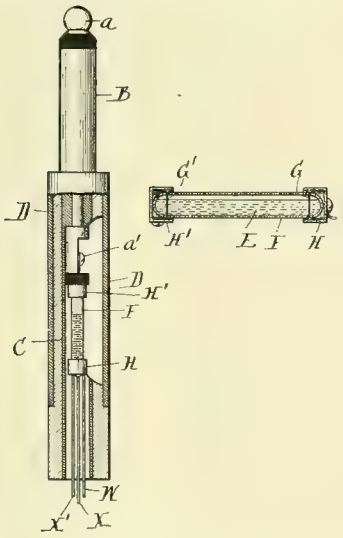
Telephone-switchboard Plug with Fluid Connection.

A novel idea for controlling the signal circuit in a telephone switchboard without the use of a third contact in the spring jack is embodied in a patent recently issued to Frank D. Pearne of Chicago.

The invention comprises a plug adapted for use with the ordinary switchboard jack and provided with means for automatically controlling the signal-wire circuit as the plug is shifted into and out of the switchboard jacks from vertical to horizontal position, and vice versa, and in the preferred form the signal-controlling means consists of a movable body, preferably a fluid of good conductivity, which shall be shifted by gravity to make or break the signal-wire circuit at the plug, accordingly as the plug is in horizontal or vertical position. If the signal circuit be a normally open circuit that must be closed for transmitting the signal when the plug is placed in the spring jack of the switchboard, then the movable body that controls the signal circuit will serve to close such circuit when the switchboard plug is in horizontal position; but, on the other hand, if the signal circuit be a normally closed circuit that is to be opened for the transmission of the signal when the plug is inserted in the spring jack, then the movable body that controls the signal circuit will serve to break the signal circuit when the plug has been placed in the switchboard and close the circuit when the plug has been restored to vertical or idle position.

Drawings of the plug and its tube with the fluid which makes the connection, are shown in the cut. A body of mercury (E) or other fluid of good conductivity is enclosed within a casing (F), preferably of glass tubing from which the air has been previously exhausted. Into or through this tubing extend metal contacts (G) and (G'). As shown, these contacts consist of wires that are inserted in the glass of the casing (F), while the glass is in plastic condition, the ends of the contact wires (G) and (G') extending to the outside. Metal caps (H) and (H') set over the ends of the casing and are electrically connected to the contacts (G). To these caps connect, respectively, the ends of the signal wires (X) and (X') that lead from the plug. As shown in Fig. 1, one side of the insulating casing (C) and the metal sleeve (B) are cut away to permit access to the interior of the plug upon removal of the cover (D).

From the foregoing description it will be seen that so long as the plug is in the normal vertical position the body of mercury (E), which does not



FIGS. 1 AND 2. TELEPHONE-SWITCHBOARD PLUG WITH FLUID CONNECTION.

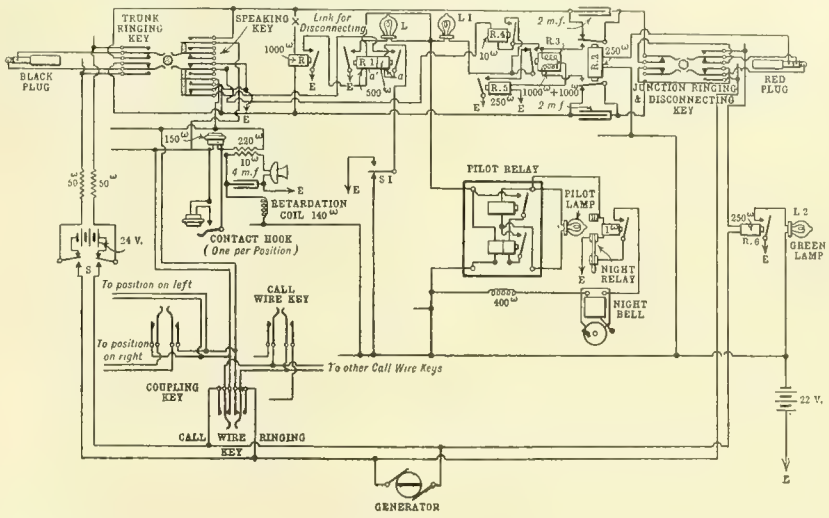
fill the tube (F), will stand below the contact (G), and hence the signal circuit will not be completed. But when the plug is brought to horizontal position and placed within the spring jack of the switchboard the body of mercury will assume a horizontal position, and in such position will electrically connect the contacts (G) and (G') and close the signal circuit between the points. When the plug is withdrawn from the switchboard and restored to idle vertical position upon the key shelf, the body of mercury will by gravity return to one end of the tube and automatically break the circuit between the contacts.

William Wolff, J. V. Thummel and William Mathews are interested in the Evansville Telephone Company of Evansville, Ill., recently incorporated with a capital of $2,500.

Operator's Cord Circuit.

Connections for the operator's cord circuit which is in use in the new London trunk exchange are shown in the accompanying illustration. The cord ends in a black plug and a red plug, with which are associated white and red lamps on the keyboard, (L) and (L_1), and two keys. When one trunk circuit is connected with another trunk circuit the connections from plug to plug are direct, with only one relay (R) in bridge between the conductors. When the circuit is used for connecting a trunk circuit to a junction, condensers are brought into circuit, and further relays are joined up for subscribers' clearing signals. The black plug is always used for connecting to a trunk circuit; the red plug is used for both trunk and junction circuits.

Relay (R) is always bridged across the circuit in order to control the clearing signal received from



OPERATOR'S CORD CIRCUIT.

any trunk circuit to which it may be connected. Associated with it are lamp (L) and relay (R_1); the latter simply responds to the movements of relay (R) and controls the local circuit of lamp (L) during the daytime, while the automatic-battery signals are in use, but at night when the switch (S_1) is reversed and "open-circuit" working is adopted on the trunk lines it converts transitory ring-off signals into permanent indications.

Relay (R_2) is actuated when the red plug is inserted into a junction-circuit switchspring, the sockets of these being ground-connected. Normally, the relay contacts short-circuit the condensers, but when the relay is energized the short-circuits are opened, and relay (R_3) with relay (R_5), "in leak," is joined across the cords. Relay (R_5) is operated by currents round the loop, or by currents between one line and ground; it therefore responds to magneto-clearing signals, while direct currents on the line conductors in parallel have no effect on (R_5), but actuate (R_5) and so light lamp (L_1). The circuit of lamp (L), which is associated with (R_3) and (R_5) is so arranged that when (R_5) is actuated the circuit is made through the retaining relay (R_4). When (R_5) is operated (the armature of (R_5) being against the back contact), (R_4) is short-circuited. The function of (R_3) is to receive the clearing signal from magneto subscribers; (R_4) is required to make that signal permanent, (R_5) is intended to receive the clearing signal from all subscribers whose circuits are arranging for automatic signaling; a retaining arrangement in connection with (R_2) is therefore unnecessary.

The pilot relay is in circuit with the clearing lamps, so that the pilot lamp glows with all clearing signals; at night-time the night relay is switched in also to give an audible signal on the bell.

Relay (R_6) controls the generator green pilot lamp (L_2), which is associated with the junction-ringing circuits, and serves also to indicate failure to ring.

Switch (S_1) joins (R_1) to the battery in one position and to short-circuit in the other. The trunk-ringing and talking key in the ringing position connects up either a 24-volt battery or a generator, according to the position of (S), to the black plug; in the talking position, the key connects the operator's talking apparatus across the cords and breaks the retaining circuits of relays (R_1) and (R_4). The disconnecting link is used for cutting of relay (R) when testing the cord circuit.

New Telephone Company for Evansville.

The Citizens' Telephone Company of Evansville, Ind., capitalized at $100,000, has been incorporated and proposes to build an exchange and operate a telephone system in the city of Evansville and in the county of Vanderburg. The company also proposes to connect with exchanges in Southern Indiana and with long-distance telephone lines. A. F. Karges and other prominent capitalists are the incorporators. The incorporation of this company is virtually a continuation of the telephone fight that has existed for two years in Evansville. However, the incorporators of the Citizens' company have put a new phase on the conditions.

The Telephone in London.

Postmaster-general Stanley of England announces that the Postoffice Department is negotiating with the National Telephone Company for the purchase of its undertaking. According to the newspapers, there seems to be a general opinion in Parliament that the telephone people are a very clever lot of business men, and for this reason, it is said, the postmaster-general has consented to the appointment of a select committee to see that the interests of the government are not jeopardized in the transaction. The telephone system of the Postoffice Department, as now operated, has cost £4,300,000 and a further investment of £3,000,000 has been authorized for extensions in London and the provinces. The London telephone service is contracted for by at least 60 per cent. of the users on the basis of a fixed charge of £5 a year and a penny for each call, with 30s. as a minimum. The average charge to users is under £8 a year for all the service they require. However, the character of the service leaves much to be desired.

GENERAL TELEPHONE NEWS.

The Williamson County Telephone Company of Taylor, Texas, will enlarge its system and make other improvements.

The Long-distance Telephone Company of Texarkana, Ark., is arranging for the construction of a line from Texarkana to Little Rock.

The Marvell (Ark.) Telephone Company has been incorporated, with L. Turner, president, and E. E. McMurray, secretary. The capital stock is $20,000.

The Eureka Telephone Company is rebuilding its telephone line between San Antonio, Texas, and Fredericksburg. Its line between San Antonio and Alice has just been rebuilt.

A new telephone line is to be constructed from Duncan, Ariz., to Guthrie. The line will connect at Guthrie with the Gila Valley Telephone Company's line, which will give Duncan direct communication with the towns of Clifton and Morenci.

The Texas Telegraph and Telephone Company, which owns and operates more than 600 miles of telephone lines in Austin and vicinity, will rebuild its line between Burnet, Texas, and Lampasas, a distance of about 25 miles. It will also make extensions of some of its other lines. At a recent meeting of the board of directors Colonel C. C. Gibbs of San Antonio, Texas, was re-elected president of the company.

Scouting with the aid of the telephone has become one of the features of modern warfare and is now being made use of by the Japanese. Two scouts proceed from the lines toward the enemy, one, the observer, is a skilled army officer who makes the observations which are transmitted back to headquarters through a telephone line paid out from a reel carried by an electrician of the signal corps. A ground return is used, the ground being made by thrusting a bayonet or hatchet into the earth and attaching one end of the line to it. The electrician carries a battery on his back. He also makes the connections and does the talking. A special conductor is used, which will stand the rough usage. In this manner a scout may be able to stay out a long time and give valuable information without being obliged to make a number of hazardous trips to the front.

The East Jersey Street Railway Company, which will absorb the East Jersey Traction Company, the Raritan Traction Company and the Perth Amboy railroad, has been incorporated at Trenton with an authorized capital of half a million dollars.

Alternating-current Dynamo Design.

Further consideration of the Institute papers of David B. Rushmore on "The Mechanical Construction of Revolving-field Alternators" and of H. M. Hobart and Franklin Punga on a "Contribution to Theory of the Regulation of Alternators" is given below. A brief news note setting forth the circumstances of the reading of these papers was given in the Western Electrician last week.

Mechanical Construction of Revolving-field Alternators.

One of the most important parts of the engine-driven alternator is the yoke. Its object is to support rigidly the armature laminations and winding while affording good ventilation and giving an artistic appearance to the machine as a whole.

For the last decade the output of single units has increased rapidly, while the speed for large sizes has remained fixed at 75 revolutions per minute. The outside diameter has thus increased constantly and with it the difficulty of proper yoke design, without excessive weight. Probably the maximum diameter has already been reached, for with the introduction of turbine-driven alternators the sizes of machines for the same output are very much reduced. After describing various methods of yoke construction Mr. Rushmore stated that there is at present no construction more satisfactory for large machines than the cast-iron yoke of box-section with laminations held by dovetails.

Coming to the matter of laminations, a designer requires primarily an accurate knowledge of the properties of his materials. While the constants for mechanical strength and electrical conductivity of the various metals are well known and the dielectric strength of insulation requires a not unusually large factor of safety, the magnetic properties of rolled-steel plate are not controlled with the certainty which is desirable.

The thickness of rolled plate for armature work is 0.014 inch, or 0.018 inch, and for field punching may be as thick as 0.062 inch, or 0.125 inch. A cubic inch weighs a little less than 0.280 pound. Insulation separating adjacent sheets may be japan, a silicate preparation or thin paper. The space occupied thereby is about 10 per cent. of the apparent section, but this varies with the thickness of plate; the section used is of peculiar form and from 20 to 60 per cent. of the original sheet is lost.

Wrought iron has been almost entirely superseded by steel for armature plates; the steel is made by the open-hearth process, either acid or basic, and limits set forth to the allowable percentages of carbon, manganese, sulphur, phosphorous, and silicon which may be present. The combined iron-loss per pound for a certain thickness of sheet at given frequency and density is limited, and also the percentage increase of this loss under continued heating at a fixed temperature for one month.

In the early days of the "pancake" coil and the smooth core, the winding was placed on the surface of the armature, but present practice is to place all coils in slots. To do this satisfactorily the shop-work must be carefully done. The die is expensive, as the number of slots is increased, and the cost may be much affected by the form of slot. The number of slots in the punchings is preferably even, to make the lapping of adjacent sections possible, otherwise the punchings must be reversed; punchings are preferably made between 24 and 36 inches in length for large machines; filing of slots is to be avoided as much as possible, hence an additional allowance is made in slot width, which becomes more important as the number of slots is increased.

The flywheel is at times a part of the generator construction. At the higher frequencies the natural velocity of the revolving field approximates that which is used for flywheels, and the two are often advantageously combined. At 25 cycles this does not give good results nor for direct-current generators.

With alternators, the problem of the flywheel is almost entirely that of the requirements for parallel running; much has been written on this subject, with but little of definite results. To give briefly the necessary relations, it may be said that in itself variation in angular velocity has but little to do with trouble in parallel running, except as it is related to other constants. The impulses from the piston give a frequency equal to the revolutions per second; the moment of inertia of the revolving part and the electrical constants of the machine give a natural period of oscillation; if these are equal, we have the condition of resonance. It is necessary for successful work that they bear an approximately fixed relation to one another.

Where cast-iron rims are used the poles are sometimes countersunk to give additional contact area. As a rule, solid rims are made of steel and may be in one piece with the arms and hub or may be separate and the spider be of iron. In the latter case, the rim may be shrunk on the arms or bolted to it. When shrunk on, one or more keys are placed on the periphery for driving. The rims are occasionally made of standard flywheel construction with one arm and the corresponding portion of rim to a section, the whole held together by links. Making the arms separate from the rim, removes the shrinkage strains, and allows the use of a cheaper metal, cast iron for the arms and hubs, while requiring more machine work.

Field coils are wound with either wire or copper strip; the number of poles and necessary exciter pressure sometimes prohibit the use of strip winding, but wherever possible, it is now used. The art of bending thin copper strip is one of recent development; coils wound in this manner have radiation constants several times greater than wire-wound coils. The outer surface of the coil is exposed to the air and thin sheets of paper separate adjacent strips; by baking the coils under pressure, the separate layers may be cemented into a solid mass. Wooden or fiber washers are placed at top and bottom of coil and insulation between the winding and the pole core; the terminals are riveted and soldered to the strip and are made of a material that does not crystallize by vibration.

The desired relation between magnetic densities in the pole core and at the pole face necessitates that the pole shoe extend beyond the core around the circumference. This also serves to hold the field coil in place. The length of the pole arc varies from 50 to 70 per cent. of the pole pitch, the relation being a compromise between opposing tendencies. In one type of alternator the tip is not extended; the coil is held in place by a wedge extending between poles; in this machine the magnetic relations are necessarily of different values.

A great disadvantage in the revolving-armature type of alternator is the difficulty of taking high-pressure current from the machine. The continuity of insulation must be broken and the exposed brushes and collector are always possible sources of danger. While, with the inductor alternator, we have no moving wire and consequently no moving contacts, with the revolving-field generator the low-pressure exciting current must be led into the field coils by means of collector rings. The rings are usually made of cast iron, and carbon brushes are employed. Several brushes per ring are used to allow for repairs or adjustment without interruption of service. The collector is preferably made open, especially if much heat is generated. Different methods of supporting and insulating the rings are shown.

A Contribution to Theory of the Regulation of Alternators.

The paper by H. M. Hobart and F. Punga of London upon the theory of the regulation of alternators was of a technical nature and contained, aside from the theoretical treatment of the subject, much data of a practical nature, from which assumptions may be made as to the best methods to pursue in securing good regulation. Quite a long discussion followed this paper, bringing out and emphasizing the salient points.

Professor C. A. Adams of Harvard University presented the first contribution to the discussion. Among other things, he said: "In nearly all electrodynamic machinery there are two electrical circuits, the primary and secondary, although in some cases the application of the word primary is somewhat a stretching of that term. We have in any case the field circuit in the alternator and the armature circuit. To go back to the simpler form of electrodynamic apparatus, the transformer, we have there distinctly three fluxes to consider, the mutual flux, which relates to both primary and secondary, the primary leakage flux and the secondary leakage flux. The two coils are closely associated, and the leakage fluxes are reduced to a minimum. In the induction motor we have another example of the same thing, distinctly primary and secondary windings, with two distinctly separate fluxes. In the alternator we have the same state of affairs again. The flux corresponds roughly to the primary of the transformer and induction motor, and the field-leakage flux and armature-leakage flux. In the case of the transformer, which is the simplest possible one, there is some little possibility of question as to what you call the leakage flux, just how to analyze the leakage fluxes and separate them from the others. In the induction motor there is still a greater difficulty, because there, with the distributed winding, we have certain portions of the flux which are linked with certain portions of one of the windings, but not all portions. It might be stated that what would be called leakage flux is any flux which is linked with more of the primary winding than the secondary winding—a larger part of the primary. In the alternator we have much the same condition, namely, that of the total flux linked with the armature. Certain portions are linked with a portion of the armature winding, the larger part, other portions of which are linked with the magnetic circuit or with the field circuit as well."

"The whole question of alterator regulation is more in the nature of a compromise than anything else—that which we must decide is where we are going to draw the line as to approximations. Take the history of alternator regulation, and you find that in the early days, as was natural, it was all attributed to reactance, the whole armature reaction, what we call longitudinal reaction, bunching together, and later called synchronous reaction. That led to very erroneous results, because the hypothetical flux which was assumed to exist in the armature, did not exist at all, and the iron was in a very high state of saturation, and the whole problem as worked out under these methods gave very unsafe results. Then the other method of attributing it to armature reaction, leaving out commutator reactance entirely, was also erroneous, because it did not take account of the fact that there was actually in the main magnetic circuit a flux which produced external electromotive force larger than the internal electromotive force, and which actually induced an electromotive force sufficient to balance the reactance of the electromotive force due to this leakage."

"I have found in a large number of machines, some of them native machines, and some of them European, the ratio of the field of excitation under short-circuit to the equivalent armature magnetomotive force varied from 1.1 up to 1.6. These were modern machines of good quality. 1.6 is hardly to be called the best quality from a certain standpoint. In the induction alternator the leakage reactances are undoubtedly larger under normal conditions, and there the corresponding ratio varied from 1.5 and 1.6 up to two and 2.5 in some cases, so that the leakage reactance is not as unimportant a factor as might be concluded. I have employed a method for which I claim no particular originality, and made an application of it to transformers and induction motors, and the analysis has given good results. I may state that the method is simply this: The whole magnetomotive force is considered as one, and the direction of that magnetomotive force, that is, the space direction, not the phase, is employed in such a manner that it does take account of the shift from the central full-phase position. The chief approximation, I think, is the position of two magnetomotive forces, field magneto force and armature magneto force, in directions in which we are assuming that the inductance and the magnetic circuit is constant, around the periphery of the armature. That, of course, in certain extreme cases, would doubtless lead to some errors. The actual results, which were published in the Harvard Engineering Journal some time ago, were very good, accompanying the actual results with the calculated results."

"Recently I had occasion to apply it to a very trying case, namely, that of a closed-coil ring armature, in which the three-phase connection gave what we call a three-belted winding, in which a single belt occupied 120°, instead of 60°, as in the ordinary three-phase machine. That makes the application of the armature magnetomotive force more complicated, but taking the differential factor, as it is called, the winding factor, distribution factor, calculating in that perfectly simple way, the results come closely."

B. A. Behrend of Cincinnati, Ohio, said: "I want to mention merely the question of regulation on 100 per cent. power factor. We designing engineers and men in charge of manufacturing concerns, receive specifications from our friends, the consulting engineers, which call for a regulation of, say, six, seven, eight, nine, 10 or 11 per cent. on a power factor of 100 per cent. Who among you gentlemen has ever made a test on a large unit on a power factor of 100 percent.? If any, please speak up. I have never had the pleasure of being able to get a thousand kilowatts of load in the shape of 100 per cent. power-factor load. It cannot be done. Your experiments are confined to small units, 100 or 200 kilowatts, in which you can make your load of german-silver strips wound non-inductive. A water load is a load of considerable electrostatic capacity. That was pointed out many years ago by a venerable German teacher, who has been forgotten since, of course, but his ideas will be dug out very soon by someone and a patent granted on the use of water resistance for the purpose of getting an electrostatic capacity. Now, if you have a very small electrostatic capacity, you have a slow leading current, and a slow leading current represents a magnetizing armature, and you say that is the best machine you ever saw—that the regulation is 3.5; I know it is seven. That is also the reason why such excellent regulation has been obtained on the inductive type of alternator, because, where it is tested on a water load, with a proper arrangement of a water rheostat, it is easy to obtain excellent regulation on a 100 per cent. power factor. The whole thing is a farce."

"The question is merely a question of general interest, as we take an interest in philosophy. No man can ever measure the power factor on a load of 100 per cent. No man can measure power factors accurately enough, considering the wave shape and that sort of thing, for lower power factors, and the question narrows down to the one question that can be put to experimental test, in the sense in which from the days of Galileo, things in actual scientific use have been tested, namely, the regulation of the power unit—the regulation can be determined at zero. By using two machines, one as synchronous motor and one as a generator, this can be done; it can also be done by splitting the field, with perhaps less accuracy, and employing the regulation curve, a test which is useful in testing machines under full-load conditions to obtain primary data. We are able to obtain fairly good regulation tests for power-factor zero. You may obtain a machine giving a regulation of 15 per cent. on purely inductive load, and having as poor regulation as 10 per cent. or as good as four per cent. on an inductive load, according as you shape the saturation curve of the machine. As long as the machine answers its purpose and carries the load for which the specification calls, or which, I should say, the specifications do not call for, but which the designing engineer knew the machine had to fulfill, the machine is all right.

"We are in a dilemma here. In human existence questions of natural science are questions that cannot be solved by the human mind. We are always proudest of the things we are weakest in, and we know we are proudest of our intellectual faculties, and those of us who have studied natural sciences

realize that there is not a single question, from the principle of the conservation of energy, to the civil laws of mechanics, that we can comprehend. Let us acknowledge our ignorance instead of trying to deceive one another that we know something which we do not know. It seems to me far more dignified and more in accordance with the spirit of the science that we are working in to say that this case is so complex, so intricate, there are so many factors to be taken into account, that it can no more be solved than you can state what the distance is to .001 of an inch between two chalk marks which you draw on the floor."

A contribution on the subject, from W. L. Walters of Milwaukee, Wis., was read. A part of Mr. Walter's letter follows:

"Some years ago, while working on the question of regulation of alternators, I made numerous experiments, measuring the self-induction of alternator armatures under various conditions. And the following figures, taken from the tests on a large number of machines, show very well the proportion that these cross-magnetization lines bear to the total self-induction lines in standard alternators.

"The table gives the self-induction per unit length of the armature; A, when the armature stands alone, the magnets not being in position, and B, when the magnets are in position and the armature winding opposite the center of the pole face.

No.	Machine.	Self Induction of Armature. Position A.	Position B.
1.	300 K. W. 60 cycle	34	60
2.	450 K. W. 60 cycle	59	93
3.	500 K. W. 50 cycle	78	120
4.	50 K. W. 40 cycle	35	78
5.	75 K. W. 50 cycle	24	50
6.	400 K. W. 60 cycle	38	94

"Position A gives practically the self-induction of the slots alone, while position B gives the self-induction of the slots plus the cross-magnetization lines. It will be seen that the total self-induction of the coils averages about double that due to the flux in the slots alone.

"At the time of making the above tests, I tried calculating the regulation of these alternators on non-inductive load by figuring the self-induction electromotive force, from the self-induction given in position B, and simply taking this electromotive force in quadrature with the main-armature electromotive force. A comparison of the calculated and actual test results are given in the following table:

Machine.	Regulation Per Cent. Actual Test.	Calculation.
No. 1	7.4	8.0
No. 2	6.1	5.2
No. 3	9.4	8 3
No. 4	8.7	8.5
No. 5	7.0	7.1
No. 6		

"The method appears to give fair results. But it is very evident that, if in addition, we tried to take into account the back ampere turns on the armature, the calculated results would differ greatly from the actual test figures."

Union Engineering Building.

The preliminary work of the conference committee on the Union Engineering Building in New York has been placed in the hands of the six architects chosen to enter the competition, although others are free to do so. The plans are to be submitted to Professor F. R. Hutton by June 15th.

The Engineering Building, on Thirty-ninth Street, will occupy about 10,500 square feet, the plot being about 125 by 100 feet. The building will contain a main auditorium on the ground floor, capable of seating about 1,500 people, and there will be six smaller meeting rooms either above or below for audiences of from 100 to 500. Above the auditorium the library probably will be located, which will be a double-floor room. Three floors above will be reserved, one each for the American Institute of Electrical Engineers, the American Institute of Mining Engineers and the American Society of Mechanical Engineers, and above these it is proposed to have three stories for the use of technical societies invited to participate in the many benefits of the building.

Probably $1,000,000 will be expended for the Union Engineering Building and the Engineers' Club, the remaining $500,000 to be used for miscellaneous expenses, such as clearing the site, excavating, fees, elevators and other machinery. As fulfilling the expressed wish of Mr. Carnegie, the architecture of both the Union Engineering Building and the Engineers' Club will be simple and dignified, that it may be in as good style in a hundred years from now. The Engineers' Club will occupy a plot 50 by 100 feet at Fortieth Street and Bryant Park. It is proposed to erect a building 11½ stories. Four floors will be devoted entirely to sleeping rooms for members. There will be 60 of these rooms. Other floors will be devoted to dining room, banquet hall, breakfast rooms, billiard rooms, reception and meeting rooms, coat rooms and cafe. A covered areaway will be constructed, connecting this building with the Union Engineering Building, and plans are considered for a bridge across at the level of the library floor of the Engineering Building.

Preparation of Materials for Standard Cells and Their Construction.[1]

By Henry S. Carhart and George A. Hulett.

In the preparation of standard cells the chemical side of the problem has hitherto received too little attention. The attempt to obtain more concordant results by giving more attention to the purity of the materials used has led us to investigate the mercurous sulphate, which serves as the depolarizer. The essential results so far obtained will be included in this paper, though the work is not yet completed. We will first describe our method of preparing the other materials.

Mercury.

The mercury was first shaken with a nitric-acid solution of $HgNO_3$, using separate funnels, and was then distilled several times in a vacuum. It is easier to prepare mercury in a high state of purity than the other materials.

Cadmium Sulphate.

The chemically pure commercial salt was dissolved at room temperature in its own weight of distilled water with the aid of a motor-driven stirrer. If it was found to be acid to congo red, it was shaken with cadmium oxide, then filtered, and the clear solution was placed in a large crystallizing dish in a room as free from dust as possible. The crystallization is a slow process, but, if carried out as indicated, it will yield perfectly transparent crystals. After about two-thirds of the liquid has evaporated, the mother liquor is poured off and only the clear crystals are taken; those that are white or colored are redissolved, the solution added to the mother liquor, and the whole is then filtered and left to crystallize.

In working up about five kilograms of $CdSO_4.3H_2O$, the final 100 cubic centimeters of mother liquor contained only the merest trace of zinc; and the zinc, which was the chief impurity to be feared, would be in this last mother liquor, since zinc sulphate is not isomorphous with cadimum sulphate.

The above result indicates that the best chemically pure cadmium sulphate to be had in the market is practically free from zinc. This method of slow crystallization yields exceptionally clear homogeneous crystals, and these crystals dried on filter paper were used in all our work.

In making a solution of the cadmium-sulphate crystals, the difficulty of a very slow rate of solution is encountered. To avoid the formation of another hydrate the solution must not be heated above about 40 degrees. The weighed crystals are brought into an Erlenmeyer flask and covered with three-fourths their weight of distilled water. A Schultz stirrer (Ber. d. d. Chem. Ges., 1896, 2883) is driven by a motor so as to cause the water to circulate just over the crystals for a half day or so, preferably in a bath at 25 degrees controlled by a thermostat. It is best to provide the Schultz stirrer with metal bearings, since glass is liable to abrade. A saturated solution can be made in this way with certainty; some of the crystals will be left and the supernatant solution will be perfectly clear, and will remain so indefinitely. We have found it entirely unnecessary and undesirable to treat the solution as above prepared with cadmium oxide and mercurous sulphate, as has often been advised.

Cadmium Amalgam.

A large crystallizing dish is nearly filled with a cadmium-sulphate solution, nearly saturated and slightly acid with H_2SO_4. In a small, low crystallizing dish is placed a weighed quantity of pure mercury, and the whole is immersed in the cadmium-sulphate solution, the mercury to serve as the cathode. Connection is made with it by means of a glass-protected platinum wire. The anode consists of pure cadmium, also placed in a small crystallizing dish to catch the dust coming from the distintegration of the cadmium. The fall of potential from anode to cathode should not exceed 0.3 volt; an ammeter is used to keep a rough account of the quantity of electricity which flows until something more than the necessary amount of cadmium has been deposited. The crystallizing dish, with the amalgam and some of the solution, is then removed and is warmed over a water bath till the amalgam melts under the cadmium-sulphate solution. When cool it forms a beautiful crystalline button, free from oxide and dust. It may be washed, dried on filter paper and weighed. The necessary amount of mercury to make a 12.5 per cent. cadmium amalgam may finally be added. It should then be again melted under the cadmium-sulphate solution and stirred to insure homogeneity. It will keep indefinitely.

Mercurous Sulphate.

Recently, both in this country and in Europe, variations in the electromotive force of standard cells have been traced to the influence of the mercurous sulphate. But little attention appears to have been given to the problem of working out a standard method of preparing this depolarizer.

Mercurous sulphate can be made by the action of H_2SO_4 on mercury, and the two evidently react at all temperature and concentrations,[2] but the reaction is very slow unless the acid is concentrated and the temperature is raised to about 300 degrees. Then the product carries with it sulphuric acid, which is difficult to remove.

Mercurous sulphate, on account of its slight solubility, can be readily prepared by precipitation from aqueous solutions. If we bring together solutions of mercurous nitrate and any sulphate, a white precipitate separates; and if the solutions are dilute and hot, and the one is added to the other slowly, the mercurous sulphate is beautifully crystalline. If this sulphate is washed with water, it turns yellow as soon as the acid has been washed out. Hydrolysis takes place, and the resulting solid, according to Gouy (Comptes Rendus, 130, 1,399), is $Hg_2OHg_2SO_4H_2O$. This hydrolized product affects very markedly the electromotive force of the cell, as we shall show later, and its presence is to be avoided.

Gouy, in the paper referred to, finds that a concentration of one gramme molecule of H_2SO_4 in 1,000 liters of water (or N/500) does not turn mercurous sulphate yellow. We have found that a much more dilute solution will not do so. A concentration H_2SO_4 in 1,900 liters does not change the color of the salt at 25 degrees; while H_2SO_4 in 2,000 liters does produce a distinct yellow primrose tint. The higher the temperature, the greater the concentration required to prevent the yellow tint. At ordinary room temperatures the salt may then be washed with H_2SO_4 in 2,000 liters. After the mother liquor has been removed by this washing the process may be completed by washing five or six times with saturated cadmium-sulphate solution, exhausting each time by a filter pump. This removes the last trace of acid, and leaves the salt moist with saturated cadmium solution and ready to be made into a paste for setting up a cadmium cell. If the mercurous sulphate is to be used in a Clark cell, the final washings will be with concentrated zinc-sulphate solution. Since a small quantity of the salt will make a number of cells, we wash in a Gooch crucible of some 25 cubic centimeters capacity with a tiny filter paper covering the perforated bottom. It is attached to a Bunsen filter flask and a filter pump. By this method the washing can be done in a few minutes Only about three cubic centimeters of the cadmium sulphate or zinc-sulphate solution are needed for each of the five or six washings.

Sunlight affects mercurous sulphate, turning it black if the exposure is long enough, and this black product gives in the cadmium cell a decidedly higher electromotive force than the white salt. So the mercurous sulphate which we have prepared by the different methods has been washed with N
— H_2SO_4 and has then been kept under the same acid
10
solution in contact with mercury and in a dark room. With these precautions it appears to keep indefinitely.

In order to study the various preparations of mercurous sulphate from the point of view of their use as a depolarizer, we have compared them with one, taken arbitrarily, as a standard. For this comparison we have used a large cell of H-form containing pure
N
mercury in both legs and filled with — H_2SO_4
10
The mercury in one leg was covered with the reference mercurous sulphate, and in the other with the particular preparation to be tested. Preliminary experiments showed that when both legs contained the same preparation, the cell had no measurable electromotive force. The experimental concentration cell and a Weston cell were kept in a bath at 25 degrees, and the temperature did not vary more than 1/50 degree. The concentration cell was connected in series with the Weston, and a difference of electromotive force introduced by the concentration cell could easily be measured to 0.000005 volt.

It was easily shown that preparations of mercurous sulphate, made by well-known firms, when tested as above, differed by as much as 1.0 millivolt, and that our own preparations, made by different methods, did not agree. For example, the sample prepared by bringing together $HgNO_3 — H_2SO_4$ gave 0.143 millivolt higher electromotive force than the standard preparation, and that made from $HgNO_3 — CdSO_4$ gave 0.206 millivolt. In fact, it was found that there was a noticeable difference between two samples of mercurous sulphate made from the same reagents, the only difference in the preparation being that in one A was dropped into B, while in the other B was dropped into A.

These results suggested that perhaps Hg_2SO_4 might carry isomorphously a small quantity of $HgNO_3$, since both of these salts crystallize in similar forms in the monoclinic system, and there is evidence that mercurous nitrate is $Hg_2(NO_3)_2$ in solution. We have been able to detect the nitrate in commercial preparations and in some of those made by ourselves from HgNO. Tests made by means of the concentration cell show that a trace of $HgNO_3$ added to the standard preparation increases in a marked degree the electromotive force.

The following method has, therefore, been advised to secure Hg_2SO_4 free from the nitrate. We wished to use only mercury and sulphuric acid; to secure at the same time a sufficiently rapid reaction without the use of strong acid, we have employed an electric current. In a flat-bottomed [illegible] dish is placed mercury a centimeter or so deep. This is covered with dilute sulphuric acid (one to six) to the depth of some 10 centimeters. A platinum wire, protected, except at its end, by a glass tube.

1 Paper read at the general meeting of the American Electrochemical Society, at Washington, D. C., April 7, 1904. It gives a preliminary account of an investigation carried out at the University of Michigan with the aid of a grant from the Elizabeth Thompson Science Fund. The authors desire to express their indebtedness to the trustees of this fund.

2. Baskerville, Jour. Amer. Chem. Soc., 19, 874.

Date		Jan 6, 1904	Jan 8, 1904	Jan 11, 1904	Jan. 19, 1904	Feb 1, 1904	Feb 15, 1904	Feb 16, 1904	Feb 17, 1904	Feb. 18, 1904	Feb. 20, 1904	Feb. 22, 1904	Feb. 24, 1904	Feb 25, 1904	Feb. 27, 1904
Temp		[illegible]	21.1°	21.1°	21.1°	21.1°	21.1°	21.1°	21.1°	21.1°	21.1°	21.2°	21.1°	21.[illegible]°	21.0°
B 1	Jan 28, '03	1.01936$_8$	1.01935	1.01937	1.01936	1.01936$_4$	...		...	...	...		...	...	1.01936$_8$
B 2	Mar 9 "	29	27	28	28	27	...			...	...	...	...	...	27$_8$
B 3	" " "	31	30	30$_8$	31	29$_8$	...	.	...		.	...	...	...	30
B 4	" " "	29	28	28	29	28	.	.	.	.	.	...	.	...	28
B 5	" " "	31	30	30	30	30	...	.	. .		.	...	...	...	29$_5$
B 6	June 22, "	36	35$_8$	34	35	35	...	.				.	...	.	34$_8$
B 7	" " "	36	36	36	36	36	1.01936	1.01936	1.01936	1.01935	1.01936	1.01936	1.01936	1.01936	1.01936
B 8	" " "	35$_6$	36	35	35	35	...	.	...	...	.		.	...	34$_8$
B 9	" " "	33	34	33	33$_5$	33	...	.	...		. .	. .	...	. .	33
B10	" " "	35	35$_6$	35	35	35$_8$	...	. .	. .	. .		.	...	.	36
D 1	Dec 21, "	08	07	06−	06	06$_5$	07$_5$	07	07	07	.	07	...	07	07
D 2	" " "	09	07+	07	06$_8$	06$_8$	08	07	08	08	...	08	...	08−	08
D 3	" " "	09	08	07	07	07	08	08	08	08	...	09	...	08$_6$	08
D 4	" " "	09	08	08	97+	07$_8$	09	08	08−	08−	...	09	...	09	08
D 5	" 24, "	63$_8$	50	44	37$_8$	35	. .	. .	. .	...	...	...	...	...	31$_5$
D 6	" " "	64	48	42	36	33+	...	. .	.	.	. .	...	...	...	29
D 7	" " "	54	43	41	38	34	. .	...		. .	.	. .	...	...	30
D 8	" " "	58$_5$	46	42	35	31	...	. .	.	.	. .	...	...	...	27
D 9	" " "	61	44	44	37	33	...	.	.	. .	. .	...	...	.	29
D10	" " "	68	53	47	39	34	...	.	.	. .	...	.	. .	...	29
F 1	Feb 15, '04	...	...	...	.	...	07	06$_8$	07	07	07	07$_8$	08	08	07$_5$
F 2	" " "	...	...	.	...	...	07	06	07	07	07−	08	08−	08	07$_5$
F 3	" " "	...	. .	.	.	.	07	07	07	07	07$_5$	08	08−	08	07$_5$
F 4	" " "	.	. .	...		. .	08	08	07+	07	08	08	08$_5$	08	07$_5$
F 5	" " "	.	...	.	...	.	08	07	07	06	08	08	08$_5$	08$_5$	08
F 6	" " "	...	...	.	.	. .	06$_8$	06	06	07	08	08	09	08$_5$	08
F 7	" " "	...	...	.	.	...	07	06	07$_5$	07	07$_8$	08	08	08	08
F 8	" " "	. .	...	. .	.	...	08	07	07$_5$	07$_8$	07	08	08	08	08
F 9	" " "	. .	.	. .	. .	.	05	07	07	07	08	08	09	09	08$_8$
F10	" " "	.	.	...	.	. .	07	06$_8$	07	07	07$_8$	08	08	08	08−
G 1	Feb 15, '04		.	. .	...	...	21$_5$	18	18$_5$	17	17	[illegible]	17—	16$_5$	15$_8$
G 2	" " "		.	...	. .	...	1.02022	1.02000	98	94$_5$	02	97	87—	80	83
G 3	" " "		. .	. .		. .	1015	[illegible]	11	12	12$_5$	11	12—	12	11$_8$
G 4	" 20 "		. .	. .		.	.				1.02025	1.02028	1.02012	1.02001	98
G 5	" " "	.	. .	. .	...	. .	...	...		...	26	14	10	08−	1.02005+
G 6	" " "		. .	...	...	...	. .	. .	.	. .	31	21	12	03	11

TABLE OF RESULTS FOR CADMIUM CELLS.

makes contact with the mercury, which serves as the anode; the cathode is a piece of sheet platinum in the H_2SO_4 solution. A current of about 0.3 ampere is passed from the mercury into the solution; crystalline mercurous sulphate at once begins to separate on the surface of the mercury. A stirrer, consisting of a glass rod, bent at right angles at the bottom, must be used to keep the mercury surface exposed. The foot of the stirrer passes close to the mercury, and must be driven rapidly by a motor.

About 2.8 grammes an hour can be prepared in this way. The sulphate should be protected from the light. By means of a separatory funnel the excess of mercury may be readily removed from below, leaving the sulphate with more or less finely divided mercury mixed with it. The preparation is often somewhat gray on account of the presence of mercury in a state of fine division. This mercury is a distinct advantage, because it insures the absence of the mercuric salt. This method, which is original with one of us, and new, so far as we know, gives what we are strongly disposed to recommend as a standard preparation of mercurous sulphate. It gives a lower electromotive force with mercury than any preparation obtained from $HgNo_3$ and H_2SO_4 or a sulphate. Samples made at different times and with different materials show an exceedingly close agreement.

It may not be inadvisable to add the precaution that the sulphate formed during the first few hours should be rejected unless one is sure of the purity of the mercury. After the electrolysis has proceeded for some time, the solubility of the mercurous sulphate to put in evidence by the appearance of mercury on the platinum cathode.

Construction of the Cadmium Cell.

The H-form of cell is the most convenient to fill: and the method, introduced by one of us, of sealing the cell with small blast flames we have made so simple that the two legs may be hermetically sealed at the top without the least danger of affecting the contents of the element.

The glass parts can be readily made by anyone possessing a little skill in glass-blowing. Fig. 1 shows the cell (half the actual size) ready to be filled. The tubing is drawn out and contracted at (a) so as to leave the diameter about six millimeters and with thin walls at this point. Fragments of the cadmium amalgam may be introduced into the clean dry cell, and may then be melted by dipping the leg of the cell into hot water; or the amalgam may be melted under cadmium-sulphate solution, and may then be introduced in the liquid form by means of a small tube, slightly contracted at the end, and of a diameter that will allow it to pass freely through the neck (a). This tube is used as a pipette; it permits the melted amalgam to be introduced rapidly and without splashing. The mercury, the thin paste, and the concentrated cadmium-sulphate solution may be introduced in the same manner. An alternative method is to introduce the materials through little funnels made out of small test tubes. The funnels must pass through the neck (a) of the cell and must reach well down toward the bottom.

The electrolytic mercurous sulphate, which has stood with mercury under dilute sulphuric acid, is brought into a Gooch crucible, avoiding free mercury, which interferes with the filtering; it is then

is no noticeable heating of the contents of the cell; but it may be advisable, before one has acquired the proper skill, to protect the cell by an asbestos disk fitted to the tube below the point (a). The disk is not necessary if the cell is made like the one shown in Fig. 1. A cell sealed in this way contains nothing except the materials of the voltaic combination: It cannot leak and can be immersed in kerosene without danger of the oil getting inside. A perfect seal has always been a most difficult thing to secure.

All the cells above tabulated were filled and sealed as described. The dates on which they were set up are contained in the second column; they are numbered in groups of 10, because they are mounted in racks holding 10 cells each for convenience in placing them in a large 60-liter kerosene-oil bath. The temperature of the bath was automatically regulated and the oil was thoroughly stirred by a motor-driven stirrer; the variation of temperature was not more than one-tenth of a degree at any time. It remained practically constant for days at a time.

The cells were compared by means of a Feussner direct-reading potentiometer, made by Otto Wolff of Berlin. The comparisons can be made rapidly and with certainty to the fifth decimal place.

It will be noticed that B1 to B10 are relatively old cells that had settled down to a constant value; they were assumed not to vary more than 0.00001 volt when kept at a fixed temperature. B7 was taken each time for setting the potentiometer at 1.01936, which is the electromotive force obtained for the cadmium cell at 21.1 degrees by assuming the Clark at 15 degrees as 1.434 international volts, and the ratio of Clark at 15 degrees to cadmium at 20 degrees as 1.40670.[1] These cells, B1 to B10, were set

pared as already described. The cells composing the F series were put into the bath and compared within six hours after they were set up. The table shows their history for the first 12 days. The very small variations which they exhibit may be more apparent than real, because they may be due in part, at least, to small variations in the reference cell B7.

It will be noticed that the cells of this F series are identical with D1 to D4, and that their apparent electromotive force is 1.01908 international volts at 21.1

Cells D5 to D10 were made with a mercurous sulphate prepared by adding a solution of mercurous nitrate to a cadmium-sulphate solution; it was the same sample which gave in our test cell an electromotive force 0.206 millivolt greater than the standard electrolytic preparation.

When these cells were first compared, immediately after setting up, they were markedly higher than B7, but their electromotive force fell rather rapidly at first, and very uniformly after they were placed in the constant-temperature bath. The table shows their history from January 6th; the upper curve in Fig. 2 was plotted from the data pertaining to D6 from January 5th for the first nine days after its temperature was maintained constant. The contrast between the behavior of this cell and that of D1, which is shown graphically in the lower curve of Fig. 2, is very marked and very characteristic. Professors Jaeger and Lindeck called attention some time ago to the rapid fall in electromotive force shown by some cadmium cells set up with mercurous sulphate obtained from one, at least, of the best manufacturers.[1] We consider it an accomplishment of considerable value and interest to be able to make cells that do not require the aging process to reach their equilibrium in electromotive force. The electrolytic method of preparation furnishes us with a mercurous sulphate absolutely free from any nitrate, and with cells that reach their equilibrium immediately. This fact, together with the lower value of the electromotive force, compared with that of cells made by the use of mercurous sulphate prepared in any other way, points to the purity of the electrolytic salt, compared especially with that made from the nitrate of mercury.

The cell marked G1 was set up with electrolytic sulphate of mercury, to which a trace of mercurous nitrate was added and mechanically mixed in the paste. G1 shows both the time element and the higher electromotive force.

Cell G2 was made with mercurous sulphate which had been exposed to sunlight for six weeks (under $N/10H_2SO_4$) and which was quite black. The cell has a very high electromotive force, showing that the salt discolored by sunlight has undergone a marked change and needs further investigation. After a cell has been set up the discoloration produced by the light is probably only superficial and may not affect the electromotive force seriously: but it is better to avoid the discoloration by excluding the light from the cell.

The mercurous salt used in G3 was made from recrystallized mercuric sulphate ($HgSO_4$), which was shaken with mercury in dilute sulphuric acid. The reduction is brought about by vigorous shaking, so as to insure the fine division of the mercury and its distribution throughout the salt. The electromotive force of this cell is very close to those made with the electrolytic sulphate; the slight time element indicates a slight impurity. This experience indicates also that the high electromotive force of other cells is not due to the presence of the mercuric salt.

Cells G4, G5 and G6 were made with mercurous sulphate which had been hydrolyzed by shaking with water and mercury, renewing the water six times, or until the conductivity of the solution was constant, showing that no further change was taking place. These cells have also a high electromotive force, and the mercurous sulphate modified in this way presents

Fig. 1. Standard Cell Ready for Filling.

Fig. 2. Curves Showing Contrast between Two Cells for the Same Period.

STANDARD CELLS AND THEIR CONSTRUCTION.

washed first with sulphuric acid (made by adding 0.5 cubic centimeter concentrated H_2SO_4, density 1.84, to a liter of water), and then with concentrated cadmium-sulphate solution, as described above. It is better to reject the top layer, which may be slightly darkened. The paste is next made in a clean agate mortar by grinding together crystals of $CdSO_4 8/3 H_2O$, and a little mercury, and then mixing in about three volumes of the mercurous sulphate and enough saturated cadmium-sulphate solution to make a thin paste. After the mercury and the paste have been introduced into the positive side of the cell, both legs are filled up to the cross-tube with the dry clean crystals of $CdSO_4 8/3H_2O$. Enough of the saturated cadmium-sulphate solution is finally added to fill the cell to the top of the cross-tube. The sealing-off is readily done by means of two small horizontal blast flames, three centimeters long, directed in a line toward each other and just meeting. The narrow part (a) of the cell is brought between the impinging flames, the glass quickly softens, and the top part is drawn off. There

up in accordance with the most approved information available at the time, and they must agree closely with the cells used for determining the Clark 15 degrees cadmium 20 degrees ratio of 1.40670.

D1 to D4 were the first cells made in which the electrolytic mercurous sulphate was used. They were put up December 22, 1903, and while they were not put into the constant-temperature bath till January 5, 1904, they showed from the first a large and constant difference from B7. Previous to January 6th their value relative to B7 had not changed perceptibly; the table shows their behavior since January 6th. These cells do not appear to have changed since they were set up by more than one part in a 100,000, and the agreement among themselves is exceptionally good. Their electromotive force is about 28 parts in 100,000 lower than B6 to B10.

The next series made with the electrolytic mercurous sulphate were set up February 15, 1904. The materials used were different from those used in the construction of D1 to D4, but they were pre

1. Zeitschrift fur Instrumentenkunde, February, 1901.

1. Zeitschrift für Instrumentenkunde, February, 1901.

another problem to be worked out. Indeed, this preliminary work has opened up a large field for chemical investigation, which we hope to report on later.

This paper deals with Weston cadmium cells only. We have also made 15 Clark cells with electrolytic mercurous sulphate; they show remarkable agreement, but they have not been under observation for so long a period as the cadmium cells.

Electric Service on the Lancashire and Yorkshire Railway in England.

One of the English steam roads which have recently changed to electrical operation is the Liverpool and Southport division of the Lancashire and Yorkshire Railway Company. The work of reconstruction has been going on for about 18 months, the scheme originating with J. A. F. Aspinwall, the general manager of the company. With steam operation the total train mileage a day was about 1,900, while with electrical operation this has been increased to 3,200. With the new system the time has been decreased to 37 minutes between Liverpool and Southport, as against 54 minutes with steam.

Three-phase alternating current is employed at 7,500 volts, reduced at sub-stations to 650 volts. The power house is situated at the center of distribution and contains four 1,500-kilowatt units and one 750-kilowatt unit. All of the high-tension switch gear is located in a fireproof room. Three of the transforming points have four rotaries installed, while the fourth contains three.

The track is provided with two contact rails, one for the outgoing and one for the return current, the former being carried outside the track rails as usual and the latter between the rails. The current, after passing through the motors, passes out by way of the car wheels to the track, and from there through bonds to the middle conducting rail.

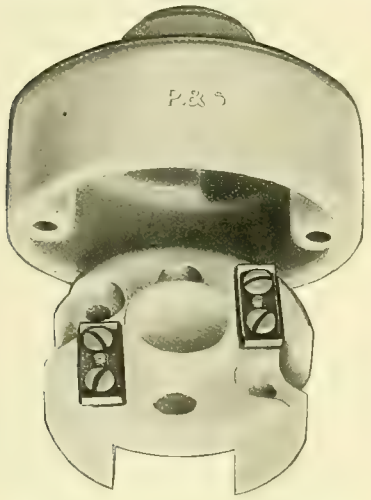
Trains are made up of two first and two third-class cars, the latter acting as motor cars and being placed on the ends of the train. Each motor car carries four 150-horsepower motors.

Chicago Engineers Inspect Switchboard.

Operating steam and electrical engineers of Chicago plants to the number of about 20 on April 30th enjoyed the hospitality of Henry Newgard & Co., electrical contractors of Chicago. The occasion was an enjoyable one and will be remembered with pleasure by those present. The firm has nearly completed a large switchboard for Pettibone, Mulliken & Co. of Chicago, which is a model of good workmanship and embodies a number of unique features. It was to inspect the new board that the guests were invited. The board is eight feet high by 20 feet long, of Tennessee marble, and is of 8,000 amperes normal capacity, though it will carry as high as 15,000 amperes for several hours without undue heating. It stands in the company's shop and was thoroughly inspected by the party. After an hour spent in the shop the party proceeded to the Sherman House, where a generous dinner was provided, and the guests were entertained until a late hour in the afternoon. Henry and Martin Newgard were the hosts of the occasion and the guests were: W. Leinard, A. Ortseifen, L. S. McMaster, William Christmann, Jr., Alfred E. Holmes, Otto Luhr, Fred Birker, F. Dresbach, J. Weiffenbaugh, T. Olson, W. P. Crockett, Will Cheney, Jr., Charles E. Brown, Mr. Harkins, A. D. Oyer, George G. Hayes, John Hamilton, E. Newman, Mr. Wilkinson, Mr. Starr and H. W. Young.

Fuseless Rosette for Concealed Work.

Illustrated herewith is a new fuseless rosette for concealed work just placed on the market by Pass & Seymour of Solvay, N. Y. This rosette embodies several new departures. The bottom of the base is recessed to permit the heads of tubes to extend one-half inch from the ceiling, completely covering them. A closed porcelain cover then slips over the whole piece, completely concealing it, thereby making a finished and complete installation.



FUSELESS ROSETTE FOR CONCEALED WORK.

New Members of the Institute.

At a directors' meeting of the American Institute of Electrical Engineers held in New York city on April 22d, 62 gentlemen were admitted as associates. Among the number were Joseph B. McCall, president of the Philadelphia Electric Company of Philadelphia; William J. Wilgus, fifth vice-president of the New York Central and Hudson River Railroad Company; Joseph Appleton of the Electric Storage Battery Company, and the following-named:

Berg, E. V., Telluride Power Company.....Provo, Utah
Bott, G. R., American Elevator Company...Columbus, Ohio
Boyd, A. A., Michigan City Electric Company.....
.....Michigan City, Ind.
Cope, A. N., Columbus Public Service Company.....
.....Columbus, Ohio
Crankshaw, J. B., Cincinnati Engineering and Investment Company.....Cincinnati, Ohio
Crane, C. E., Mutual Light and Heat Company, Seattle, Wash.
Davenport, A. L., Edison Electric Company of Los Angeles.....Long Beach, Cal.
Fletcher, R. F., McMaster & Fletcher.....Columbus, Ohio
Gresham, W. A., Georgia Electric Company.....Atlanta, Ga.
Hale, W. B., Western Electric Company.....Chicago, Ill.
Hulme, F. W., Hydro-electric Company.....St. Louis, Mo.
Kaiser, L. T., Thomas Emery's Sons.....Cincinnati, Ohio
Lohman, F. H., Calumet and Arizona Mining Company.....Douglas, Ariz.
McMasters, J. C., McMasters & Fletcher, Columbus, Ohio
McNamee, T. W., Wabash Electric Light Company.....
.....Wabash, Ind.
Mettler, H. W., Chicago Edison Company.....Chicago
Mitchell, A. J., Adams-Bagnall Electric Company, Atlanta, Ga.
Richardson, J. W. A.....New Orleans, La.
Riggs, W. M., Clemson Agricultural College.....
.....Clemson College, S. C.
Salomon, A. F., Nernst Lamp Company....St. Louis, Mo.
Snyder, H. N., Santa Paula Electric Company.....
.....Santa Paula, Cal.
Tobey, J. O., Northern California Power Company....
..... Manton, Cal.
Vickers, F. E., General Electric Company..Los Angeles, Cal.
Wilmerding, C. H.....Chicago, Ill.
Yundt, G. J., Southern Bell Telephone and Telegraph Company.....Atlanta, Ga.

Electropneumatic System in Department Store.

The air-compressor plant which is installed in one of Chicago's largest department stores is of unusual interest. Two of the compressors have cylinder dimensions of 16¼ and 12¼ by 12 inches, and the remaining one is eight by eight inches. The cylinders are not compounded, each being separate so as to allow of a supply of air at different pressures.

The larger compressors are belt connected to 50-horsepower electric motors, while the smaller one is driven by a 7½-horsepower motor. The former are both connected to the same piping system and only one is operated at a time.

Various uses are found for the compressed air. Pressure at 65 pounds is used for carpet and fur cleaning. The 500 pneumatic self-opening elevator doors are operated by air pressure at 25 pounds to the square inch.

The small compressor supplies air at 25 pounds to doctors and dentists in the office building adjoining the store and under the same management. The air for the latter purpose is first carefully cleaned and purified in a tank, from which the compressor draws its supply.

Automatic control is provided for each motor, which runs intermittently. When the pressure falls below a certain point a silver needle makes contact, energizing a relay, which in turn makes the circuit for a solenoid switch which starts the motor. When the pressure has again reached the normal point the circuit is broken and the motor stops, no attendance being required.

The Copper Market.

During the latter part of April the tone of the copper market showed a decided improvement. Electrolytic bars were quoted at 13¾ cents a pound against 12½ cents for the same period in March, resulting from the heavy March exports, which reached 22,852 tons. The total exports for the first three months of this year reached 69,010 tons, or 85 per cent. of the domestic production for that period. It is quite probable that the bulk of this was taken by consumers and not stored to reappear on the market later, since trade conditions have improved in Europe, which is capable of absorbing copper more quickly than a year ago. With the present healthy trade conditions and a large legitimate demand it appears that the copper market is resting on a firm foundation.

Chicago Street-railway Situation.

It is probable that representatives of the Chicago Union Traction Company, the Chicago City Railway Company and the local transportation committee of the City Council will soon get together for the discussion of means for a settlement of the unsatisfactory traction situation as regards franchise extension. John S. Miller for the Union Traction Company and Colonel E. R. Bliss for the Chicago City company have answered Chairman Foreman's invitation to submit their desires, and it is understood are ready to take the matter up with the committee. The matter of purchasing 100 new cars for the Union Traction Company is about to be taken up.

CORRESPONDENCE.

Great Britain.

London, April 20.—For the last two or three years the attitude of parliamentary committees, especially towards tube-railway bills on financial matters, has been severely commented upon. This attitude is that unless the promoters can produce an absolute guarantee that the necessary capital will be found, the bill will not be passed. Going back to the root of the matter it must be confessed that the advent of the American millionaire in England has had not a little to do with this condition of affairs, for it was in 1901 when Mr. Yerkes and Mr. Morgan were competing for the control of certain railway lines in London that the principle of "planking down the sovereigns" was first enunciated. Since then in all large electrical schemes almost the first question asked by the committee is, "Have you any guarantee that your capital will be subscribed?" However desirable this attitude may be from some aspects, it is having a serious effect in many directions, for no company will ever be in a position to go to the public for subscriptions. Furthermore, promoters will be very chary of bringing schemes to Parliament, however good they may be. This policy of the parliamentary committees, however, is being extended and only last week a scheme which proposed to supply electric power over a large area to the east of London was rejected practically because the promoters had not their capital already subscribed before the bill was passed.

In spite of the fact that no electric-lighting provisional order under the Electric Lighting Acts gives the owner a monopoly of supply in any particular area, the municipalities which are supplying electricity in the areas covered by some of the newer power schemes have been very successful in their opposition. It is true that last year was rather disastrous from the municipal point of view in this matter, inasmuch as several power bills were passed, which included many towns where a supply was already given, but in previous years the promoting companies have been glad to make concessions to the larger municipalities and to exclude their areas, rather than to incur the expense of a prolonged fight in Parliament. Rather than give way in this manner, however, the Lincolnshire and Yorkshire electric-power bill, which has already gone several stages this year, has come to an untimely end. Something like 30 local authorities desired to have an absolute veto to keep the power company from supplying within their towns, and the oppression was so great that the promoters decided to abandon the bill for this year. The capital of the proposed company was some $5,000,000. Altogether private enterprise in the directions indicated above is not having a too easy time in Great Britain at present.

With regard to the announcement recently made by the chairman of the Marconi Wireless Telegraph Company, that arrangements are being concluded with the postoffice for facilitating the receipt and inland forwarding of wireless telegrams, the postmaster-general states that the negotiations are still in progress. Although at present he finds it impossible to publish any details of what is taking place, it is expected that during the course of the session a statement will be made by the government on the subject of space telegraphy and the arrangements which the postoffice hopes to conclude with the Marconi company in particular.

Another matter in which the government is at present deeply interested is the question of the acquisition of the undertaking of the National Telephone Company. I recently made reference to the statement made in Parliament. A few days ago a conference was held in London by a large number of municipal authorities to consider what action should be taken by them in regard to this matter. The chairman stated as his opinion that representations should at once be made to the postmaster-general so that the local authorities should have an opportunity of being heard before the negotiations between the government and the National company assumed too definite a form. The opinion was also expressed that the municipalities should work the local lines and the government the trunk lines. The City of London Corporation is also convening a conference on the matter.

A short time ago most of the American journals made some mention of a new process which was being exploited here, for the electrical conversion of peat into coal. The first meeting of the company owning the patents has now been held, when the statement was made that all the trials had proved eminently satisfactory, and that "electropeat" coal could be produced at five shillings a ton. The idea is to form subsidiary companies for the manufacture of peat coal all over the British Isles, such companies to number 200.

The decision of Parliament that a tramway company should have compulsory running power over municipal lines has created a great stir in municipal circles, and considerable opposition is being made to the bill in question. A conference was held yesterday with regard to the matter when great indignation was expressed at the decision of the parliamentary committee in question. All the larger municipalities [illegible] the question out.

G.

New York.

New York, April 30.—The Rapid Transit Commission has reached an important conclusion in deciding that bids shall be made by sections for the new subway franchises, in order that the rivalry of the Metropolitan and Belmont interests may be accurately gauged. It was also decided that there shall be no open ditchwork in constructing the next tunnel, but that the work should be done by boring. Twelve months must elapse, however, before any contract can be arranged on account of the consideration of the necessary details as to the route and the securing of the approval of various civic authorities. It is also hoped that an amendment of the rapid-transit act, enabling the subway franchises to be assessable for taxation purposes, may be obtained during the next legislative session. It is interesting to note that the Belmont subway, now practically completed, is especially exempt from taxation by law. As to the routes, it is recommended that the new subway shall be a combination of an east and west-side route, running south on the east side from the present subway station at One-hundred-and-forty-ninth Street and Third Avenue, and eventually proceeding through Canal Street over the new Manhattan Bridge, and so out to Fort Hamilton, via Flatbush Avenue, Brooklyn. It will be seen that the commissioners have thus extended the original plans of the Metropolitan company, and also favored the Metropolitan idea as offering great advantages to the public in the matter of transfer facilities. Mr. Thomas F. Ryan, the head of the Metropolitan company, states that the routes are entirely satisfactory. The rapid-transit commissioners have practically decided that the unsightly kiosks which have been erected at the new subway stations shall not be allowed in connection with any future subways. It is even suggested that legislation shall be secured by which future subway stations must be erected on private property, similar to those on the London underground systems.

In spite of protest upon the part of adjacent property owners, the New York Central Railroad will fill in the Spuyten Duyvil Creek, in order to straighten the tracks along which it proposes to run its electric trains. Incidentally, when this is completed, it will change the topography of Manhattan Island by joining it with the mainland. The railroad company has agreed to run electric trains on a five-minute headway only on condition that there should be no drawbridges on the creek.

The traffic condition of Brooklyn Bridge still continues to call forth numberless suggestions, prompted more or less by self-interest, as to alleviating the crush. This week a plan has been published by Mr. Niels Poulson, president of the Hecla Iron Works, who suggests that a superstructure for foot passengers should be constructed. He advocates the building of five platforms for the electric cars at the Manhattan end, so that four trains could be continually loading or unloading, and he further declares that this improvement could be completed within two months.

Considerable attention has been attracted by the publication of statements by Capt. F. Norton Goddard, chairman of a sub-committee of the City Club, implicating the Western Union Telegraph Company with poolroom-keepers. Captain Goddard sent men to negotiate with the company for the supply of racing information, and they were offered a service at $25 a day for a local track, with $5 more for each additional track, the money to be paid daily to the operator, it is said. This arrangement was verified on behalf of the company by Mr. Mitchell, who is reported to have said that he would provide an operator "who has had a large experience in poolrooms and who knows the ropes and who knows enough to climb out of the window when trouble comes." Another suggestion was that the wires should be brought down a chimney in order more effectively to delude the police. The local papers have dealt at great length with these revelations, even to the extent of publishing a list of 29 directors of the company.

The Jones Electric Manufacturing Company of New York has been incorporated with a capital of $50,000, the directors being O. C. Brasse of West New Brighton and S. F. Jones and H. H. Sherman, both of New York.

Alexander McKenzie, said to be a professional beggar, has invented a device for the protection of the third rail, and it is thought will receive the prize offered by the Interborough company. On the police records McKenzie is classified with the harmless mendicants. For weeks at a time he would be seen every afternoon at the stations along the Sixth Avenue line, and then he would be arrested and sent to the island. During his various periods of confinement he perfected the models for protecting the third rail. At least that's what the newspapers say. D. W. W.

New England.

Boston, April 30.—The final payment on the new issue of stock of the Edison Electric Illuminating Company of Boston will be payable May 3d, when certificates will be issued. Under the terms of the circular sent out when the stock subscriptions were called for stockholders who paid the entire amount on February 1st are entitled to interest thereon at the rate of four per cent. About 80 per cent. of the subscribers availed themselves of the offer.

The Massachusetts Legislature, which declined to sanction a general bill authorizing cities and towns to invest in the securities of street-railway companies operating within their borders, has before it now a special bill to grant the town of Plymouth the privilege of purchasing $15,000 more stock of the Plymouth, Carver and Wareham Street Railway Company. It already has $15,000 invested therein in accordance with permission granted last year.

The Massachusetts railroad commissioners have authorized the issues of stock asked for by the Boston and Worcester and the Berkshire street-railway companies to the amount of $100,000 and $200,000 respectively; also the former road's issue of $200,000 additional bonds.

Work was begun on April 25th on the new Rockland, South Thomaston and Owl's Head railway in Maine, which is to cost $115,000.

The transformer plant which the Meriden Electric Railroad Company has been erecting at Hanover Park, near Meriden, Conn., is ready for business and will be set in operation at once. Power will be obtained from the third-rail power station at Berlin, a distance of nine miles. About $50,000 has been expended on the new station. B.

Dominion of Canada.

Winnipeg, Man., April 30.—The Ottawa Electric Company has offered to do the street lighting of the city of Ottawa by contract at the rate of $56.94 a year, the present rate being $65. A second bid was from the Consumers' Electric Supply Company, which offered to supply power for the civic system at $14.75 per horsepower, but quoted no figure for lighting by contract. The civic committee recommended that this offer be accepted, it being asserted on an expert's report that the city can do its street lighting at a cost of $40 a light. The estimated cost of a municipal plant is $40,000, exclusive of the poles, and it is proposed to buy the power and utilize the poles of the existing companies, which is permitted by the terms of the existing franchises. The total annual charges for maintenance are placed at $19,900, or, roughly, $42 a lamp, but the power having been offered at 25 cents per horsepower below the estimate, and the city not having to pay for the use of poles, as is provided for in the estimate, makes the net cost, according to the city engineer's figures, $40 a lamp. There are 475 arc lamps in the city and in the future there will be no moonlight schedule.

The Suburban Tramway and Power Company of Montreal, promoted by Paul Galibert and J. L. DeCarie of Montreal, Arren Weil and Rufus McDuffie of New York, and Charles Allard of Chambly, has a bill before the Quebec Legislature asking the right to construct and operate railways and tramways in seven counties, to acquire waterpower and operate electric works for the use and transmission of electricity, and to manufacture, use, supply and dispose of electricity for street-railway, light and other purposes. The capital stock will be $2,000,000.

Some poles and wire belonging to the Montreal Light, Heat and Power Company have been carried away in an ice break. The wire that brings the electric power from Shawinigan Falls to Montreal has been rendered useless for several days, with a loss of at least 10,000 horsepower to Montreal.

The third annual report of the Sao Paulo Tramway Company shows a very successful season. The company has received from manufacturers in Sao Paulo contracts for 600 additional horsepower, which it will begin supplying within six months; this is an increase of 25 per cent. in horsepower supplied and contracted for.

C. A. Stoess, engineer of the Stave Lake (B. C.) Power Company, has a large number of men engaged on work at the Stave River Falls, where they are harnessing 20,000 horsepower. The cutting of a canal is the first part of an extensive scheme whereby this valuable waterpower may be utilized for use in the city of Vancouver, which is 35 miles distant.

The Legislature of New Brunswick has passed the bills of the Twin Tree Mines Railway Company (electric) and the Shediac Electric Light and Power Company. H.

Indiana.

Indianapolis, May 2.—Judge Carter of the Superior Court of this county has appointed the Union Trust Company receiver for the Home Heating and Lighting Company on application of the Knight & Jillson Company.

The Common Council of the city of Elkhart has authorized a suit brought against the St. Joseph Power Company for alleged damages to streets and sewers by reason of back water from the power company's Hen Island dam. The Indiana Supreme Court has recently decided that a corporation is liable to land owners for damages occasioned by back water due to the construction of a dam. The city of Elkhart thinks the same doctrine will apply to damages to streets and sewers.

The Geneva Traction Company, which is building a line from Celina, Ohio, to Marion, Ind., is asking for franchises in a number of Indiana towns and cities through which the line passes.

C. N. Wilson, general manager of the Columbus, Greensburg and Richmond Traction Company, is experiencing much difficulty in getting into Richmond. Five routes into the city have been surveyed, but in each case the council declined to grant a franchise over any street in which a majority of the property owners object. The company has concluded to arrange for terminal facilities on the west side of the river.

The first of seven arched spans to support the roof of the train sheds of the new terminal interurban station in this city has been placed in position. Each span is 138 feet wide, 68 feet high and contains 15 tons of steel.

A mortgage covering the property of the New Albany waterworks for $750,000 has been filed. A portion of this money is to pay the cost of a modern filtration system and private electric-lighting plant for the company. F.

Michigan.

Detroit, April 30.—It is said that when cars of the Detroit United Railway Company get behind their schedule time the motorman puts out a sign, and during the time the sign is out no passengers are taken on board. When the car catches up to its schedule the sign is removed.

The Kalamazoo Valley Electric Company, which now furnishes light for the village of Allegan, will ask for a commercial franchise.

The car barns of the Grand Rapids, Grand Haven and Muskegon railway were destroyed this week by fire which burned two dummy locomotives and several passenger coaches.

W. A. Boland has formed a new company, capitalized at $1,000,000, called the Consolidated Traction Company of Jackson, to take over the property of the Jackson and Suburban Traction Company, now operated by the Jackson city lines, and also a line to Grass Lake. This new company is at present independent of the Jackson and Battle Creek Traction Company and also of the Jackson and Ann Arbor Company, but the owners of these companies are believed to be on friendly terms, and this seems to be an important step toward the construction of the Boland system to the eastern part of the state.

The Bay City Traction and Lighting Company offers to furnish the city with street lights at $60 a year for each arc light. This offer is made, it is said, to demonstrate that a private corporation can furnish light cheaper than the city can. The report of the city light station shows that it costs the city $69.40 a year for each arc light, with an average run of about eight hours a day.

The management of the Detroit United Railway Company has been working upon the new street-railway schedule, as provided by the ordinance recently passed by the council. An employe of the company has figured that there will have to be about 25 cars added to the service to live up to the requirements of the ordinance. C. G. W.

Ohio.

Cleveland, April 30.—H. R. Probasco, representing the Miami and Erie Canal Association, has made a request of the State Board of Public Works that the Miami and Erie Canal Transportation Company be ousted from the use of the canal from Cincinnati to Dayton. It is pointed out that the company has not completed its line within the specified time and that the towpath is impassable for mules in many places.

The Cleveland Electric Railway Company has arranged to use an electric welder on the Payne Avenue and Superior Street lines this summer, in an effort to bring the tracks up to a better condition.

Permission has been given by the City Council of Zanesville to the Cleveland, Painesville and Eastern and the Cleveland, Painesville and Ashtabula, to connect their lines in that place, thus giving a continuous road from Cleveland to Ashtabula.

Among the improvements planned by the Cincinnati Traction Company is the installation of a new 1,500-kilowatt generator in the Eighth Street station.

Attorney W. B. Sanders, for the Cleveland Electric Railway Company, has filed a brief with the Supreme Court in the Hopkins-Cope four-cent-fare cases. He says that the company was granted a franchise on Kinsman Street at one time with the understanding that council reserve the right to fix the fare, but that in the extension of the franchise later that body withdrew its right and agreed to a five-cent cash fare of 11 tickets for 50 cents. No decision will likely be reached for several months.

The Southeastern Ohio Railway, Light and Power Company of Zanesville has begun work on the road from that city to Sayre. E. R. Myer and M. W. Hissey are interested in the new road.

The Electric Controller and Supply Company of Cleveland will have an exhibit of its electric planers and lifting magnets at the St. Louis Fair. The National Carbon Company will also have on exhibition goods which are manufactured for all electrical purposes. The Brown Hoisting and Conveying Machinery Company will have an interesting exhibit of all the heavy conveying appliances that are turned out at the Cleveland shops.

In the suit of Albert L. Lancaster against Harry Hamburger, the Supreme Court of this state has decided that a passenger on a street car "incurs no liability to a conductor by reporting to the superintendent of the company such conductor's misconduct, while on duty, toward a passenger, though in making the report he is prompted by ill will and a desire to secure the conductor's discharge from the service of the company."

It is said that the Northern Ohio Traction and Light Company will probably lease its coal land

in Noble County, with the provision that coal for its own consumption be furnished at cost. The expenses of operating will thus be reduced quite a little.

It is reported that the bondholders of the Springfield and Xenia Traction Company have made arrangements to purchase the property, and will either operate or sell it. Arrangements have been made, it is said, to rent power. It is altogether probable that a company will be formed to operate the road.

The Chillicothe, Bainbridge and Aberdeen Railway Company, incorporated a week ago, will pass through a portion of the territory that the proposed line of the Chillicothe and Hillsboro will traverse.

The Western Union Telegraph Company has moved to its new quarters corner of Fourth and Vine Streets, Cincinnati. The business office and be on the first floor, while the operating rooms and other departments occupy the fourteenth, fifteenth and sixteenth floors. Exactly 1,600 wires enter the building from conduits, and there is room for 220 operators, in comparison with the 180 that were crowded into the old quarters. Eighteen motors are used for furnishing current to operate the plant.

The Columbus, Newark and Zanesville railway will probably have a regular schedule over a portion of its line within a short time. O. M. C.

Texas and Mexico.

Austin, Texas, April 28.—An electric-light and power plant is to be established at Caldwell, Texas. The Business Men's League of the city is interested in the project.

It is reported that the street-railway system of the Beaumont Traction Company of Beaumont has been purchased by an eastern syndicate, which is negotiating for systems of street railway in other cities of Texas.

The canal and tunnel for the Atlixco Light and Power Company has been completed by the contractors, Hill Bros. of Puebla, Mexico, and the work of constructing the pipe line for the company has been commenced. The canal is 300 meters long and the tunnel is 950 meters long.

W. W. Wheatley, the new general manager of the Federal District Street Railway Company of the City of Mexico, is making a careful personal investigation and study of the various lines comprising that system with the view of making extensive improvements. The company now has six lines, which are operated with mules. It is proposed to convert these into electric transit lines as rapidly as possible and to operate them in connection with the other electric lines of the system.

The demand for electrical machinery in Mexico is constantly increasing. During the nine months ended March 31st, Mexico purchased electral machinery from the United States to the value of $361,458.

The work of enlarging the electric-light and power plant of the Compania Hidro-Electrica of Queretaro, Mexico, is in progress. This company recently increased its capital stock to $500,000.

Application has been made to the Mexican government by S. P. Bracon of the City of Mexico for a concession to establish an electrical power plant on the Baluspe River.

Good progress is being made in the construction of the electric street-railway system in Aguascalientes, Mexico, by the company headed by Juan Douglas.

It is reported that an English syndicate headed by Thomas B. Herfell, who has been at Campeche, Mexico, will install an electric-light plant there and in other cities of Mexico.

It is stated that the American company operating the Watson mining property near Colima, Mexico, contemplates constructing an electric railroad from the mine to the port of Navidad on the Pacific Coast. The power is to be generated from a large waterfall at the mine.

Francisco Olvera has obtained a concession to establish an electric power plant on the Tula or Montezuma River, near Tasquillo, Mexico. He is also granted authority to use the waters of those streams for irrigation purposes and to construct telephone and telegraph lines in that district. H.

Northwestern States.

Minneapolis, April 30.—The Montivedeo (Minn.) Electric Light and Power Company has been incorporated.

It has been decided not to begin work on the proposed La Crosse (Wis.) and Black River Falls interurban line this year.

An effort is being made at Oshkosh, Wis., to have a conduit system installed in the business section of the city.

L. Crosby of Packard, Iowa, has purchased the electric-light plant at Clarksville, Iowa.

The Sheboygan (Wis.) and Elkhart Lake Street Railway and Power Company has filed a trust deed for $800,000 and will begin work at once on the trolley line from Sheboygan through Plymouth to Elkhart Lake.

The city of Beaver Dam, Wis., has voted $25,000 worth of bonds to aid in the building of an interurban electric railway from Green Bay to Madison by way of Oshkosh.

Bids will be received until July 5th for installing electric-light fixtures in the new Capitol Building at St. Paul, Minn. A check for $2,000 must accompany each bid.

The Eau Claire (Wis.) Light and Power Company has sold out to the Chippewa Valley Electric Railway Company.

The Electric Machinery Company of Minneapolis has secured the contract for a generator and motor for the electric-light plant at Rochester, Minn.

The new municipal electric-light plant at Seward, Neb., has been put in operation. It cost about $12,000.

Work will begin at once on the proposed interurban line between Lincoln and Omaha, Neb.

Both the Eastern Iowa Railway Company and the Davenport, Iowa City and Muscatine Electric Railway Company are engaged in securing land for the right-of-way for the lines they propose to build from Muscatine to West Liberty. R.

Southeastern States.

Charlotte, N. C., April 30.—Engineers have gone over the proposed route of an electric railroad to be built from Roanoke, Va., to Mount Airy, N. C. The line will run through Roanoke, Floyd and Carroll Counties, Va., into Surry County, N. C.

The stockholders of the Rapid Transit Company of Chattanooga, Tenn., have decided to issue $250,000 bonds for improvements and extensions and to consolidate all the lines under one system.

The Chattanooga Electric Railway Company will finish its line to Rossville by June 1st. It will then probably be completed to Chickamauga Park. A schedule of 15 minutes will be maintained on the new line.

W. D. Ryan of the General Electric Company, Boston, Mass., will make a talk before the American Cotton Manufacturers' Association, soon to meet in Washington, D. C. His subject will be "Light and Illuminating Engineering," with special reference to the lighting of mills. L.

Rocky Mountain States.

Salt Lake City, April 29.—The Tucson Electric Light and Power Company of Tucson, Ariz., has signed a contract to extend its lines to the University Building, for the purpose of lighting the university grounds and buildings.

The Nevada Power, Light and Water Company of Reno, Nev., will extend its line at East Reno and will improve the city system. A new street-light transformer is being installed.

Fair progress is being made toward the establishment of an electric-light plant for lighting the towns of Orangeville and Castledale, Utah. W. E. Raines of the Salt Lake Electric Supply Company has submitted figures to the town boards. The estimated cost is $10,000.

An ordinance has been passed which grants to Maynard Gunsul the right to furnish electricity for power, heat and illuminating purposes in Roswell, New Mexico.

Preliminary surveys are being made by the Standard Power Company, 18 miles south of Richfield, Utah, for a large flume and power plant. It will have a capacity of 500 horsepower. Robert Forrester is vice-president and manager of the company.

The Westinghouse Machine Company and the Westinghouse Electric Company of Salt Lake City have been awarded contracts for the equipment of a power plant for the copper mines at Newhouse. The contract provides for two 800-horsepower Westinghouse-Parsons steam turbines and generators.

The promoters of the proposed electric railroad connecting Boise, Pearl and Caldwell, Idaho, have submitted a report to the City Council in which they assure the members that the plan is feasible and that work will be commenced on the line some time in May. The funds for the big enterprise have been arranged for, and it is estimated that the total outlay will be about $400,000. A committee of the Chamber of Commerce has been investigating the project, but it is understood that the line is to be constructed by the Boise Traction Company.

The dam and flume of the Lolo Creek Power Company at Greer, Idaho, have been washed away by high water, with a loss to the owners of $10,000. The damage is being repaired as rapidly as possible. The city of Nezperce was dependent upon the power company for energy for electric-lighting and numerous manufacturing enterprises. The original cost of the dam and flume was $25,000.

Amended articles of incorporation of the Salt Lake (Utah) Southern electric road, increasing the capital stock of the company from $500,000 to $2,000,000, have been filed with the county clerk. Important improvements and extensions through the southern suburbs are contemplated by the company, and the construction work during the next year will cost approximately $1,500,000. A. V. Taylor, the local manager, states that the company will have 30 miles of road in operation before the end of the year. The company has acquired 5,000 acres of land near Cottonwood Canyon, about five miles from the city, where a large summer resort will be established. This land will also be used as a site for the company's power plant, which will have a capacity of 3,500 horsepower.

The new electric railroad at Trinidad, Colo., has been completed, and the initial run in the new cars was made a few days ago. The cars for the day were turned over to citizens who had subscribed for the building of the road. G.

Pacific Slope.

San Francisco, April 28.—A. J. Meyers, who has been with the California Electrical Works for some time, has given up his position there to accept a place with the Wagner-Bullock Company. Mr. Squires of Chicago will take the position just vacated.

W. L. Bechtel, who is interested in the Nevada Power, Light and Water Company of Reno, Nev., was in San Francisco last week on business.

H. W. Porter of the export department of the Westinghouse Electric and Manufacturing Company has sailed for Panama to be absent about a month.

The Electric Boat Company, with offices in San Francisco, has just received a contract from the Russian government for six submarine boats of the Holland type.

The National Electric Company has secured the contract for the electric lighting of the new Hill theater to be erected at Petaluma.

The Northern San Joaquin Electric Company has absorbed the plant and business of the Lodi Electric Light Works at Lodi, Cal. It is the intention of the purchaser to run branch lines to Woodbridge, Acampo, Galt and Lockeford.

President H. H. Noble of the Northern California Power Company, is at present inspecting the various plants operated by his company.

An ordinance has been passed by the City Council of Oakland, Cal., granting to the San Francisco, Oakland and San Jose railway a franchise to construct and maintain an electric railway in that city.

The Vallejo, Napa and Benecia Electric Railway Company has closed a contract with the Westinghouse Electric and Manufacturing Company for the electrical equipment for a single-phase alternating-current electric railway. The grading is progressing between Vallejo and Napa and the road is expected to be finished in about six months.

The Department of Columbia has decided to install electric lights at the post at Vancouver, Wash. The Vancouver Electric Light Company will probably receive the contract, and arrangements are being made to purchase additional engines and other equipment.

The county commissioners have granted a franchise to William Snyder of Snohomish to build and operate a trolley line from Snohomish to the King County line, Washington. The cost of the proposed trolley construction will be between $800,000 and $1,000,000.

The Ione and Eastern Railway Company, which was incorporated at San Francisco recently, is preparing to open headquarters in the Rialto Building.

The Siskiyou Electric Power Company has completed the survey from Fort Jones to Greenview and let the pole contract between these two points and from the main line at Greenhorn Gulch to Humbug. A.

PERSONAL.

A floating newspaper paragraph is to this effect: "Marconi, the inventor of the wireless telegraph, is said to have a fine tenor voice and has been chosen by Perosi to sing the principal part in the latter's 'The Last Judgment' when it is produced in Rome."

At a meeting of the directors of the Marconi Wireless Telegraph Company of America, John D. Oppe was elected second vice-president and general manager, vice William H. Bentley, resigned. Mr. Bentley remains a member of the board and will continue his interest in the affairs of the company. Mr. Oppe is also general manager of the Canadian Marconi Company.

T. C. Penington, secretary of the American Street Railway Association, was married on April 25th at Chatham, Ontario, to Miss Ida E. Tomkins. After June 1st Mr. and Mrs. Penington will be at home at 4012 Drexel Boulevard, Chicago. Mr. Penington is treasurer of the Chicago City Railway Company and one of the best-known and best-liked of American street-railway men.

P. E. Fansler, chief clerk in the Department of Electricity of the Louisiana Purchase Exposition, delivered the sixth lecture in the course of the Carnegie Technical School at Pittsburg recently. He spoke on electricity as a factor in expositions, and about 800 people were present. Mr. Fansler spoke in the stead of Professor W. E. Goldsborough, chief of the Department of Electricity at the exposition, who was scheduled to speak, but who was unable to be present. Mr. Fansler talked instructively about the great development which has taken place in the electric displays at expositions since the Centennial Exposition at Philadelphia in 1876.

Herman A. Strauss was appointed general manager of the Sheboygan Light, Power and Railway Company of Sheboygan, Wis., early this year. This company operates about 30 miles of city and interurban trackage and all the lighting systems of the city of Sheboygan. This appointment comes after about one year's service as engineer of the Construction Company of America in the design and construction of 10 miles of interurban railway and a large modern fireproof power station for the Sheboygan Light, Power and Railway Company. Mr. Strauss was attached to the engineering staff of the Westinghouse Electric and Manufacturing Company for several years; he has acted for two years as the assistant electrical engineer for the Manhattan Elevated Railway Company of New York

city throughout the period of electrification of this system and he has done considerable independent consulting engineering work.

E. B. Ellicott, the city electrician of Chicago and the constructing engineer of the St. Louis Exposition, has attracted the attention of the daily newspapers of Chicago by refusing to accept any salary from the city during the time of his leave-of-absence to serve at the exposition. Mr. Ellicott is officially in charge of the Electrical Department of Chicago while in St. Louis, and his salary was tendered him as usual, but he is said to have refused to accept it, with the declaration that he was not entitled to it. The amount involved is about $2,500, it is said.

ELECTRIC LIGHTING.

A stock company of local capitalists has been formed at Broxton, Ga., and will proceed at once to construct an electric-light plant in that city.

A bond issue of $123,000 will be made by the city of Greenwood, Miss., for the purchase of the electric-light plant, waterworks and sewerage systems.

The Greensboro Light and Power Company has received a franchise from the City Council of Greensboro, Ga., and will install a $15,000 electric-light and ice plant.

The Chickasha Electric and Gas Company, Enid, Okla., organized by J. M. Dodson, H. H. Watkins and J. B. Thieme, has been incorporated with a capital of $45,000.

Manager Mowbray of the Economy Steam Heating Company will make application to the City Council of Sedalia, Mo., for a franchise to construct an electric-light plant.

The name of the Carthage Electric Light and Power Company of Carthage, Ill., has been changed to the Carthage Electric Light and Heating Company. The capital stock has also been increased from $20,000 to $50,000.

At a special election in Moberly, Mo., recently it was voted to grant a franchise to the Moberly Light, Power and Fuel Company permitting it to construct and operate an electric and gas plant in the city for the purpose of furnishing light, power and heat.

That portion of the buildings of the Janesville (Wis.) Art Study and Manufacturing Company occupied by the Janesville Electric Company was saved from the recent destructive fire suffered by the former company. The loss to the electric company was slight.

The bill for the ratification of the act passed by the territory of Hawaii granting a charter to the Hawaiian Electric Company for the purpose of maintaining and operating an electric-light and power system on the island and in the territory, has passed Congress and has been approved.

Sealed proposals will be received by the president and board of trustees of the town of New Harmony, Ind., until May 16th, for all machinery, apparatus, materials and supplies of every kind for an electric-light plant for that town. Plans and specifications may be seen at the office of the town clerk in New Harmony or at the office of the engineer, G. C. Morgan, Royal Insurance Building, Chicago.

ELECTRIC RAILWAYS

W. H. St. John of Yazoo City, Miss., is preparing an estimate of cost for four miles of street railway, plant and equipment in that city.

The government of Bolivia has submitted to Congress a proposal having for its object the building of a railway from La Paz to Yungas, in that country. The introduction of electric traction is suggested.

The Rochester (N. Y.) Railway Company has come curiously into possession of the valuable franchise for an extension down University Avenue for 50 years for the sum of $13 and the deposit of a bond for $2,000. Under the White charter, all new franchises must be put up to public auction, and in this case there was only one bidder.

The Hutchinson, Newton, Sedgwick Interurban Electric Railway Company has decided to build parallel to the Atchison, Topeka and Santa Fe tracks east from Hutchinson to Newton, via Burrton and Halstead. A branch will leave the main line at Halstead to Wichita, via Sedgwick and Valley Center. J. J. Burns is the promoter and builder.

It is likely that within the next four weeks the Public Service Corporation of New Jersey will institute a trolley service between Jersey City and Philadelphia, via Newark, Elizabeth, Westfield, Plainfield, New Brunswick and Trenton, and thence to Philadelphia by boat. The corporation does not control all the lines, but has succeeded in making suitable arrangements. The trip from Jersey City to Trenton will take about four hour and 20 minutes.

The Kansas-Oklahoma Interurban Railway Company has filed an application for a charter. It will run an electric railway between Arkansas City and Winfield, Kan., and also run the street-car lines in both towns with electricity. The company will have a capital of $1,000,000 and hopes to build a line north to Wichita and south into Oklahoma in the near future. The directors of the company are L. H. Northup, C. L. Brown, A. J. Hunt, N. D. Sanders and Thomas Baird of Arkansas City, and W. H. Somermier and W. C. Robinson of Winfield.

A proposition has been made to equip the St. Petersburg (Russia) street railways with electric power, thus doing away with the horse cars. For this purpose the City Council has appointed a commission to ascertain and report if the River Wuoksa is capable of furnishing enough motive power.

The promoters of the Fox River Traction Company's road have, it is stated, succeeded in securing the necessary capital to build their electric line from Yorkville to Plano, thence to Sandwich, Ill. The cars will run over the Yorkville line into the center of the city of Aurora under a contract with the Elgin, Aurora and Southern Traction Company. The power house will be at Plano, Ill., and later on the road will be extended to Somonauk, Earlville, Leland and Mendota.

Capitalists of Chester, Pa., and Wilmington, Del., have united in the purchase of a double track that lies along the line of the Wilmington division of the Chester traction company, and on which they will install funeral trolley cars which will be at the service of people burying their dead. The tracks will extend into the cemetery, and it is the intention of the company to so reduce the expenses of burial that this cemetery will be used by two cities, being about midway between them.

POWER TRANSMISSION.

Francis Jenkins of Moscow, Idaho, has purchased from John O. Bender of Lewiston the water right at Elk Creek Falls, about 50 miles from Lewiston, in the North Fork country. Mr. Jenkins will at once organize a company to develop electric power there to be transmitted through the Patlach and Palouse countries for running the electric railways and light plants.

After five years of preparation, the Great Northern Power Company is said to have begun the purchase of machinery, and within a few months the actual work of utilizing the waters of the St. Louis River and the watershed back to Duluth, Minn., will be started. A plant of 30,000 horsepower, it is said, will be installed at first. When the entire plans proposed are carried out, the promoters assert, the result will be the greatest waterpower in the world, materially exceeding the famous plant at Niagara Falls.

REMOVALS.

Announcement is made by the Fahnestock Transmitter Company of its removal to 132 Havemeyer Street, Brooklyn, N. Y., near the entrance to the new Williamsburg Bridge.

The offices of the Green Engineering Company of Chicago have been moved from the fourth floor of the Western Union Building to larger quarters on the fifth floor of the same building.

Charles W. Carman & Co., consulting electrical and mechanical engineers of Chicago, have removed from 88 La Salle Street to the Railway Exchange Building, on the corner of Michigan Avenue and Jackson Street.

TELEGRAPH.

An increase in the capital from $10,000 to $800,000 has been arranged by the Commercial Union Telegraph Company of Troy, N. Y. The Amsterdam Automatic Telegraph Company has also increased its capital from $15,000 to $100,000.

The steamer Lumbador of the Venezuelan navy arrived at Maracaibo, Venezuela, some time ago and began the laying of the cable between Bella Vista and the city of Altagracia. The distance is about 10 English miles. The cable was made in the United States and was laid by American engineers and is said to be giving satisfaction.

It is reported that a settlement of the Gould-Cassatt controversy over the destruction of telegraph poles belonging to the Western Union Telegraph Company on the right-of-way of the Pennsylvania Railroad Company has been effected by payment for damage done by the Pennsylvania company. The estimate is that through the intervention of financial interests the Pennsylvania company paid to Mr. Gould approximately $1,250,000 and further contributed to the legal expenses. The Western Union, it is asserted, has lost about $600,000 a year in business as a result of interference with its lines on the Pennsylvania right-of-way.

SPACE TELEGRAPHY.

It is reported that J. P. Copeland of Elizabeth City, N. C., is organizing a company, to be capitalized at $20,000, for the purpose of operating a space-telegraph system between New Berne, Hatteras, Roanoke Island, Elizabeth City and Norfolk, N. C.

At a meeting of the Marconi Wireless Telegraph Company recently held in Jersey City, James W. Pike, J. P. Cotton and G. Marconi were elected directors to serve terms of five years, and H. H. McClure to serve until 1907. An address was made by the president of the company and one of the directors outlined the work accomplished and the rapid strides with which the work of space telegraphy is being carried to a successful issue.

SOCIETIES AND SCHOOLS.

A preliminary list of the papers, committee reports, etc., for the Boston meeting of the National Electric Light Association has been sent out by Secretary Davis. Judging from the brief outline of the general plan to be incorporated in the programme, the visitors will be amply repaid for attending the convention. Competent men have been selected to look after every detail, and the programme for the entertainment of the visitors is unusually attractive. The Question Box contains nearly 450 questions; more than 100 "wrinkles" have been submitted and the papers already in print offer valuable information on live subjects.

PUBLICATIONS.

A circular from Leroy W. Stanton, consulting and constructing telephone engineer of Cleveland, sets forth the merits of the multiple tap-cable system and also contains many testimonial letters regarding Mr. Stanton's ability as an engineer.

The Central Electric Company, Chicago, is sending out a small catalogue on "Telephones, Apparatus and Material." This is an attractive little book, and, according to the company's statement, is intended to supplement its general catalogue and give in concise form such specialties and construction material as are of a special interest to telephone companies.

The biographical calendar for the month of May issued by the Bullock Electric Manufacturing Company of Cincinnati gives a picture and sketch of Charles P. Steinmetz, past-president of the American Institute of Electrical Engineers. These little souvenirs, which appear each month, are attractive and show much care and skill in their preparation.

The Fort Wayne Electric Works of Fort Wayne, Ind., has issued two new bulletins and also an instruction book on "Single-phase Wood Alternating-current Generators." One of the bulletins describes single-phase integrating induction wattmeters, known as type K. The other bulletin gives information on small rotary transformers, self-exciting alternators and motor-generator sets. In the instruction book are given a brief description of Wood alternating-current generators and some helpful instructions for the installation and management of these machines, including numerous diagrams of connections.

MISCELLANEOUS.

Dr. E. Stillman Bailey of the Hahnemann Medical College recently made the statement before the Homeopathic Medical Society of Chicago that radium is an antidote for the venom of poisonous snakes. It has been found, too, it is said, that the rays will kill the deadly anthrax bacillus. As yet, however, the antidote is impracticable on account of the scarcity of radium.

It is proposed to extend the electric-light system at Zanzibar, East Africa (at present confined to the sultan's palace), to the general lighting of the entire city. A. S. Rogers, regent and prime minister to the sultan, says that no contracts have been let or closed with any European companies. There is also under consideration the building of an electric trolley line through the city and into the suburbs.

The engineering commission of the Panama Canal Company is completing the examination of the canal route and the commencement of active work on the canal seems near at hand. The stockholders of the company at a meeting in Paris on April 23d ratified the transfer of the canal to the United States for the sum of $40,000,000. The money will now be paid over as also $10,000,000 to which the state of Panama is entitled under its treaty.

Dr. Charles Baskerville, professor of chemistry in the University of North Carolina, announced recently before the Chemists' Club in New York that he has resolved thorium into two new elements, one of which he has named caroliniun and the other berzelium, the latter in honor of the great Swedish chemist who discovered thorium nearly 100 years ago. Before this it has never been the good fortune of an American chemist to discover an element, if, indeed, the new discoveries are really elements.

The electric plant at Seoul, Korea, recently destroyed by fire, together with thousands of dollars worth of instruments and machinery, is to be reinstalled. The plant was destroyed at the time of the burning of the Korean imperial palace, which entailed a loss estimated at $3,000,000. All the government records and accounts were lost together with much treasure. United States Minister Allen formed the American marines into a bucket brigade and by extreme precautions prevented the flames reaching the legation.

A 100-ton alternating-current crane, with two trolleys, is in use in the Los Angeles repair shops of the Southern Pacific Company. The crane is of the double-girder class. Each girder weighs 17,400 pounds; the crane span is 37 feet five inches and the lift of the main hook is 16½ feet. Each trolley has a hoisting capacity of 50 tons and one of them is equipped with an auxiliary five-ton hoist. Each main hoist is driven by a 50-horsepower motor, lifting the full load at the rate of 10 feet per minute or the light load 20 feet per minute; the trolleys are moved along the bridge by 10-horsepower motors, with a full-load speed of 80 feet and a light-load speed of

100 feet; and the bridge is driven by a 50-horsepower motor at a full-load speed of 175 feet and a light-load speed of 225 feet per minute. The motors are three-phase 44-volt, 50-cycle Westinghouse variable-speed induction type.

Sheriff Barrett and Jailer Whitman of Cook County, it is understood, will ask the co-operation of all sheriffs in Illinois in a plan to have the Legislature institute electrical execution instead of the gallows for criminals condemned to death. The plan also provides for relieving the county jails of the custody of condemned men and placing them in the state penitentiary to await execution. This conclusion is the outcome of the extreme vigilance required in the case of the three car-barn murderers, Gustav Marx, Peter Niedemeyer and Harvey Van Dine, executed in Chicago last week, to prevent the carrying out of threats of suicide.

TRADE NEWS.

The Helios-Upton Company of Philadelphia has been reorganized under the name of the Helios Manufacturing Company.

The Hacker-Gardner Company of Irvine, Ky., has been incorporated with $50,000 capital, to manufacture a device known as the telegraph-relay magnifier.

G. G. Barry, J. C. Farwell and E. W. Himsett of Chicago have incorporated the Peliance Electric and Manufacturing Company, to be located in Chicago. The capital is $2,500.

With a capital of $25,000 the "Anynun" Fuse and Electrical Company has been formed, with its headquarters at Buffalo, N. Y. The directors are Daniel Haist, G. B. Bailey and J. H. Holder, all of Buffalo.

Among recent Illinois incorporations is the Western Meter and Manufacturing Company (electrical) of Chicago, capitalized at $50,000. The incorporators are J. C. Kenney, C. H. Thorardsen and J. A. Kenney.

The Black Hawk Electric and Automobile Company has recently been incorporated at Davenport, Iowa, to do a general electrical and mechanical engineering business, including the erecting and complete installation of steam and waterpower, electric-light and power plants. W. A. Fuller, who has charge of this department, was formerly electrical engineer at the Rock Island Arsenal for the United States government, and previous to that time was connected with the General Electric Company in Chicago for many years. The new company is composed of W. A. Fuller, James E. Bayliss and John H. Eagal. The capital stock is $10,000.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 31st for new magnetic controlling devices and new safety devices, etc., for the electric passenger elevator in the United States courthouse and postoffice at Scranton, Pa., in accordance with the specifications, copies of which may be obtained of the supervising architect.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 26th, for the installation of a conduit and electric-wiring system for the postoffice at Waterbury, Conn., in accordance with the drawings and specifications, copies of which may be obtained at the office of the superintendent of construction at Waterbury.

The Nernst Lamp Company has established a branch office auxiliary to the Pittsburg district office at 537 Scofield Building, Cleveland, Ohio, in charge of J. C. Wright. This office will carry a stock of Nernst lamps and renewal parts, insuring prompt attention to all orders in this district. The company has recently received two large orders, one from the Saco & Pettee Machine Shops, Biddleford, Maine, for 575 three-glower lamps, and one from the Arlington Mills, Lawrence, Mass., for 600 lamps of the 44-watt type.

The Wagner Electric Manufacturing Company of St. Louis wishes to state, in answer to the many inquiries which it has received regarding its relations with the Allis-Chalmers-Bullock coalition, that it is not a party to the combination, although it entertains the most cordial good will toward the new company. The offices of the Wagner company are unchanged and it invites the continued inquiries of its patrons at the nearest district office. The company is issuing invitations by which electrical visitors are asked to make its general offices their headquarters during visits to the Louisiana Purchase Exposition. Adequate facilities, stenographic and otherwise, will be provided for the prompt disposition of personal business matters, and it will be the pleasure of the company's general staff to further the comfort of visitors in every way possible. Personal mail may be addressed in the care of the company. The general offices and factory of the company are at 2017 Locust Street. The World's Fair headquarters is in Block 9, Electricity Building.

BUSINESS.

The H. W. Johns-Manville Company is supplying the Dreamland Company, Coney Island, N. Y., with several thousand squares of Asbestoside, to be used for siding the buildings in "Dreamland," a large pleasure resort on Coney Island.

The Miller Electric Company of Davenport, Iowa, announces that it is specially equipped to do repair work on all classes of electrical apparatus and that all work is guaranteed. The company says that work done by it has been always satisfactory.

The Electric Appliance Company, Chicago, says that its customers are taking time by the forelock and contracting now for their next winter's supply of lamps. These contracts, the company declares, will be taken care of in A-1 shape and filled with high-grade Packard lamps.

The Charles E. Dustin Company, 11 Broadway, New York, N. Y., is now furnishing the Valley Traction Company, Chambersburg, Pa., with three large direct-connected units for the new power house at Bridgeport, Pa. Two of the units are 250-kilowatt Westinghouse 2,200-volt two-phase 60-cycle four-pole alternators direct connected to 16 and 30 by 24-inch Pennsylvania Iron Works cross-compound engines. One is a 300-kilowatt Westinghouse eight-pole 550-600-volt direct-current generator direct connected to a 20 and 32 by 24-inch engine.

As in the drying of all material air movement is essential, so it is in the drying of soap. In recent processes the soap is placed in kilns, into which heated air is forced by means of a fan. An even distribution of the air results, the moisture from the soap is absorbed and the moisture-laden air is then discharged to the outside. With this system the quality and quantity of the air and its temperature can be varied at will and the drying is entirely independent of the weather. The B. F. Sturtevant Company of Boston furnishes fan equipments for this service.

The Westinghouse Electric and Manufacturing Company is pushing a new line of high-grade switchboard instruments. There are three general styles, types D, E and H. The first is a round-pattern instrument with a longer scale than usual. In type E two tabular lamps are arranged to give uniform light to the opal glass scale, 20 inches in length. Type H is of the edgewise pattern. It is only 5¼ inches wide, allowing of a large number of instruments being mounted side by side in a small space. The instruments are of strong construction and are of sufficient sensitiveness to insure reliable indications.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) April 26, 1904.

758,057. Ground Connection for Electric Conductors. Frederick P. Fuller, New York, and John J. Walsh, Yonkers, N. Y. Application filed October 16, 1902.

Encircling the conductor is a flexible band with a clamping device engaging the ends of the band, and a screw intermediate the clamping device and the conductor to push the clamping device away from the conducting object to take up the slack in the band and engage both ends of the band more firmly.

758,084. Electric Time Switch. Henry C. Little, Boston, Mass. Application filed August 26, 1903.

In a switch-controlling apparatus is a switch member, an operating train, a timing train, a stop for the operating train operated by the timing train, and means for controlling the stop according to the position of the switch member.

758,094. Electric Steam and Vapor Generator. Thomas W. Neely, Marshall, Ill. Application filed April 23, 1901.

A tightly closed shell has two alined electrodes within for the production of an arc within a body of water, and to effect the decomposition of the water by electrolysis. Means are provided for supplying a combustible vapor or gas to the arc for admixture with the gases of the decomposed water and the burning of these added gases with production of heat and pressure.

758,095. Process of Generating Steam. Thomas W. Neely, Marshall, Ill. Application filed May 2, 1901.

For generating steam and supplementing its expansive power, an electrical current is passed through electrodes immersed in water to form an electric arc with electrolysis of the water. A combustible gas is admitted to the electrodes to be combined with the water gases by combustion. The resultant gaseous product is confined to form pressure for motive power.

758,106. Transmission of Electrical Impulses. John S. Richmond, New York, N. Y. Application filed April 27, 1901.

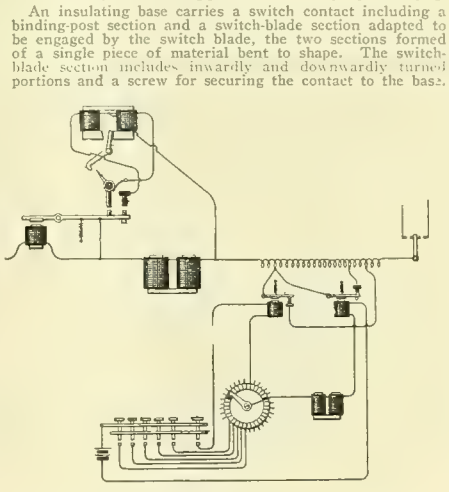
Two equal conductors, forming the sides of a metallic circuit are combined with means for maintaining zero potential at the meeting points of the two conductors, and means for creating impulses in the conductors simultaneously. The impulses are equal at contiguous points but differ in this, that the impulses in one conductor are equally above as those in the other are below the maintained zero potential.

758,116. Supervisory Signal Apparatus for Telephone Switchboards. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed September 14, 1903.

Combined with a telephone line and a sub-station switch controlling its circuit is a central-office relay having an armature responsive to the switch. A supervisory signal, a number of governing devices for the signal, each adapted to produce a distinctive indication, and means controlled by the movements of the relay armature for consecutively bringing the different governing devices into operative relation to the signal are also features of the invention.

758,120. Switch. Henry Trumbull, Plainville, Conn., assignor to the Trumbull Electric Company, Plainville, Conn. Application filed July 18, 1903.

An insulating base carries a switch contact including a binding-post section and a switch-blade section adapted to be engaged by the switch blade, the two sections formed of a single piece of material bent to shape. The switch-blade section includes inwardly and downwardly turned portions and a screw for securing the contact to the base.



NO. 758,250.—PRINTING TELEGRAPH.

758,140. Magnetic Brake. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed September 2, 1903.

An exciting coil moves the brake in one direction and electromagnetic means, upon the deenergizing of the coil, permits of a gradual action of the brake in the opposite direction.

758,153. Ice Cutter for Third-rail Electric Railways. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 20, 1901.

Upon the motor truck are ice-breaking wheels, the wheels having toothed peripheries adapted to engage the upper surface of the third rail. Scrapers remove the ice broken by the wheels independently of the direction of movement of the truck. (See cut on next page.)

758,157. Means for Preventing Arcing Between Commutator Brushes. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 29, 1903.

Between the brushes is a barrier or barriers of non-conducting material to prevent arcing between the brushes.

758,164. Rheostat. William C. Yates, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 16, 1901.

A rheostat contains two ranges of contact studs continuously connected in series relation and means for operating the one having the larger resistance units intermittently during the operation of the other.

758,165. Insulation. Edmund E. Bechtold, Chicago, Ill. Application filed June 22, 1903.

Insulation is bent to form an inner, an outer and an intermediate portion substantially parallel with one another, the inner portion having a series of slots and a number of openings located between the slots. Insulating material is located between the outer and intermediate portions.

758,172. Blow-out Fuse. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 2, 1902.

A thermal cutout is provided with terminals for connection with an electric circuit, and plates of magnetic material at the sides of the fusible element adapted to be polarized by the current passing through the fusible element.

758,175. Insulator. Scott C. Cutter, Oswego, Ill. Application filed December 11 1902.

An insulator composed entirely of insulating material, has a corrugated back, a horizontal bore, and a vertical slot leading to the bore. The head of the insulator is rounded into the slot, the lower edges of the slot extending into the bore to form retention pockets.

758,200. Telephone-climbers Seat. James E. Bennett, Momence, Ill. Application filed December 20, 1902.

The seat is attachable to a [illegible] comprises fingers or tongs which hold the seat in place and which are capable of adjustment to any sized pole. The legs are secured to the seat and enter the pole at an angle below the seat, the arms holding up the legs, and the legs the seat.

758,202. Telegraph Receiver. L. Cerebotani, Munich, Germany, assignor of one-half to Albert Silberman, Berlin, Germany. Application filed May 21, 1903.

A chamber [illegible] ing lens is provided with a corresponding aperture located below the first aperture and containing a sensitized band traveling below the latter aperture through the focus of the lens. [illegible]

oted armature responding to the line current impulses, which armature when at rest separates and covers the apertures, and when operated uncovers them. The rays then act upon the sensitized paper forming Morse characters.

758,217. Sparking-igniter Mechanism. Carl C. Riotte and Eugene A. Riotte, New York, N. Y. Application filed April 15, 1901.

A cam for operating the igniter contains transmitting mechanism between it and the igniter. An operating arm moves the transmitting mechanism and is adapted to bear normally automatically and in all positions against a friction plate for holding the transmitting mechanism passive in any position to which it is moved.

758,225. Electric Motor. Alexis Vanderbeck, Roseland, Kan. Application filed October 10, 1903.

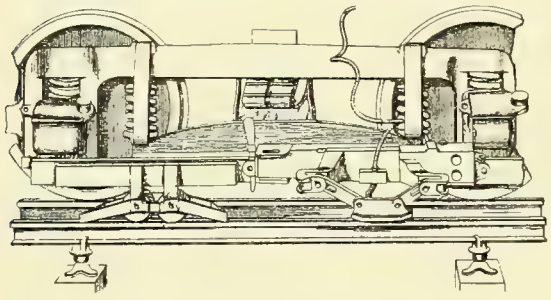
A form of reciprocating motor for transmitting motion to a shaft through a pitman is described.

758,230. Train-control System. Harold E. White, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 20, 1902.

A pair of motors have permanent connections between the field of each motor and the armature of the other motor, and means for connecting the motor armature and field combinations in series and in parallel.

758,232. Telegraph Transmitter. Charles Adams-Randall, New York, N. Y. Application filed August 25, 1902.

An electric circuit includes contacts and a vibrating lever, also a key lever having a segmental portion provided with grooves or corrugations adapted to engage the vibrating lever for automatically actuating it between the contacts to alternately make and break the circuit and to impress or transmit impulses representing the character indicated by the key lever.



NO. 758,153.—ICE CUTTER FOR THIRD RAIL.

758,236. Electromagnet. Harold W. Chamberlain, Brunswick, Me. Application filed August 27, 1903.

An electromagnet contains an armature fulcrumed thereon in direct polar and magnetic contact. A transverse extension piece on the armature is adjusted to play in proximity to, but out of contact with one of the poles.

758,250. Printing Telegraph. Clarence L. Healy, Newark, N. J. Application filed June 16, 1903.

A unison device consisting of an electromagnet, an armature lever therefor, two stops for the armature lever, one of which moves in proportion to the type carrier, a detent for the type carrier and means whereby the stop with which the armature lever collides will determine the action of the detent go to make up the apparatus. (See cut on preceding page.)

758,293. Electromagnetic Gearing. Edward M. Bentley, Lawrence, N. Y. Application filed December 2, 1903.

Combined with a dynamo-electric machine is a regulator acting to vary the effective rate of relative movement of field-magnet poles and armatures comprising a pole shifter for the field magnet giving the poles a rotation adjustable for regulation and supplementary to the relative mechanical movement of field magnet and armature.

758,303. Electric Heater. Ernst Eckmann, Berlin, Germany, assignor to Martin Petersen, Friedrichsgabekoog, Schleswig-Holstein, Germany. Application filed August 15, 1902.

In a cylindrical casing is an opening in one side and an integral projecting motor casing on the other. A shaft carrying a motor-driven fan extends through the projecting motor casing, the casing having openings leading to the outside air and to the interior of the cylinder. The cylinder has a tangential delivery opening for the heated air.

758,304. Office-desk Telephone Allan R. Fergusson, New York, N. Y., assignor to the Electro-Mechanical Specialty Company, New York, N. Y. Application filed November 16, 1901.

Carried by a staff mounted upon a support is the transmitter. A universal point permits of the staff being swung upon the support in a substantial arc in diverse directions to and from an upright position. A switch on the staff is operated by a receiver when the staff is in an upright position.

758,305. Electric Fan. Allan R. Fergusson, New York N. Y. Application filed December 16, 1902.

The fan driven by a motor is mounted upon a flexible extension of the motor shaft.

758,306. Electric Switch. Allan R. Fergusson, New York, N. Y., assignor to the Electro-Mechanical Specialty Company, New York, N. Y. Application filed December 16, 1902.

A telephone transmitter is mounted on a swing staff. The receiver hook makes or breaks the circuit of the switching device.

758,342. Switch Mechanism for Electric Signs. Frank S. Wahl, Buffalo, N. Y., assignor of one-half to Alfred W. Horn, Buffalo, N. Y. Application filed July 14, 1902.

A rotary drum provided with a peripheral contact surface forming one terminal of an electric circuit bears perforated pattern cards mounted on the surface. Contact pins are adapted to engage with the drum and cards and form the other terminal of the electric circuits. An escapement wheel turning with the drum is provided with an annular row of teeth, and a pallet movable transversely of the path of the teeth and having two V-shaped jaws which operate successively on each tooth.

758,352. Apparatus for Electroplating Sound Records. George K. Cheney, New York, N. Y. Application filed June 6, 1903.

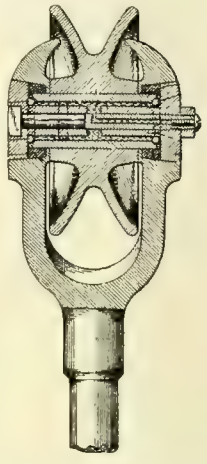
Across the tank above the surface of the liquid extend circuit rods. An annulus of non-conducting material having a tapered bore to receive the record tablet and frictionally securing it at points throughout its circumference is provided with means for suspending the annulus in the solution.

758,355. Trolley Wheel. James S. Fletcher and Donald H. Waters, Chicago, Ill. Application filed September 3, 1903.

A liquid metal, such as mercury, surrounds the trolley axle inside of a hollow shaft on the harp carrying the axle. (See cut.)

758,363. Telephone Receiver. Miller R. Hutchison, Norwood, N. J., assignor to the Hutchison Accoustic Company. Application filed November 25, 1902.

A casing in two parts connected together by a screw thread contains a magnet in one part and a diaphragm in the other. A scale on the outside of one part and an index on the other shows the distance between the pole or poles of the magnet and the diaphragm.



NO 758,355. —TROLLEY WHEEL.

758,378. Alternating-current Motor. Ralph McNeill, New York, N. Y., assignor to Arthur O. Granger, Philadelphia, Pa. Application filed December 4, 1902.

Independent energizing circuits are associated with independent armature circuits, the latter being each adapted successively to make contact with each of the energizing circuits without being at any time short-circuited upon itself and to always be in contact with at least one of the energizing circuits.

758,415. Telephone Instrument. Albert C. Christopher, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed February 3, 1904.

A box-like cover is adapted to inclose the switch-hook contacts of a subscribers' set.

758,445. Trolley Head. Peter D. Hean and John J. Egan, Media, Pa. Application filed December 26, 1903.

The trolley mechanism comprises a trolley head, guard members journaled in suitable bearings upon the head, tripping mechanism and means intermediate the mechanism and the guard members to automatically open the guard members.

758,468. Alternating-current Signal-receiving Apparatus. Greenleaf W. Pickard, Amesbury, Mass., assignor to the American Telephone and Telegraph Company. Application filed February 29, 1904.

A receiving apparatus for high-frequency currents or impulses, comprises two pole pieces or magnetic cores with means for establishing in them simultaneously opposed and cyclically changing magnetizations. Means actuated by and responsive to the high-frequency currents or impulses for accelerating the magnetic change in one of the pole pieces, and an armature mounted with its free end held normally in a position intermediate between the pole pieces, and adapted to oscillate toward one or the other as either may become the stronger, are provided.

758,478. Electric Switch. Joseph H. Rusby, Nutley, N. J. Application filed June 25, 1903.

A switch support comprising a swinging projecting lug and a second lug seated or fitted in the first lug is described.

758,485. Railroad Signal or Alarm. Robert F. Stuart, Logansport, Ind. Application filed October 14, 1903.

Plungers adapted to be operated by a moving train make circuits actuating the signals.

758,503. Process of Forming Vessels from Sheet Metal. Hermann G. Blevins and James E. Whittaker, Newcastle, Pa. Application filed July 1, 1903.

The ends of the material to be welded are secured in overlapped position upon an insulating support. A perfect contact is secured between the end portions, the portions adjacent the joint being connected with the terminals of an electrical supply circuit having a variable resistance. (See cut.)

758,517. Art of Wireless Telegraphy. Lee de Forest, New York, N. Y. Application filed September 21, 1903.

Determining the distance to a sending wireless signaling station may be accomplished by employing a damping or choking influence of regulable amount in the receiving apparatus to reduce the intensity of the signals received to a standard of comparison and comparing the amount of the damping influence required with results obtained under known conditions and distances.

758,527. Signaling and Operating System. Hedley C. W. Graham, Rochester, N. Y. Application filed July 9, 1903.

In a system for operating controlling means from a distant point by etheric waves there are embodied a suitable transmitting circuit, a receiving circuit containing a receiver, a coherer connected thereto, and an alarm device controlled by the coherer, the alarm device being provided with a switch element, and a controller governed by the switch element.

758,528. Current Collector. John E. Greenwood, Utica, N. Y. Application filed May 16, 1903.

A form of trolley pole is described.

758,541. Block-signalling Apparatus. John A. Lehr, North York, Pa. Application filed February 18, 1903.

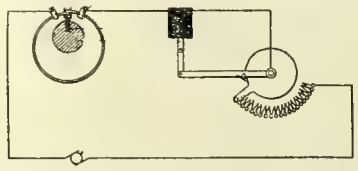
Operating in conjunction with a contact roller is a rotary switch plate electrically connected with the wheels of a car, parallel concentric non-overlapping flanges upon the plate, contacts, one of which is at all times in position upon one of the flanges, an alarm electrically connected to each contact, and an electrical connection between the alarms and the contact roller.

758,589. Light-controlling System. Harry Faltermayer, Philadelphia, Pa., assignor of one-half to William J. Caskey, Philadelphia, Pa. Application filed October 2, 1903.

The switch includes a number of contacts, a number of current-receiving devices connected to the switch, a number of pieces for the switch constructed to coact with the contacts to permit only predetermined ones of the receiving devices to be supplied with current, and means for selecting certain of the pieces and presenting them to the switch.

758,592. Safety Trolley. William M. Gruner and William C. Fink, Springdale, Pa., assignor of one-fourth to Henry G. G. Fink, Springdale, Pa. Application filed November 5, 1903.

Carried by the main trolley is a lengthwise-extendible sub-trolley, and means operating upon extending action of the sub-trolley, to recomplete the motor circuit.



NO. 757,503.—ELECTRIC WELDER FOR SHEET METAL.

758,594. Electric-railway Signal. William S. Jackson, Hoboken, N. J., assignor of one-half to David Young, Newark, N. J. Application filed June 30, 1902.

A pivoted semaphore, an actuating lever having a curved arm arranged to ride against the semaphore, and a cam track are associated with a rolling shiftable member fitted to the cam track and linked to the lever. Magnets are included in different circuits, and links connect the cores of the levers with the shiftable member.

758,598. Transmission of Electrical Impulses. John S. Richmond, New York, N. Y. Original application filed April 27, 1901. Divided and this application filed September 16, 1903.

An improvement in electrical transmission consists in producing in adjacent conductors electrical impulses simultaneously equal at contiguous points but differing in this that the potential of the one is above and that of the other equally below the maintained zero potential.

REISSUE.

12,214. Process of Obtaining Tin by Electrolysis. Ernest Quintaine, Argenteuil, France. Application filed April 20, 1903.

Separating tin electrolytically from scrap tin is done by suspending the scrap, as the anode, in a bath composed of an aqueous solution of acid nitrate of tin to which have been added a salt of ammonia and chloride of tin, suspending a suitable cathode in the bath, and finally passing the electric current through the anode, bath and cathode.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on May 3, 1904:

362,053. Electric Rock Drill. Charles E. Ball, Philadelphia, Pa.
362,076. Composition for Insulating and Other Purposes. Samuel H. Gilson, Salt Lake City, Utah.
362,108. Connector for Electrical Appliances. Charles G. Perkins, Hartford, Conn.
362,115. Telephone Support. Samuel Rosenblatt, New York, N. Y.
362,128. Incandescent Electric Lamp. Silvanus F. Van Choate, New York, N. Y.
362,133. Electrotherapeutic Strength-testing Machine. Edwin H. Whitney, Manchester, N. H.
362,135. Polarized Electromagnet. John C. Wilson, Boston, Mass.
362,192. Electrical Circuit Closer. George E. Thaxter, Boston, Mass.
362,212. Electric Regulator of Heating Apparatus. Richard L. Guion, Elmira, N. Y.
362,213. Electric Thermostat. Richard L. Guion, Elmira, N. Y.
362,216. Electric Signaling Apparatus. Salomon Iliyne-Berline, Paris, France.
362,217. Multiple Switchboard. Milo G. Kellogg, Hyde Park Ill.
362,312. Electric Arc Lamp. Henri Pieper, Fils, Liege, Belgium.
362,322. Electric Motor. Robert J. Sheehy, New York, N. Y.
362,323. Electrical Railway. Sidney H. Short and John W. Nesmith, Denver, Colo.
362,376. Electric Cable Clip. Claude C. Gould and Walton Smith, Batavia, N. Y.
362,399. Support for Electric Lights. Augustus G. Schlotterbeck, Portland, Me.
362,409. Railway Signal. Pierson J. Wicks, Green Point, N. Y.
362,451. Electrical Current Indicator. Philipp Lange, New York, N. Y.
362,469. Electric Switch. Alfred Swan, New Castle-upon-Tyne, County of Northumberland, England.
362,477. Electric Police-call Alarm Box. John J. Couchlin, Boston, Mass.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, MAY 14, 1904 No. 20

Foreign Electric Heaters and Cooking Apparatus.

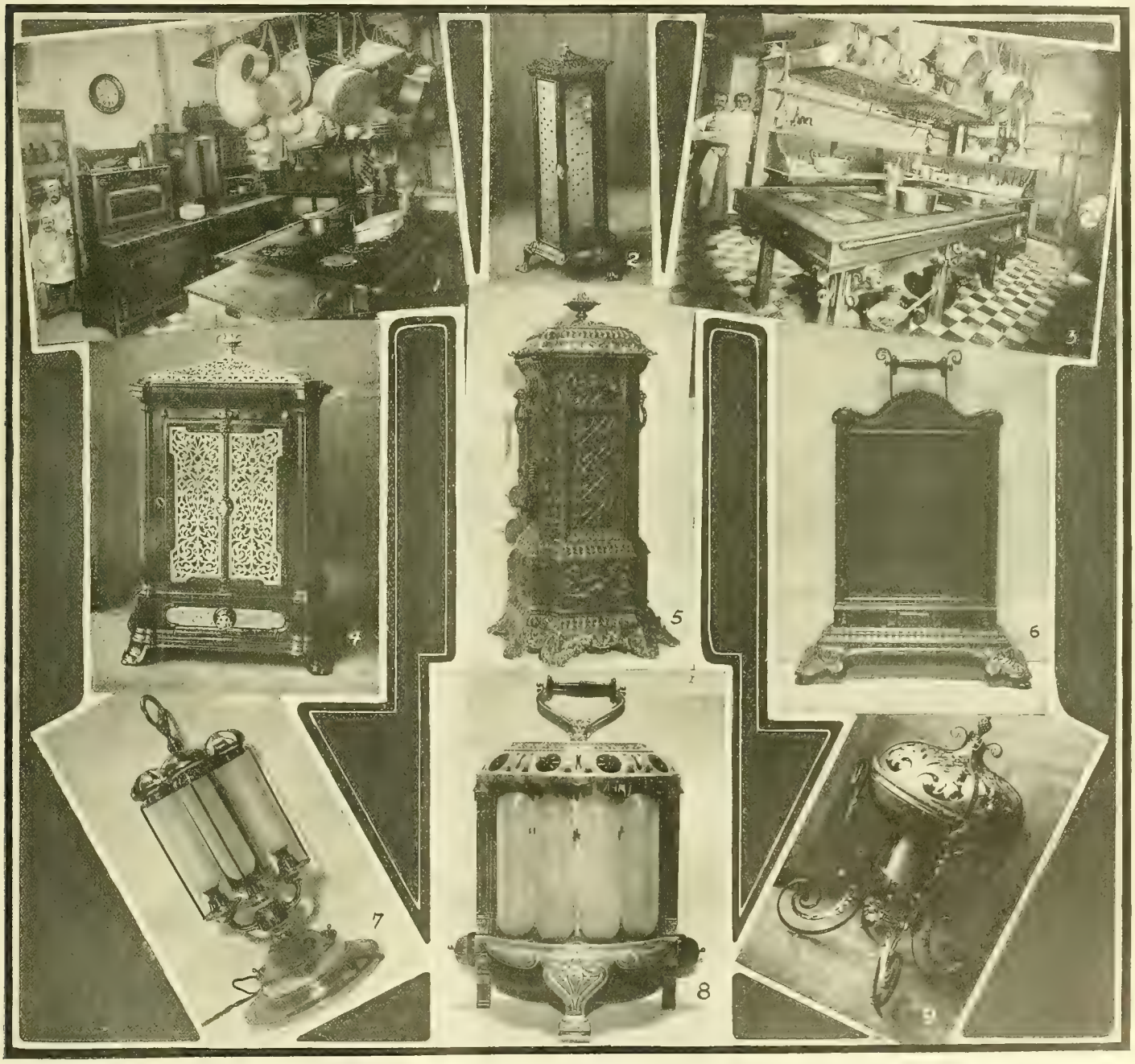
By Frank C. Perkins.

In almost every known electrical device there is a considerable waste of energy except in the electrical heater. A large proportion of otherwise wasted energy in these devices is turned into heat, and the high efficiency of the electric cooking apparatus and heaters is due to the fact that practically all of the electrical energy may be transformed into heat, which is the form of energy desired, and it can be localized in electric cooking utensils to advantage. There is no danger from explosions or fires and no labor in maintaining or making the fire, while in the various operations in the kitchen there is less consumption of time and no large cooking range is required. The cleanliness of the electric heating device is very desirable, as there is no vitiation of the atmosphere, all smoke, flame and soot being avoided.

The electric heater is most extensively used in the United States on electric-railway lines for warming the cars, but is also employed very largely in manufacturing establishments for special operations and is used also to considerable extent for the operation of electric cooking devices and for laundry work.

In England electric radiators of novel construction have been designed and manufactured by a London company. The accompanying illustrations show several designs of the English electric glow radiators, the heating units resembling large incandescent lamps. The electric heaters give off a pure radiant heat, far purer than can be produced by any other method of heating. The radiant heat is diffused by rays which pass through the air in their immediate vicinity, heating any objects which come within their limit without affecting the air temperature to any great extent. Radiant heat, therefore, differs from convected heat, which is produced by other forms of radiators, and it is generally supposed that the glow or luminous radiator gives off more heat for the same consumption of current than the other radiator, but this is not true. All the current consumed in an electric radiator of whatever form is given off in heat, and none is lost.

The advantages claimed for the electric heater are many. The heat, being given off immediately the current is switched on, is peculiarly suitable for bedroom and studies, where temporary heat is required. It is said that the glow radiators give a particularly pleasing effect, their appearance resembling the glow of an open fire. Where large rooms are to be heated, electric radiators should be installed, on the same principle as steam heaters, the designers of the glow radiators holding that, for average conditions, 75 [illegible] space should be distributed [illegible] possible, not less than one for every 12 running feet by nine feet from face of radiator for a room



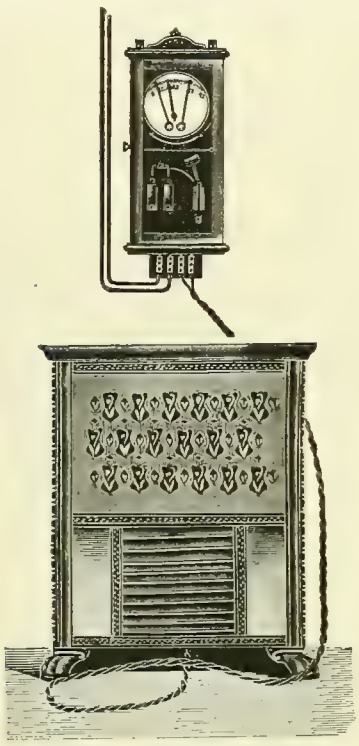
1. French Electric Grill-room Equipment.
2. French Bronze Electric Stove, (Three Amperes at 550 Volts).
3. French Electric Grill-room Equipment.
4. French Electric Radiator 3½ Amperes at 110 Volts.
5. English Pillar Pattern Electric Heater (1,800 Watts).
6. English Portable Double-surface Electric Stove 1,200 Watts.
7. English Electric Glow Radiator (12 Inches Wide and 28 Inches High).
8. English Electric Glow Radiator (1,200 Watts—250 Volts).
9. French Electric [illegible] 12 Amperes at 110 Volts.

FOREIGN ELECTRIC HEATERS AND COOKING APPARATUS.

10 to 12 feet high, while, if placed centrally in the room, the same space should be taken in a circle around each radiator.

As to the cost of electric heating, it may be definitely stated that it cannot be asserted that electric radiators are cheaper to heat a good-sized room than by a coal fire or by gas; still, the many advantages of this method of heating must be taken into consideration. Not only is a perfectly pure heat obtained without fumes of any sort, but the heat can be obtained at any moment by merely turning on a switch. In localities where electric power is cheap, being derived from hydro-electric stations, and where the cost of fuel is high, the electric heater may be used to greater advantage.

An electric heater 0.5 meter high constructed in Berlin is shown in the illustration below. This heater is arranged with an automatic temperature regulator arranged to switch on the current if the temperature of the room becomes lower than a pre-



GERMAN ELECTRIC HEATER AND THERMOSTAT.

determined amount, the circuit being opened as soon as this temperature has been reached, thus maintaining an even heat continuously. These heaters require from 3,000 to 5,000 watts an hour and for each 100 cubic meters to be heated. With this device the thermostat and switch are mounted in a case placed upon the wall in a similar manner to an electric clock, a dial and indicator pointer being provided to show the temperature at which the room is maintained.

The French electric heaters utilized for heating the cars of the Compagnie des Chemins De Fer De l'Ouest were built by the same firm in Paris which constructed the unique electric heaters of French design shown in the accompanying illustration as well as the electric cooking apparatus shown in the grill-rooms. The electric car heaters are 80 centimeters long and are designed for 110 volts, five of the heaters being arranged in series for operation in the cars at a pressure of from 550 to 600 volts. Ten of these car heaters are used in each carriage, with a consumption of 1,100 watts.

The French electric plates or stoves take from 0.3 ampere to 0.7 ampere at 110 volts and the electric toasters, broilers, coffeepots and chafing dishes take from 0.2 ampere to eight amperes at a pressure of 110 volts, according to the size, while the electric ovens and baking devices require from nine ameperes to 60 amperes, the latter current being used by a large electric oven 0.8 meter long, 0.55 meter high and 0.45 meter wide. The French electric radiator and stoves are of very artistic design, from 0.75 to 0.85 meter in height, and elaborately nickel-plated. These heaters consume from 1,500 watts to 2,500 watts at from 550 to 600 volts pressure, the current being from three to five amperes.

The English electric glow radiators are fitted with highly polished aluminum reflectors, the heating lamps having very large bases and designed for pressure up to 250 volts. The heating lamps are held in position by aluminum clips which are not affected in any way by the heat. These radiators are provided with four or more lamps in two circuits, the current consumed being from 900 to 1,500 watts. The four lamps are controlled by two switches, and when more lamps are provided with three switches, so that three variations of heat may be obtained. The pillar-pattern English radiators, using the glow lamps, are wired for a maximum of 3,000 watts and for pressures up to 250 volts, and they give a most beautiful effect when lighted, as a soft glow comes through the decorated framing from a lamp within, giving a cheerful effect. The English ship radiators and electric car heaters consume from 400 to 1,200 watts at pressures from 50 volts to 600 volts. The electric heaters for the state-rooms of steamships are 14 inches long, five inches wide and 2½ inches deep, and are used frequently as an auxiliary to steam-heating systems. The electric car heaters are 22 inches long, seven inches wide and five inches deep, with a radiating surface of 450 square inches, this being the floor type, while the heaters designed for fixing under the seats are only 1¼ inches deep, ¼ inch wide and 22¼ inches long, being wired on two circuits giving three variations of heat.

Ingenious Panel Board for Office Buildings.

Modern office buildings, on account of their size and the great number of individual circuits made necessary by the subdivision for the numerous tenants, present difficulties in the way of electrical wiring, and it is only by the most systematic arrangement of the circuits that confusion is prevented. In many of these buildings, even those built within the last few years, will be found a veritable tangle of wires at distributing points and at the meters, due to the many changes that are made in the rental of offices and the subsequent rearrangement of suites

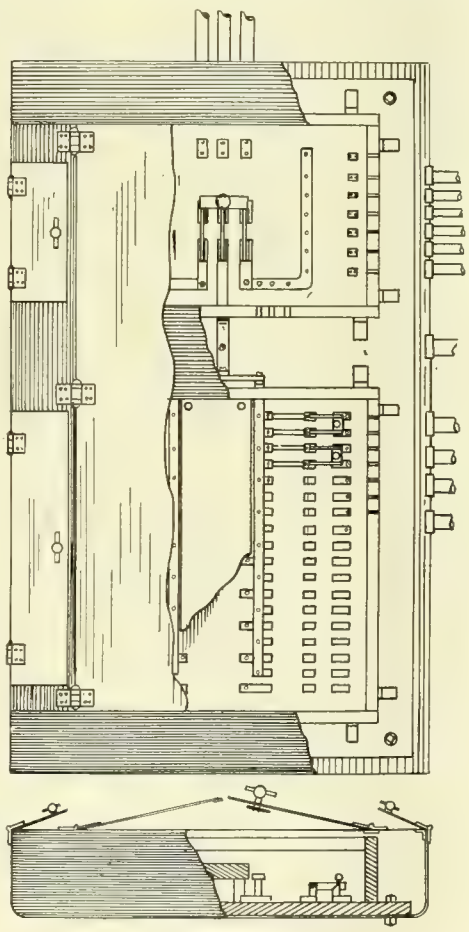


FIG. 1. PANEL BOARD FOR OFFICE BUILDINGS.—GENERAL ARRANGEMENT.

and of meter wiring. Therefore, a flexible system, by means of which any of the office circuits may be attached to any meter, or several offices to the same meter, without in any way disturbing the meter wiring, is of decided advantage.

In the large new Railway Exchange Building in Chicago a type of panel board has been adopted which is compact and at the same time gives great flexibility in connecting the various circuits in the building to the metering system. The board is the invention of George H. Jones of Chicago, and 45 of these boards have been installed in the Exchange Building alone, two boards being installed on each of the floors of the building and several in the basement.

Fig. 1 is a diagram showing the general arrangement of the board. It is mounted in a shallow steel box and is divided into two sections, vertically. The feeders from the three-wire service enter at the top of the board and are led through the fuses to the main switch. The neutral passes from the switch down to two bus bars in the lower portion of the board. These bus bars are common to one side of each of the office circuits. The other side of each individual office circuit ends in a terimnal on the board, and from this terminal a wire is carried up to the customer's meter, the current passing from the meter back to the other side of the main circuit, as shown in Fig. 2.

In Fig. 2 one of the meters is shown as registering on the two right-hand circuits at the top and bottom of the panel. Suppose the lower one of these offices is to be vacated and the other retained. All that is

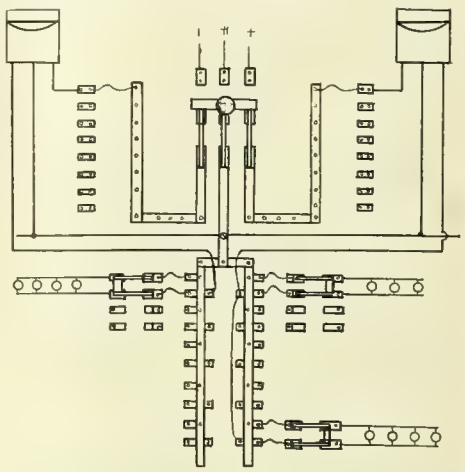


FIG. 2. PANEL BOARD FOR OFFICE BUILDINGS. CONNECTIONS TO METER.

necessary to change the meter to the one circuit is to remove the jumper wire connecting the two, which is a simple process and disturbs no other wiring.

The wiring of all the meters served by each panel board is brought in at the sides near the top (Fig. 1), and the lamp circuits lead out opposite their respective switches at the lower portion of the board. The wiring on both sides is identical, although Fig. 1 only shows it as entering one side.

Steel doors cover the front of the case, and back of them is a marble slab covering the fuses and wiring for both the upper and lower portions. All that is necessary to get at the panel itself is to remove two screws in each of these slabs. Two small doors at the top and bottom of the case near the edge (see Fig. 1) may be opened to show at a glance which leads are connected to the respective fuses.

A patent has been issued to Mr. Jones on the invention here described.

Formulas for Dry Cells.

A subscriber of the Western Electrician in Buenos Aires, Argentine Republic, writes for a formula for dry batteries, such as are used for small pocket lamps. Foster's Electrical Engineer's Pocket Book gives two formulas for dry batteries. One form of dry cell, the Burnley, is made as follows: One element is a zinc tube acting as a containing vessel. A carbon cylinder is the negative element. The exciting solution consists of one part sal-ammoniac, one part chloride of zinc, three parts plaster of paris, 0.87 part flour and two parts water. In constructing the cell a plunger a little larger than the carbon element is placed in the vessel, and the above solution or paste poured around it, which quickly becomes stiff. The plunger is withdrawn and the carbon inserted. The remaining space is surrounded by a depolarizing agent consisting of one part chloride of zinc, one part peroxide of manganese, one part granulated carbon, three parts plaster of paris, one part flour, and two parts water. The receptacle is then sealed.

In the Gasner dry cell the exciting solution consists of one part by weight of oxide of zinc, one part sal-ammoniac, three parts plaster of paris, one part chloride of zinc and two parts of water.

A small vent must be left for the escape of ammonia gas.

An electric-light and power plant is to be erected a short distance from Venice, Italy, in the province of Treviso. The power will be obtained from the Cellina River. The chief purpose of the plant will be to furnish Venice with electricity.

Scott's Alternating-current Distribution System.

Charles F. Scott of Pittsburg, past president of the American Institute of Electrical Engineers, is the inventor of a system of alternating-current distribution which is designed to supply electric cars on two parallel tracks from a single transmission line. The illustrations clearly display the connections in the system.

In Fig. 1 a three-phase generator is shown as indicative of the power-house source of supply for the three-phase transmission line (2), it being understood that the source may be either a single generator or a number of generators connected in parallel to the transmission line and that it may also include step-up transformers in case a higher transmission electromotive force is desired than may be conveniently supplied directly by the generators. The two trolley conductors (3) and (4) are shown as overhead conductors. The respective track rails (7) and (8) of the two parallel lines of road are shown as constituting the return conductors of the work circuit.

In order to supply each of the working circuits with a single-phase current for operating its motors, two transformers (9) and (10) are employed, the primary windings (11) and (12) of which are connected to each other and to the three-phase circuit. The secondary windings (13) and (14) of these two transformers have their respective outer terminals connected to the trolley conductors by means of conductors (15) and (16), and their inner terminals are connected together and to both of the return conductors by means of a conductor (17). It follows from this arrangement of apparatus that a saving of conductors for the transmission circuit is effected by employing a three-phase system and that a further saving is effected by using the rails of the two roads as a common return for both circuits, thus reducing the current in each rail-return below that in each of the trolley conductors.

In Fig. 2 the source of energy is represented by a single-phase generator (1^a), and the transmission circuit (2^a) is therefore a single-phase circuit. Energy at a lower potential may obviously be derived from the transmission circuit for the translating devices by means of separate step-down transformers; but in the illustration energy is supplied to the two work circuits by means of a single transformer (18), the outer terminals of the secondary (19) of which are respectively connected to the power conductors (3) and (4) by conductors (20) and (21). An intermediate point in the secondary winding is connected to both of the return conductors by means of a conductor (22). This arrangement may be made such as to provide for separate voltages for the two work circuits, if desired, by connecting the conductor (22) to some other than the middle point of the winding.

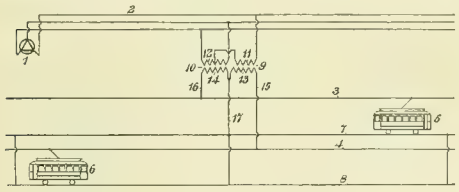


Fig. 1.

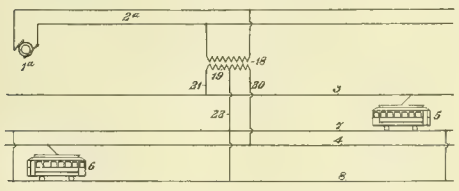


Fig. 2.

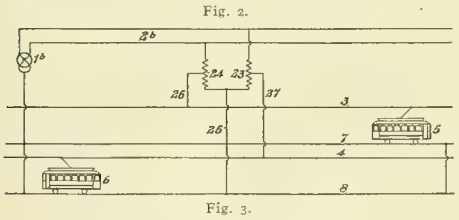


Fig. 3.

SCOTT'S ALTERNATING-CURRENT DISTRIBUTION SYSTEM.

In Fig. 3 the power-house source of energy is represented by a two-phase generator (1^b). As shown, the two return conductors (here indicated as the track rails) constitute the return conductors for the generator (1^b) as well as of the transformers which directly supply the work circuit. The other portion (2^b) of the transmission circuit is connected to the conductors by transformer windings (23) and (24). Intermediate points in the windings are connected to the respective conductors by conductors (26) and (27).

With this system are to be had the advantages of a polyphase transmission circuit and a saving in conductors by the use of the rails as return circuits for both phases of the high-voltage circuits and also for the two trolley circuits.

As many transformers or sets of interconnected transformers may be employed as may be necessary, the number depending upon the distance over which the energy is transmitted and utilized. The transformers may be of either the auto or two-coil type, and in each case the return conductors may be independent of the track rails, though, as already stated, it will be found in general more economical to utilize the track rails as return conductors.

Annual Meeting of the Institute.

An interesting programme has been prepared for the next annual meeting of the American Institute of Electrical Engineers, which is to be held on May 17th and 18th in New York. A number of good papers will be given, and the result of the annual election of officers will be announced.

Three papers will be given on the morning of the first day. W. L. Walters, chief engineer of the National Electric Company of Milwaukee, will present a paper on the "Predetermination of Sparking in Direct-current Machines." The other papers are: "Effect of Self-induction on Railway-motor Commutation," by E. H. Anderson, General Electric Company, and "On the Calculation of Line Batteries," by W. E. Winship of the Gould Storage Battery Company, Philadelphia. After the papers will come the annual meeting of the board of directors. In the afternoon the announcement of the result of the election will be made and the reports read, followed by the reading and discussion of a paper on "Data and Tests on a 10,000-cycle-per-second Alternator," by B. G. Lamme, assistant chief engineer of the Westinghouse Electric and Manufacturing Company.

On the second day the following papers will be read and discussed: "Notes on Flywheels," by H. H. Barnes, Jr., Stanley Electric Manufacturing Company, Pittsfield, Mass.; "The Single-phase Induction Motor," by W. S. Franklin, professor of physics and electrical engineering, Lehigh University, Bethlehem, Pa.; "Wave-form Variations of a Long-distance Line," by George H. Rowe, professor of electrical engineering, Leland Stanford University, Palo Alto, Cal. A visit to library and technical laboratories of Columbia University will be made in the afternoon.

Members of the Institute are reminded that the annual convention will be held at the St. Louis Exposition during the week ending September 17, 1904. Members and associates are notified that no unsolicited Institute papers will be presented or discussed at that time.

Chicago Lighting Statistics.

Statistics of the city of Chicago for the year ended December 31, 1903, have just been published by the Chicago Municipal Library and Bureau of Statistics. The monthly average of public street lights of all kinds operated is shown to have been 36,480. This number was divided as follows, the figures being the monthly averages: Gas lights, 24,855; gasoline lights, 6,172; electric arc lights, operated by the city, 4,827; rented electric arc lights, 618. The average daily candlepower used for lighting the streets was 12,267,351, as compared with 11,601,277 in 1902.

According to figures obtained from the Department of Electricity, each arc light of the municipal lighting plants cost the city for the year $54.50, while the cost of the rented arc lights was $103 each. Rented electric lights had an estimated candlepower of 1,236,000 and the cost is given at $63,871.85. The estimated candlepower of the municipal lights was 9,054,000 and the asserted cost was $2?5,071.50.

There were at the end of the year 1,244 electric-lighting stations in the city under the jurisdiction of the Department of Electricity, and they supplied current to 36,674 arc lights and 1,975,409 incandescent lamps, equivalent to 16 candlepower. The stations are described as follows:

	No.	Arc Lights	Incandescent Lights
Commercial companies, central stations	56	17,831	[illegible]
Isolated plants	1,108	14,[illegible]	[illegible]
City plants, street	8	4,024	[illegible]
City plants, isolated	12	31	1,180
	1,244	36,674	1,9[illegible]

The Department of Electricity made 28,000 inspections during the year and issued 9,988 permits for electric installations. The electric motors inspected represented a total capacity of 116,387⅜ horsepower.

Stately Telephone Building in Memphis.

The accompanying illustration shows the ornate facade of the new exchange and office building of the Cumberland Telephone and Telegraph Company in Memphis. The Greek architecture, with the imposing portico and statuary ornamentation, gives an air of distinction which few telephone-exchange buildings attain in this utilitarian age. Conspicuous are the four bells, surrounded by laurel wreaths, carved on the stone entablature above the columns,

STATELY TELEPHONE BUILDING IN MEMPHIS

which show at a glance to the experienced eye not only that the building is used for telephone purposes but that it is devoted to the Bell interests.

Although its external appearance would not so indicate, the building has a commodious basement for distributing rack, charging apparatus, etc. The first or street floor is devoted to the offices of the manager, cashier, traffic department and the accommodation of the public for long-distance messages. The whole interior is fitted up very handsomely in quarter-sawed oak, with glass and wooden office partitions, desks, booths, etc. The rear of the first floor is used by the trouble department. The second floor is given up to the operating room, both local and long-distance, the whole being finely lighted. The entire switchboard equipment is of the latest central-energy design.

While the company owns handsome exchange buildings in all the large towns throughout its territory, some of them larger and more expensive, possibly, than the Memphis building, still it takes particular pride in the edifice illustrated, from its unique—telephonically unique—architecture. The four-story building just finished at Hopkinsville, Ky., ranks next to the Memphis building, perhaps, in beauty of design. The Memphis building was planned and built especially for telephone purposes. The architects are Thompson, Gibbell & Asmus.

The electric-light plant owned by the city of Leon, Iowa, will be offered for sale. The population of the city is 2,000. Mr. I. N. Beard is chairman of the committee.

Exhibits in the Palace of Electricity on the Opening Day.

By W. E. Goldsborough.

France.—The French section in the Palace of Electricity has an area of 21,269 square feet of exhibit space. The installation in this section is proceeding handsomely. Many of the exhibits are completely installed; many of the hangings are in place, and booths constructed. I estimate the installation to be 60 per cent. complete, all told.

Great Britain.—The British section, occupying 6,000 square feet of exhibit space, has its exhibit installed 90 per cent. complete. The section of Great Britain is at present very handsome and attractive.

Germany.—The German section in the Palace of Electricity covers an area of 14,069 square feet of exhibit space. The installation is entirely completed in 12,000 square feet of this section, and presents a very handsome and attractive appearance. The remainder of this section is at the present time unoccupied.

Italy.—The Italian section in the Palace of Electricity covers an area of 2,500 square feet of exhibit space. A few boxes have been opened, and a small amount of apparatus set up. I estimate the installation to be approximately 20 per cent. complete.

Brazil.—The Brazilian section in the Palace of Electricity occupies an area of 410 square feet of exhibit space. This section is attractively installed, the booth and exhibit installation being entirely complete.

Japan.—The installation in the Japanese section covers 1,182 square feet of exhibit space. It consists of a very attractive booth, arranged in accordance with Japanese architecture, and an exhibit of electrical machinery and electrical instruments, with photographs of prominent installations. I estimate same to be 95 per cent. complete.

Denmark.—The Danish section in the Palace of Electricity covers 141 square feet of exhibit space. It is to be occupied by one exhibitor, Messrs. Helleseus, Enke & V. Ludvigsen, the exhibit of whom is now in transit.

Spain.—The Spanish section in the Palace of Electricity occupies an area of 132 square feet of exhibit space. The exhibit is now in transit.

Portugal.—The Portuguese section in the Palace of Electricity covers an area of 39 square feet, having a combined floor and wall area of 200 square feet. The exhibit has arrived and is on space, but not installed.

Mexico.—The Mexican section in the Palace of Electricity occupies 500 square feet of exhibit space. At the present time the booth is 80 per cent. complete. The installation has not yet been started.

Argentine.—The Argentine section in the Palace of Electricity covers 39 square feet of exhibit space, having a combined floor and wall area of 200 square feet. Exhibit has arrived, but has not been installed.

On the opening day there were in all 18 domestic exhibits which were connected up to the power mains and in working operation. These were as follows:

Shedd Electric and Manufacturing Company, occupying 140 square feet of exhibit space, had its exhibit complete, a large number of electric oscillating fans being connected up and in operation.

The Bristol Company, occupying 273 square feet of exhibit space, had both its booth and exhibit installation complete, with a large number of electric recording instruments, as well as its lighting system, connected up and in operation.

The General Electric Company, occupying 10,000 square feet of exhibit space, had its booth 85 per cent. complete; its exhibit installation is 65 per cent. complete. It had, however, one electric locomotive, two automatic portable boring machines, one electric searchlight, several arc lamps, and several mercury-vapor tubes, as well as several electric signs, connected up and in operation.

The Bullock Electric Manufacturing Company, occupying 5,439 square feet of exhibit space, had its booth entirely complete. It further had four electric equipments connected up and in operation and, in addition to these, had 14 large electrical items ready to operate.

The Heinze Electric Company, occupying 310 square feet of exhibit space, had its booth construction entirely complete, with electrotherapeutic apparatus connected, showing disruptive-discharge phenomena, etc.

W. Scheidel & Co., occupying 375 square feet of exhibit space, had its booth entirely completed and its exhibit apparatus completely installed and connected, showing the operation of disruptive-discharge phenomena.

Electric Controller and Supply Company, occupying 1,135 square feet of exhibit space, had its booth and exhibit installation 85 per cent. complete. It also had one system of electric control adapted for the operation of a large planer, and one electric-control system, adapted for the control of plate rolls in a boring mill, connected up and in operation.

Holophane Glass Company, occupying 2,362 square feet of exhibit space, had its booth installation 60 per cent. complete. Total cost of the booth is $20,000. The company also had a very handsome three-colored electric sign connected in with an electric flasher, and in operation.

Weston Electrical Instrument Company, occupying 992 feet of exhibit space, had its booth and installation entirely complete. The booth was beautifully illuminated, and the company's electrical instruments were connected up to show their working.

James Clark, Jr., & Co., occupying 568 square feet of exhibit space, had their installation completely installed, machines connected up and operating, showing the working of a model electrical machine shop manufacturing parts of electrical machinery.

American De Forest Wireless Telegraph Company, occupying 654 square feet of exhibit space, had its installation entirely complete, and was sending wireless-telegraph messages between its space in the Palace of Electricity and the Administration Building.

American Bell Telephone Company, occupying 2,336 square feet of exhibit space, had its very handsome booth entirely completed on the opening day and its installation 70 per cent. complete. The exhibit was connected up with the power mains, and in part in operation.

Miller Reese Hutchison, occupying 320 square feet of exhibit space under the colonnade in the Palace of Electricity, had the court of the Palace of Electricity encircled, so that wireless communication by telephone could be received at any point within the court, and at points within 50 feet from the court on the inside of the building. The installation was complete, and tested at midnight of the day before the opening.

Hutchison Acoustic Company, occupying 730 square feet of exhibit space, had its booth entirely complete, and its installation installed and operating. It had in attendance on the opening day two deaf mutes, demonstrating the use of the "acousticon" and the "massacon," in enabling these deaf mutes to hear, and thereby learn to speak.

The Central Telephone Company, occupying 372 square feet of exhibit space, had its exhibit 90 per cent. complete, and its apparatus wired up and in operation, showing the operation of the manufacture of electric fuses.

United States Electric Signal Company, occupying 97 square feet of exhibit space, showing electrical signal apparatus, had its exhibit completely installed and operating.

Kellogg Switchboard and Supply Company, occupying 3,465 square feet of exhibit space, had its telephone exchange 60 per cent. installed, connected up and operating. It also had four insulating machines wired up and ready to operate, but it was impossible to get power to them. The booth, which is very handsome, is 90 per cent. complete.

S. R. Dresser, occupying 150 square feet of exhibit space, had his installation and exhibit complete, wired up and operating.

Electric Storage Battery Company, occupying 1,444 square feet of exhibit space, had a very handsome installation, consisting of a working exhibit, which is 90 per cent. complete, connected and in operation.

A number of other exhibits were ready for power, but it was impossible to get current to them prior to noon of the opening day. They are as follows:

Northern Electrical Manufacturing Company, occupying 2,085 square feet of exhibit space, had its installation 70 per cent. complete, with 20 items, showing the application of electricity to industrial appliances connected up and ready to operate.

Wagner Electric Manufacturing Company, occupying 1,943 square feet of exhibit space, had its booth and exhibit completely installed, consisting of a large number of items, connected up and ready to operate.

Fort Wayne Electric Works, occupying 2,100 square feet of exhibit space, would have been able to operate interesting pieces of electrical machinery had it been possible to get power to them.

Westinghouse Electric and Manufacturing Company, occupying 7,843 square feet of exhibit space, having its booth 40 per cent. complete and its installation 65 per cent. complete, would have been in a position to operate several pieces of machinery, had it been possible to get current to them. In all, it had a large switchboard and 75 separate and distinct pieces of generator and motor machinery in place for exhibit on its space.

Triumph Electric Company, occupying 1,107 square feet of exhibit space, had its installation 80 per cent. complete, with 13 separate applications of electrical motor equipment, ready for operation.

Western Electric Company, occupying 5,764 square feet of exhibit space, had its exhibit installation 85 per cent. complete, and had a variety of electrical apparatus, including rotary converters, fan motors, electrical control equipments for machine tools, sewing machines, mill equipments, etc., all connected up and ready to operate.

American Electric Heater Company, occupying 790 square feet of exhibit space, had a complete electrical kitchen equipment, showing a wide variety of electrical apparatus for household and factory purposes, ready to operate.

Baldwin Locomotive Works, occupying 1,624 square feet of exhibit space, had its installation 60 per cent. complete, its three electric locomotives, fully equipped, being placed on the space.

The joint exhibit between the Standard Underground Cable Company and the McRoy Clay Works, occupying 1,042 square feet of exhibit space, was 90 per cent. complete, and represents a very handsome installation, showing the placing of electrical cables underground in conduits, and has attracted a great deal of attention.

National Electric Company, occupying 2,579 square feet of exhibit space, had its booth construction and its apparatus 90 per cent. installed, showing 15 separate and distinct generators and applications installed in its space.

The Dayton Electrical Manufacturing Company had its booth complete and its exhibit installation 50 per cent. installed, occupying 929 square feet of exhibit space.

Association of Edison Illuminating Companies, occupying 4,100 square feet of exhibit space, had its booth complete and its exhibit 70 per cent. installed. This is a very attractive installation, being an historical exhibit in honor of Mr. Thomas A. Edison.

Gould Storage Battery Company, occupying 1,056 square feet of exhibit space, had its booth 90 per cent. complete and its working exhibit 60 per cent. installed.

American Electric Fuse Company, occupying 481 square feet of exhibit space, had its booth entirely complete, and its exhibit 65 per cent. installed.

D. A. Kusel Telephone and Electric Manufacturing Company, occupying 341 square feet of exhibit space, had its booth and exhibit installation both entirely complete.

Faller Automatic Telephone Exchange Company, occupying 531 square feet of exhibit space, had its booth 60 per cent. complete. Its installation has not yet started.

Carl Bajohr, occupying 431 square feet of exhibit space, having an exhibit showing the proper insulation of lightning conductors for tall buildings and chimneys, had his exhibit 90 per cent. complete. It is an attractive installation.

Federal Electric Company, occupying 273 square feet of exhibit space, had its booth 90 per cent. completed.

Burdette-Rountree Manufacturing Company, occupying 294 square feet of exhibit space, had its installation of electrical push-button elevators completely installed and ready for connection to the power mains.

United States Incandescent Lamp Company, occupying 3,175 square feet of exhibit space, had its booth construction 30 per cent. complete. This company will install a complete incandescent electric lamp factory, showing every step in the manufacture of incandescent lamps. The installation will be completed within one week.

Electric Novelty and Manufacturing Company, occupying 1,031 square feet of exhibit space, had its

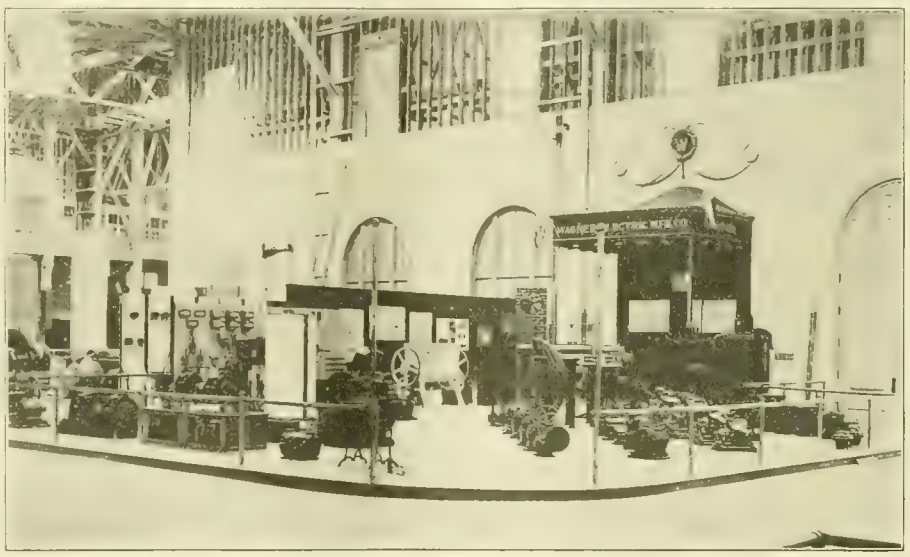


EXHIBIT OF WAGNER COMPANY AT ST. LOUIS EXPOSITION.

booth 70 per cent. completed. This company will show the manufacture of electrical novelties, and will be most attractively interesting.

C. H. Thordarson, occupying 500 square feet of exhibit space, represents an installation of high-tension electric-discharge apparatus, at a potential of 500,000 volts, and requires special installation construction, as well as time for completion of same. Exhibit has not yet been shipped.

The National Bureau of Standards, occupying 4,654 square feet of exhibit space, had its booth 90 per cent. completed and its exhibit installation about 25 per cent. completed; the remaining instruments for this operating standardization laboratory are in transit and will be delivered and set up very shortly.

American Carbon and Battery Company, occupying 210 square feet of exhibit space, had its booth and its exhibit installation entirely completed, connected up and ready for inspection.

National Carbon Company had its handsome exhibit of carbons entirely complete, the booth being built of large carbons which it manufactures, occupying 528 square feet of exhibit space.

The Electric Contract Company, occupying 150 square feet of exhibit space, had its exhibit completely installed, ready for inspection.

I estimate that the exhibits in the Palace of Electricity will be, to all intents and purposes, complete and ready for final inspection on Wednesday, May 11th, as practically all of the material not now in place on the exhibit space in the Palace of Electricity is outside of the exposition gates, awaiting entry into the exposition grounds. With one exception, every exhibitor in the Palace of Electricity had shipped his goods to St. Louis on or before April 15th, except where shipments have been made by express on or before April 25th.

It is worthy of note that the installation on the opening day in the Palace of Electricity was far more complete in all of its details and appointments, and especially in the matter of operating exhibits, than has been the exhibit on the opening day in any of the palaces of electricity of any of the expositions which have previously been held, if the records available and relating to installations of this character can be relied upon.

FIRST ILLUMINATION OF FESTIVAL HALL AND THE CASCADES AT ST. LOUIS

East St. Louis Electric Railways' World's Fair Service.

The street-railway interests of East St. Louis, Ill., have made provisions for the accommodation of World's Fair visitors coming from a radius of 150 miles of East St. Louis over the nine steam railroads which enter the city. By a convenient arrangement what is called the Great East Side Electric System will operate cars across the Eads Bridge over the Mississippi River from the Relay Depot in East St. Louis, direct to Third Street and Washington Avenue, St. Louis, Mo. It is the intention of this line to afford those coming to East St. Louis on excursions at reduced rates during the exposition an opportunity to benefit by cheap fare across the bridge and of still better facilities for reaching the fair grounds. For they will be landed in St. Louis at the turning point of the St. Louis electric-car system, where cars are empty and there is a first chance at seats. The various roads of the East Side system are equipped with cars of the most modern pattern and offer an opportunity of seeing the interesting and picturesque spots forming the eastern environments of St. Louis.

The royal Italian minister of finance has granted an Italian firm permission to import, free of duty, electric power by wire from a power station to be erected in Swiss territory. No provision, it seems, has been made in the Italian tariff for taxing imported electric power.

Working Electrical Exhibits at St. Louis.

[From the Exposition correspondent of the Western Electrician.]

In Machinery Hall and the Palace of Electricity working exhibits will be the rule and not the exception. In the latter building particularly, the exhibitors have responded to the importunings of Chief Goldsborough, and as a result there will be shown under this roof more working exhibits of every character than have ever been gathered together under a single roof. In comparing this with other expositions the exhibitors and the department are to be congratulated upon the remarkable showing made on the opening day, when over a score of working exhibits were shown complete and in full operation. The building, taken as a whole, was over 80 per cent. complete, and at noon on opening day, when the president of the United States closed the circuit that set in operation the exposition machinery and cascades, this building presented a more finished and tidy appearance than any exhibit building on the grounds. Over 400 men labored during the entire preceding night, and when morning came and the janitor force had gone over the building for the last time, every aisle was clear and on nearly every exhibit space material was in evidence. Hung with bunting and banners, the building presented a very attractive appearance, and soon after the conclusion of the ceremonies on the Plaza of St. Louis, the building was filled with visitors. The value of a working exhibit was soon made apparent by the crowds that gathered around the spaces where machinery was in operation, equally well arranged still exhibits attracting comparatively little attention.

The 30-ton crane installed by Pawling & Harnischfeger of Milwaukee, which has been used in the installation of exhibits, was moved up and down the west bay. This was the first working exhibit in operation in the building. The first complete operating installation, that of the American DeForest Wireless Telegraph Company, was surrounded with visitors during the entire day. The three slender towers rising above the roof trusses from which are hung the antennæ, constitute a model of the Seattle (Wash.) station, which the De Forest company is now erecting for its Alaskan work. Dr. Lee De Forest, the inventor and scientific director, and Mr. Abraham White, president of the company, were in attendance, and the transmission of messages to other parts of the grounds was watched with great interest by the people that surrounded the space. Earlier in the week congratulatory messages were sent to President Francis and other exposition officials in the Administration Building, a mile away, these being the first wireless messages sent from the Electricity Building.

Just across the aisle is the exhibit of James Clark, Jr., & Co. of Cincinnai, machine-tool makers, and this company's exhibit divided interest with that of the De Forest company. This was the first complete machine-tool exhibit in the building. Every machine was in operation, and during the day a large number of armature disks were punched and distributed as souvenirs, the first one being presented to Professor Goldsborough. The Japanese exhibit, in the same section of the building, although not yet operative, drew many visitors. A 100,000-volt transformer of 15 kilowatts capacity was probably the most interesting of the many pieces of apparatus exhibited. A direct-connected generating set, dynamos, motors and a collection of telephone apparatus are also shown.

A number of machines in the Bullock exhibit were also in operation, although this installation is not quite complete. The General Electric Company, in the east corridor of the building, attracted a large crowd by reason of its nearly completed exhibit of electrical machinery of a most varied and interesting nature. Mr. Patton spent the afternoon on a beautifully equipped and finished mining locomotive, which ran back and forth on a short stretch of track on the west side of the exhibit. The ease of manipulation of this 12-ton locomotive, which ran down the track and then back again, automatically picking up the cable that supplied the current for motors, was a source of wonder to the many visitors who had never seen a locomotive of this type. The General Electric Company also had several portable boring mills in operation, while crowning the dome of its beautiful booth was a marine searchlight controlled from the floor, that swept the eastern corridor.

The Hutchison Acoustic Company had its exhibit complete, and Mr. M. R. Hutchison gave demonstrations of his acousticon and massacon—electromagnetic instruments for the alleviation of deafness. Two congenital deaf mutes were provided by the Education Department, and these boys, who had heard no sound since birth, were made to hear music and the voice by using the acousticon. This instrument consists of a specially designed telephone receiver and transmitter, and a battery. The receiver amplifies the sound waves and imparts them to the auditory nerves. The massacon is a magnetic instrument which emits sounds in sharp saw-tooth form, and sets the ear drum in vibration, stimulating it in the same manner as weakened muscles are stimulated by massage, and restoring it to normal conditions.

Of the electrotherapeutic exhibits, that of the Heinze Electric Company was the first complete, and attracted the largest crowd. The feature of the display was the 30-inch induction coil, which is of novel design. Each coil of the secondary is taped to a micanite insulating sheet, and impregnated with a special preparation. The secondary sections are thus placed upon the insulating tube which covers the primary, but no paraffin is used in the construction. This design permits of the removal of any section of the secondary, in case of a breakdown, and the insertion of a new section, with but very little trouble. The discharge from this large coil, when operated with six one-gallon Leyden jars produces a spark over 30 inches long, with over 6,000 interruptions per second, and is accompanied by a report like a gatling gun that can be heard over the entire building. The smaller sizes of coils shown are similar to those recently supplied to the Japanese government for use in wireless telegraphy.

The booth of the Western Electrician was the only one of the electrical journals open for the reception of visitors, and many copies of the World's Fair number were distributed. The bookcases contained copies of the publications of the Electrician Publishing Company, and a complete set of bound volumes of the Western Electrician, dating from July 2, 1887, when the first copy was issued. Immediately west are located the exhibits of the Western Union and Postal Telegraph companies, and both of these were in full operation. These represent modern telegraph offices, and are the headquarters of the companies on the exposition grounds.

Two telephone central exchanges were also working, that of the Kellogg Switchboard and Supply Company being operated in connection with the Independent system (Kinloch), and that of the Western Electric in connection with the Bell Telephone Company of Missouri. The Kellogg booth is one of the largest and finest in the building, and contains, besides the main switchboard and accessories, a large number of sections for small exchanges, toll lines, etc., and a complete exhibit of the telephones and telephone appliances made by this company. The model exchange includes a main distributing frame equipped with the latest type of lightning arrester and sneak-current heat coil, an intermediate distributing frame and a complete power plant, including duplicate charging and ringing machines, power board and storage batteries. The switchboard proper consists of four sections of 3,600-line capacity, equipped for 1,200 lines, a chief operator's desk, a monitor's desk, wire chief's desk, and a multiple toll board. A feature of this exchange is the Kellogg harmonic four-party selective system. The power plan includes a multi-cycle ringing set, furnishing current at the four different frequencies required for the operation of the system.

The American Telephone and Telegraph Company

[Continued on page]

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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DATES AHEAD.

American Institute of Electrical Engineers (annual meeting), New York city, May 17th and 18th.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

American Society of Mechanical Engineers and the (British) Institution of Mechanical Engineers (joint meeting), Auditorium Hotel, Chicago, May 31st to June 3d.

Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.

Canadian Electrical Association (annual meeting), Hamilton, Ont., June 15th to 17th.

High-pressure Transmission convention of the American Institute of Electrical Engineers, Chicago, June 21st and 22d.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

FIGURES recently compiled hardly corroborate the impression that the German electrical industry is recovering, although slowly, from its recent depression. Thus the list of promotions in Germany during 1903 shows that three electrical companies were formed with a total capital of $1,500,000, as compared with 10 companies and $3,400,000 capital in 1902. These figures are instructive when contrasted with the companies established in former years, which represented in 1897 a share capital of $24,000,000, $11,500,000 in 1898, $8,500,000 in 1899 and $7,000,000 in 1900, while in 1901 the total capital of new electrical enterprises further declined to $1,600,000. It will be seen that last year was the lowest in electrical capitalization of all those named.

RADIO-ACTIVITY and its diverse and complex phenomena continue to engage the attention of scientific investigators at home and abroad. An interesting summary of the recent work of Professors Elster and Geitel on the radio-activity of the air and the soil is contained in a recent number of the Geneva (Switzerland) Archives des Sciences. In order to test whether the radio-activity of the air was inherent or induced from outside, a steel boiler of 23 cubic meters' capacity was kept closed during six weeks, and an aluminum wire was then introduced and negatively charged to a potential of 2,000 volts. No radio-activity was induced on the wire, and the air, isolated in this way from the rest of the atmosphere, was completely inactive. The radio-activity is attributed to an emanation produced by some radio-active substance in the soil which finds its way into the included air, and thence into the free atmosphere as well as into the water of mineral springs. An attempt was made to isolate the radio-active constituents of a specially active earth from the Italian Alps, and the results obtained were in accordance with the view that the soil contained a trace of radium; the hydrochloric-acid extract yielded a barium-sulphate precipitate about as active as potassium uranyl sulphate, and a platinum cathode immersed in the solution became, it is said—although this assertion seems open to doubt—permanently radio-active. Further support of this view is found in the fact that the induced activity separated from the air declines at the same rate as that induced by radium salts.

DALNY, the made-to-order city of Manchuria, is reported to have been occupied by the Japanese, and it is interesting to note that this capture may possibly enable the invaders to cut off the electric supply of Port Arthur. Just why Port Arthur should not have its own generating plant is not clear, for the two places are something like 25 miles apart, but of course the local conditions may be such that the transmission was thought advisable. However, Tokyo advices are to the effect that "In consequence of the capture of Dalny, Port Arthur's electrical supply will be cut off and searchlights and other lights required by the garrison will be seriously interfered with." Dalny is on the eastern shore of the Liaotung Peninsula. It is located on the site of several small Chinese fishing villages, but has shown a remarkable development in the last five years, being an important Russian seaport and railroad terminus before the outbreak of the war. On January 1, 1903, the population was 41,260. The city has substantial brick and stone buildings, schools, churches, clubs, a bank, a hospital and all the comforts of modern city life—or did have before the war was begun. It has telephones, waterworks, and electric lights. The electric-light and power station is one of the finest in Asia, with three Ganz generators having a total of 1,000 horsepower capacity and reserve space for as much more. If it is true that Dalny has been taken and also true that the plant in that city supplies the Port Arthur fortifications with current, the blow will be a serious one to the garrison of the besieged city.

DR. RICHARD STRAUSS, the musical composer, calls attention to an improvement which should be made in the electric-light wiring of sleeping rooms in American houses and hotels. In many German hotels there are two places in each sleeping room where the electric light can be turned off—one by the door where the guest enters, and one close beside the head of the bed. This comfortable arrangement Dr. Strauss greatly missed. "I retire for the night and wish to read until I grow sleepy," he said. "A half hour passes and I feel drowsy. I close my book, reach out to turn off my light, and go to sleep. Not an electric button in sight. I have to climb out of bed, walk clear across the room, turn out the light, grope my way back through the darkness, and land in bed so wide awake again that I lie there another half hour in the dark before I grow drowsy enough to fall asleep." The convenient bed-side switch is uncommon in American hotels, if it exists at all, although, curiously enough, not a few sleeping-car berths are provided with it.

THE recent explosion in the battery room on board William K. Vanderbilt's turbine yacht Tarantula, while doing no great harm, emphasizes the fact that care must be taken to follow the rules laid down by the storage-battery companies in the operation of batteries. According to the meager reports of the accident printed in the daily papers the explosion took place while the yacht was lying awaiting repairs, and it was said that one of the storage batteries "blew up." Of course this was not literally the case, the explosion being undoubtedly due to the accumulation of gases in the battery room. It is a well-known fact that oxygen and hydrogen gases when combined in exactly the right proportions form an explosive mixture, and a storage battery while being charged gives off these two gases. This fact, together with a probable lack of ventilation in the battery room of the boat, evidently led to the explosion, it only being necessary for some one carelessly entering the room with a light to ignite the gases. The occurrence was a very uncommon one, but the possibility of such an accident taking place is well recognized by makers of storage batteries, who provide in the rules for operation that no light shall be brought in the vicinity of the battery during charging where the installation is in a confined place. One reason why there are not more explosions of this nature is the difficulty of confining hydrogen gas, which will even pass through sheet rubber. But very likely the battery room on board the yacht was caulked up air and water tight, giving no opportunity for the escape of the gases.

CHEAP power is of course an important factor in the development of manufacturing industries. Other considerations are the conditions of the labor market, proximity or favorable transportation of raw materials and accessibility to the market for the product. In the first of these conditions, thanks to Nature and modern possibilities in the way of transmitting power by electricity, the Niagara district is conspicuously favored. In the others it is at no great disadvantage. General F. V. Greene, manager of the Ontario Power Company, considered the problems involved in an address on "The Future of Western New York," recently delivered before the Economic League of Lockport. He seemed to think that with intelligent effort much of the flour milling now done at Minneapolis, the shoe manufacturing of Lynn, and the woolen manufactures of New England cities could be centered in the region about Niagara Falls. "The development of cheap power at Niagara," he said, "will furnish cheap motive power for factories and for metallurgical industries which depend entirely upon cheap electricity and will also reduce the cost of transportation by rail. On these two factors—cheap transportation and cheap power—our hopes are built." Other localities have also cheap power and cheap transportation, and the question of raw materials, the prestige of years of successful operation, labor conditions and other factors are also to be considered. But it does seem that the Niagara frontier, with its peculiar advantages, is bound to attract manufacturing industries in increasing number, although not at such a rapid rate, perhaps, as its exploiters fondly imagine.

New Steam-turbine Developments.[1]

By W. L. R. Emmet.

The first vertical-shaft turbines built by the General Electric Company were of 500-kilowatt, 1,500-kilowatt and 5,000-kilowatt capacities, and in the matter of arrangement of stages, nozzles and buckets were very similar to the horizontal-shaft machines originally built. In these respects they were based upon the ideas embodied in Mr. Curtis' first conceptions. The first of these vertical-shaft machines was put into commercial operation less than a year ago, and since then about 50 have been shipped and at least 20 have been put into service. In operating all these machines there has been ample opportunity to test the practicability and value of the novel features which they embody.

The first machine of this type to be put into service was of 500-kilowatt capacity, and was installed at Newport, R. I. Since its installation two other similar machines have been put into the same station. The first of these machines has been in service since July, 1903, and the other two have been in service for several months. The service of this station has been carried by these turbines without interruption, and the results accomplished by them have been very satisfactory. Several troubles were discovered soon after starting, and much experimenting has been done with the owner's consent, this plant being, by agreement, selected for this particular purpose. These experiments have led to the circulation of reports of trouble, but in reality have not arisen from any trouble of a very serious character. A short time ago tests were conducted on these machines by George H. Barrus on behalf of the purchasers, with a view to ascertaining whether they

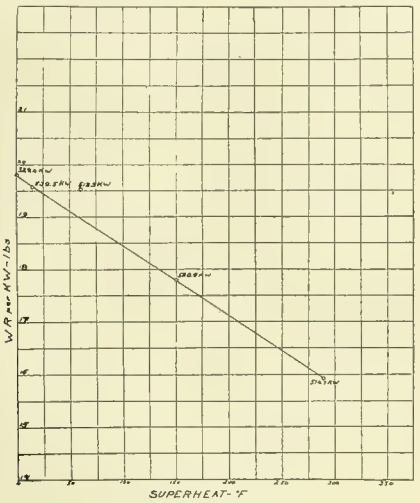


Fig. 1. Curve Showing Effect of Superheat on Steam Consumption.

had met the guarantees of the contract. The tests showed that the contract guarantees had been met and also showed many of the practical advantages of machines of this type. The following report gives the results of tests made upon a 500-kilowatt turbine set manufactured by the General Electric Company and installed at Newport, R. I. This set is equipped with a 60-cycle, 2,300-volt generator and is used for a supply of current for lighting and railway purposes, the railway work being the most important part of the load. The tests were conducted by George H. Barrus of Boston, who represented the owners, the Massachusetts Electric Company, Richard H. Rice, recently of Rice & Sargent, and A. R. Dodge, who represented the General Electric Company. Tests were made and water rates measured with various conditions of fixed load with and without superheat, as shown by the curves (Figs. 1, 2 and 3). Tests were also made with such commercial loads as are daily experienced in this plant, and the steam consumption per kilowatt-hour under working conditions was ascertained by the most careful determinations of the total water condensed, and the load as measured by many instruments and as recorded by carefully checked recording wattmeters.

Attention is specially called to the records of operation under commercial load, since they illustrate the great practical advantage afforded by apparatus of this kind. Diagrams of the load taken during these tests indicate incessant fluctuations, with an average sudden variation of about 100 kilowatts, and with an average load of only 253 kilowatts in one case and 421 in another. In the former case the average steam consumption per kilowatt-hour was only 22.38 pounds. It can be positively asserted that the best steam engines now used for such purposes, in this country, would consume at least 28 pounds of steam per kilowatt-hour under such load conditions, and in most cases the consumption would be considerably larger. The consumption of 20.73 pounds per kilowatt-hour with an average of 421 kilowatts of such variable load, is also a very fine performance.

In considering these results, it should also be borne in mind that the plant which gives these results possesses many other practical advantages which conduce to economy. All the condensed water in this plant, since it originally started, has been returned directly to the boilers, and the boilers are, consequently, at the present time in a perfectly clean condition, although the natural water supply of Newport is bad. During all this time no oil has passed into the boilers nor been wasted; it is simply circulated and used over and over again. The absence of air leakage in the turbine, and the absence of air in the feed water, greatly simplify the maintenance of a good vacuum, which, of course, contributes to these excellent practical results. The whole arrangement of this plant is compact, simple and easy of maintenance, and the results are representative of those which can be obtained anywhere from such apparatus where the water for condensation is available.

These results were obtained from the first of our commercial turbines, and we expect in future work to greatly exceed the degree of economy here shown. Since the design of this machine our turbines have been greatly changed and improved, and these results should not be considered as representative of the type. It is questionable, however, whether practical results under service conditions as good as these can be shown by other existing engines or turbines, although less water consumption may be shown under certain conditions of load.

Following is a summary of commercial runs of January 15 and 26, 1904:

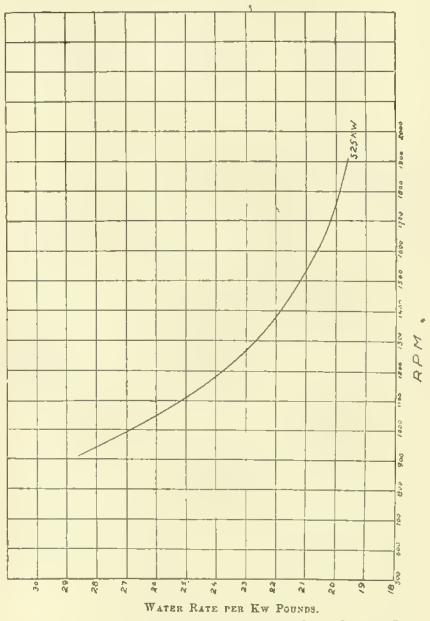


Fig. 2 Curve Showing Effect of Speed on Steam Consumption.

NEW STEAM-TURBINE DEVELOPMENTS.

	January 15, 1904	January 26, 1904
Duration	12 hours	15 hours
Total coal (wet)	13,517 pounds	10,205 pounds
Moisture in coal	3.1 per ct.	5.5 per ct.
Water evaporated	127,267 pounds	104,026 pounds
Drip withdrawn from steam pipe per hour		46 pounds
Moisture by calorimeter	3.05 per ct.	2.1 per ct.
Total steam to turbine	108,100 pounds	86,833 pounds
Steam per hour to turbine	9,008.5 pounds	5,769 pounds
Dry steam per hour to turbine	8,733.8 pounds	5,667 pounds
Load by polyphase meter	406.4 kw.	234.7 kw.
Load on auxiliaries (average)	14.9 kw.	18.5 kw.
Total load (average)	421.3 kw.	253.2 kw.
Dry steam per kw.-hour	20.73 pounds	22.38 pounds
Dry coal per kw.-hour	2.67 pounds	2.54 pounds

In October, 1903, the first 5,000-kilowatt turbine was installed in the new plant of the Chicago Edison Company. This machine was put into commercial service soon after its installation, and since that time two others have been installed. The first machine has been in commercial service daily since its original starting, and the second machine has been in service for several months past. Neither of them has been subject to any interruptions of service through its own defects, and for some time past they have both operated almost continuously. They have, on some occasions, been kept under load for five days without stopping. In many cases they have operated with extreme overloads and have regularly been depended upon throughout the winter. Several unforeseen troubles have been experienced with these machines. The valves, as originally designed, have been subject to difficulties, and have been replaced by valves of such improved construction as could be applied without loss of time or interruption of service. This trouble with valves has, however, caused no stoppages, since the principle of governing is such that each valve operates independently, so that the failure of one simply serves to throw the work on to the next in order.

There have also been in Chicago certain unexpected movements of wheels, through variations of temperature, which have made necessary certain adjustments which were not originally intended. The fact that machines have been required for daily service has made it impossible to correct the cause of these difficulties and has occasioned a little inconvenience in handling them. No trouble has arisen in connection with these, or other machines, which is not readily curable and which cannot be avoided in all future machines, and none of the troubles has been of sufficient magnitude to interrupt the continuity of service or appreciably impair the efficiency of action.

The machines in Chicago operate with wonderful steadiness and freedom from vibration under all conditions of load. The generators are cool and have given no trouble whatever. The electrical regulation is good and the speed control has always been perfect, in spite of the difficulties with valves above mentioned. The machines have repeatedly been subjected to sudden accessions of heavy load, in cases of accidents with other apparatus, and have repeatedly been called upon to operate non-condensing without interruption of service, through some failure of the condensing facilities. In all such cases they have successfully performed the duty for which they were designed. The step bearings have never given any trouble from the time the plant was started. Some changes are still contemplated in connection with these machines, and they will be applied when any of the machines can be spared from regular service. These changes are not of an important character, and it is expected that they will overcome the small inconveniences which remain. No official tests of the Chicago units have ever been made, and no accurate knowledge concerning their steam consumption is possessed. Tests were begun at one time, but a large and variable leakage in the condenser made it impossible to weigh water, and testing was postponed on account of the late season, which made it necessary to keep the machine in commercial service. The facilities for shipment limit the diameter of a 5,000-kilowatt machine of the Chicago type, and it is therefore designed for a lower peripheral velocity than other machines of the kind. It was guaranteed to give about the same steam

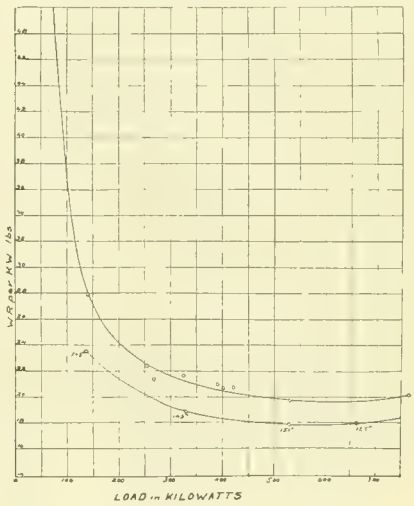


Fig. Curves of Steam Consumption With and Without Superheat.

economy as the machine at Newport, and it is probable that it gives a very similar result.

As has been said, the development of our ideas led us to adopt new principles of turbine designs before the machines above mentioned were put into service, and it is only very recently that the first machine of this new type has been run and tested. These new condensing turbines, which have been designed within the last year, are still of the vertical-shaft type, but have four stages, while the machines above mentioned have only two. In each of these four stages there is a cast-steel wheel carrying at its outer edge two rows of buckets, the stages being separated by diaphragms which form separate compartments, and which are so shaped as to bear the pressure of steam to which they are subjected. In these diaphragms, or attached to them, are sets of nozzles which deliver the steam to the wheel of the succeeding stage, the number and size of these nozzles, and the portion of the circle which they cover, increasing from stage to stage as the steam expands. The wheels of these machines are of extremely simple construction and the attachment of buckets is simple and strong. They are operated with ample clearances and no adjustment whatever is required in their operation under any conditions. The machines can be started immediately, without preliminary heating, and require no adjustments with changes of temperature, load or vacuum. These new machines are governed solely by the original admission of steam, the number of first stage nozzles in flow being controlled by the governor and always kept proportional to the load. The stationary buckets in these machines project from heavy strips of metal fitted in slots and firmly held to the stationary part by heavy bolts from the outside. The construction is such that the injury through accidental interference between the moving and stationary parts is very small, no distortion or warping being possible. The construction of the machine, however, and the ample clearance, make it easy to avoid such touching altogether, even where machines are started for the first time.

We have recently tested a 2,000-kilowatt machine of our new four-stage type, under the conditions of vacuum and superheat afforded by our Schenectady power station. These tests have not yet been carried far enough to fully analyze the possibilities of this

1. Abstract of paper read before the Engineers' Club of Philadelphia on March 19, 1904

machine with the best adjustment of shell pressures and all other conditions. The tests have, however, shown remarkably fine steam economy, and it is probable that still better results will be produced within a short time. The results and conditions of some of these tests are as follows:

	February.			March.				
	24d	25th.		11th.		12th.		
	1	2	3	4	5	6	7	8
Load in kilowatts	1,750	2,400	1,740	2,210	2,760	650	1,000	2,000
Revolutions per minute	760	760	760	750	750	750	750	750
Gauge pressure	140.5	156.5	155	160	160	150	160	160
Superheat, F.	200	200	202	212	192	215	242	242
Inches of vacuum	28.5	28.5	28.7	28.50	28.25	28.2	28.9	28.8
Pounds of water per kilowatt hour	14.2	13.5	15.30	15.20	16.20	20.1	16.30	15.30

After the first two tests here reported, a change in the arrangement of the machine was made, and this change produced an unforeseen condition, which we think was very disadvantageous to the machine. All the tests given were made with the best facilities for long periods with perfectly fixed conditions, and we have every reason to believe that all are nearly correct. The tests made under the second condition were witnessed by many prominent engineers, and all the conditions were accurately verified. It seems to be quite certain that the best arrangement of the machine will give a result better than any that has been obtained. While these tests do not give a complete and conclusive record of the possibilities of this machine under all conditions, they certainly demonstrate that its steam economy is superior to that of most engines or turbines which are available for similar purposes.

Satisfactory tests, without superheat, have not yet been made upon this machine. The indications of such tests as have been made are that the improvement with superheat is very large, and that in this respect the functioning of the machine is very similar to that of the Parsons turbines, which show more benefit from superheat than the earlier turbines of the Curtis type. The use of high degrees of superheat has been considered commercially desirable in connection with the Parsons turbines, and the indications are that the same reasoning applies to machines of this type.

These machines are designed to operate with superheat, without any mechanical difficulty, and it is probable that future steam plants designed for the use of such apparatus will use high steam temperatures. In the course of tests with experimental turbines, Mr. A. R. Dodge of Schenectady has observed certain conditions which indicate serious errors in the ideas previously accepted concerning the specific heat of superheated steam, and these observations have led us to make investigations of this matter. By delivering superheated steam to a turbine fitted with a water brake we can, at will, vary the amount of work extracted from the steam, until the exhaust is brought to a saturated condition. If we know accurately the temperature and weight of exhaust steam, and the temperature and pressure of the steam admitted, and have an exact measure of the work extracted from the steam, and of the heat radiated, we have in our possession all data necessary to calculate the total heat of steam admitted. This method of test is subject to certain difficulties and inaccuracies, but has the advantage that it can be carried on on a considerable scale with large flows and steadily maintained conditions. We have made such tests with different degrees of superheat, and have checked approximately some of our results by other methods of investigation. The result of these tests indicates that the specific heat of superheated steam under the conditions ordinarily used is much greater than has generally been supposed. The idea, generally accepted, until quite recently, has been that the specific heat of superheated steam under all conditions was 0.48. Our investigations indicate the following figures, for values of C_p at 155 pounds absolute (C_p being the average of specific heat up to these temperatures, not the heat required for a rise of 1° at these temperatures):

Superheat.	C_p
0° F.	0.52
100° F.	0.65
150° F.	0.7
200° F.	0.71
250° F.	0.75

It is probable that our investigations on this subject will be carried further, and that Mr. Dodge will publish fuller and more accurate figures. Since this work was done, very similar figures have been arrived at independently and by different methods in England and in Germany.

The design of steam turbines is susceptible of many variations in mechanical arrangement and steam action. It is probable, however, that the four-stage machine here described will hold its own against all competing engines for some time to come, and that it will be extensively used.

John R. Piercy, president of the Southern Illinois Electric Railway Company, has been to St. Louis, where the contract was closed with the Traction Engineering and Construction Company of St. Louis for the complete construction and installation of all the lines and branches of the electric railway. It is hoped to have the line from Belleville to Okawville, Ill., completed by July 15th.

Lamme Single-phase Railway Motor.

Now that the single-phase system for electric traction is attracting so much attention, those interested in the subject will be glad to follow the various patents taken out on apparatus for this purpose as indicative of the advancement in the art. One of these patents, and an important one, is that issued to Benjamin G. Lamme, assistant chief engineer of the Westinghouse Electric and Manufacturing Company and assigned by him to that company. It is dated May 3, 1904, and the application was filed December 26, 1901.

In describing the system it will be found convenient first to consider the principles to be applied in order to produce an efficient motor for alternating-current traction work. The prime characteristic is that the torque shall increase with the current. Such a motor is the seat of three principal electromotive forces: (a) the electromotive force of self-induction in the field due to alternating magnetic flux acting through the field-turns; (b) the electromotive force of self-induction in the armature due to cross-induction from the armature through the poles, and (c) the armature counter-electromotive force due to rotation.

The electromotive force of self-induction of the field is due to the alternating magnetic flux acting through the field-turns and depends upon the induction per pole, the number of field-turns in series, and the rate of alternation. The electromotive force of self-induction of the armature is due to cross-induction from the armature through the poles and is dependent upon the construction of any given motor and may be modified in various ways, as will be presently pointed out. The armature counter electromotive force depends upon the number of armature wires in series, the induction per pole, and the rate of revolution, and is independent of the rate of alternation. As the electromotive force of field self-induction and the armature counter-electromotive force both depend upon the induction per pole, there is an intimate relation between them. This relation is a function of the speed, the windings, and the rate of alternation. The higher the speed and the lower the rate of alternation and the fewer the field windings compared with the armature windings the lower will be the ratio of the electromotive force of field self-induction to the armature counter-electromotive force. As the current in the motor increases the field magnetic strength and the armature magnetic strength increase, and the torque is proportional to the product of these two strengths. If there is no magnetic saturation, the field strength will increase directly with the current, and the armature strength will also increase directly with the current, and consequently the torque will increase as the square of the current in the motor.

Two cases may be described—the first that in which the field magnetic strength increases in approximate proportion with the current, and the second that in which the field magnetic strength is constant, and therefore independent of the strength of the current. The first case represents an ideal condition for certain operations—such, for instance, as those required in railway service; but it has its limitations in that the greatest torque which can be developed may be insufficient for the maximum requirements. In the second case the torque which can be developed is practically unlimited; but, on the other hand, the general characteristics of the motor may not be well adapted for the given conditions of operation. It is desirable, therefore, in certain cases to so design and proportion the motor as to combine some of the elements of both arrangements, and thus secure a motor which will through a certain range of working have a field magnetic strength approximately proportional to the current and yet be capable of developing the required maximum torque.

As the electromotive force due to cross-induction of the armature through the poles acts with the electromotive force of self-induction of the field in limiting the flow of current, it is desirable that this should be kept within proper limits. It follows, therefore, that the electromotive force of self-induction of the motor as a whole in normal working should be relatively small with relation to the applied electromotive force and should also have a limiting value which is less than the applied electromotive force, even when the motor is operating under maximum conditions of torque. The desired relatively low electromotive force of self-induction of the motor may be obtained by suitable general arrangements and proportions between the various elements of the motor, while the limiting value of this electromotive force of self-induction may be secured by means of special constructions of certain parts. In order to determine the general proportions to be used for securing the relatively low electromotive force of self-induction it is necessary to consider the general relations existing between the different elements within the motor itself and also between the motor and the conditions under which it is operated, such as the speed of the motor and the frequency or rate of alternation of the current supplied to the motor. The electromotive force of self-induction of the field is generally much greater than the electromotive force of self-induction of the armature due to cross-magnetic flux, so that special provision should be made for reducing the electromotive force of self-induction of the field.

The electromotive force of field self-induction is dependent upon the induction per pole, the number of field-turns in series, and the rate of alternation. The armature counter-electromotive force is dependent upon the induction per pole, the armature winding and the rate of revolution. These relations may be expressed as follows: Electromotive force of self-induction of field equals alternations multiplied by field-turns in series multiplied by induction per pole multiplied by constant. The counter-electromotive force of the armature equals revolutions multiplied by the number of armature wires multiplied by induction per pole multiplied by constant. The constants used are dependent upon the characteristics of the supply circuit and upon the units in which the different terms are expressed, their values are determined in any given case according to well-established laws, and the armature winding is assumed to be of the usual parallel type. We have, therefore, the following relation between the electromotive force of self-induction of the field and the counter-electromotive force of the armature:

$$\frac{\text{Electromotive force of field self-induction}}{\text{Armature counter-electromotive force}} = \frac{\text{Line alternations} \times \text{field-turns in series} \times \text{induction per pole}}{\text{Revolutions} \times \text{armature-wires} \times \text{induction per pole}} \times \text{Constant}$$

or

$$\frac{\text{Electromotive force of field self-induction}}{\text{Armature counter-electromotive force}} = \frac{\text{Line alternations}}{\text{Poles} \times \text{revolutions}} \times \frac{\text{Field ampere turns}}{\text{Armature ampere-turns}} \times \frac{\text{Constant}}{2}$$

In order that the ratio between the electromotive force of field self-induction and the counter-electromotive force of the armature may be low, it is necessary that the values of the terms in the numerator of the second member of the equation be made small with relation to the values of the terms of the denominator. Such a ratio is secured, on the one hand, by having a small number of line alternations, a large number of poles, and a high speed, and by having a small number of field ampere-turns and a relatively large number of armature ampere-turns.

The absolute values and the ratios between these several elements which are admissible and suitable for practical design and operation will now be considered. The ratio of field ampere-turns to the armature ampere-turns has generally a minimum value, which is fixed by the proper operation of the motor itself. If the field ampere-turns are too small as compared with the armature ampere-turns, the magnetic field will be distorted and good commutation will be difficult. The minimum ratio of field ampere-turns to armature ampere-turns is dependent upon many factors in the design; but in general it may be said that this ratio should be greater than 0.5, and may sometimes be as high as 0.75. Therefore when definite limits have been assigned to two of the ratios in the last equation—namely, the ratio of electromotive force of field self-induction to armature counter-electromotive force and the ratio of field ampere-turns to armature ampere-turns—then there is also a definite limit fixed for the remaining term in the equation—i. e., a definite relation between the alternations in the supply circuit, the number of poles of the motor and its rate of revolution, or, in other words, between the line alternations and the armature alternations. It may be noted that an average working value for the last-mentioned ratio is approximately 0.625, and it has been found that the expression $\frac{\text{constant}}{2}$ in the foregoing formula closely approximates the reciprocal of 0.625—i. e., 1.6. It follows, therefore, that the last two ratios of the formula cancel out, leaving only the ratios of electromotive force of field self-induction to armature counter-electromotive force and line alternations to armature alternations for which definite limits are fixed, as hereinbefore pointed out. With a given number of revolutions the number of poles must be directly proportional to the alternations in the supply circuit. Thus, for instance, if an eight-pole 700-revolution motor of a certain capacity is required for 2,000 alternations per minute, 3,000 alternations per minute will require a 12-pole motor at 700 revolutions per minute.

The electromotive forces of field self-induction and armature self-induction may both be limited by special construction of the pole-pieces. For instance, slots or holes may be cut in the body of each of the field poles-pieces. The cross-section of iron in the poles is preferably such that but little magnetizing power is absorbed in addition to that required for the air-gap until the current exceeds the normal rated amperes of the motor. Beyond this normal current the teeth between the pole-slots rapidly approach saturation. In order to secure this result the parts in which the cross-section of the magnetic circuit is reduced should be of comparatively short length, but should of course be worked at a high induction. The electromotive force of self-induction of the armature which results from a cross-induction through the poles in which the mag-

netic lines enter at one edge or side of the pole and pass through the core to the opposite edge or side may be reduced and limited by the arrangement of slots or holes, which has been described and which would not be obtained in the same degree if the whole yoke were saturated, provided the field-cores in the two cases required the same number of ampere-turns in the field for magnetizing them.

The cross-induction of the armature is due to the magnetic flux which passes through the field-poles, the path for any given pole being through the teeth at one side, then across the slots, and also across the pole back of the slots, and then along the teeth at the other side of the pole and back to the armature. The smaller the section of the teeth and the more highly they are saturated the less will be the cross-induction with a given current in the armature. The total useful flux through the armature and field sets up no effective electromotive force of self-induction in the armature windings, as it will add to the counter-electromotive force at one part and subtract at another part of such winding; but the electromotive force set up by the cross-induction does not neutralize itself in the same way, and thus becomes an electromotive force of the same character as that set up in the field windings. The cross-flux from the armature may be further limited by the suitable interposition of a secondary circuit if desired.

The armature winding of the motor is of the closed-coil type and is closed upon itself before being connected to the commutator, relatively high resistance leads being inserted between the winding and the respective commutator bars.

As the magnetic field of the motor is alternating any short-circuited turn through which the magnetic flux from a field pole passes will have a secondary current set up in it. By the well-known laws of the transformer the ampere-turns in such short-circuited secondary will approximate the ampere-turns in the primary winding, which is in this case the field-magnet winding. Certain coils of the armature winding are short-circuited through the brushes when the adjacent commutator bars to which the ends of the coils are connected are bridged by the brushes, and when the latter are located in neutral positions or without lead the short-circuited turns surround the paths of the magnetic flux, and are therefore good secondary circuits in which relatively large secondary currents are set up by induction. This is the principal cause of the excessive sparking in series motors of ordinary construction when it is attempted to operate them upon an alternating-current circuit. In order to obviate destructive sparking the current in the short-circuited turns of the armature coils should be limited to an amount materially less than what would normally flow. By inserting a definite amount of resistance in each of the leads between the closed winding and the commutator bars it is possible to so limit the secondary current due to the alternating field flux as to prevent injurious sparking. The working currents in the armature winding will not pass through these resistances except at the bars in contact with the brushes, because the armature winding is closed on itself inside or beyond the resistance leads. Consequently the loss in the winding due to the introduction of the resistance can be relatively small, and when the armature is rotating this loss is distributed successively through all the resistances, thus making the average loss per resistance-lead very small.

In the accompanying drawings, Fig. 1 is a view,

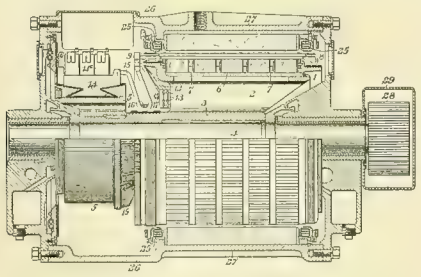


FIG. 1. LAMME SINGLE-PHASE RAILWAY MOTOR.

partially in side elevation and partially in longitudinal section, of a motor constructed in accordance with Mr. Lamme's invention. The armature comprises a skeleton open-work frame or spider (2), the hub of which is in the form of a sleeve mounted upon and suitably keyed to a shaft, this sleeve being extended at one end to receive a commutator cylinder (5), which is also suitably keyed to it. The core of the armature is built up in the usual manner of thin plates or laminæ properly spaced apart at intervals by ventilating spacers and provided with slots, which in the present case are 72 in number, in which are mounted the insulated conductors (8), constituting the coils of the armature winding. These coils or conductors, as shown, are of strap copper, the turns of which are located side by side in the slots, forming three separate coils, which span the core from the first to the ninth slot, and so on around the core. The armature winding is closed and connected to balancing rings inside of the connections made to the commutator segments.

The commutator brushes (14ª) are arranged in sets in the holders or arms, and the arms or holders are eight in number. The brushes and arms may be of usual materials and construction and connected in the usual manner to properly co-operate with the commutator cylinder and the supply circuit.

The field-magnet core is in the form of a hollow cylinder and is built up of thin plates or laminæ, the laminated construction being necessary by reason of the fact that the magnetic flux due to the field-magnet winding is alternating. The polar projections or pole-pieces are provided with holes or perforations, extending through them transversely to the direction of armature rotation and located in close proximity to the ends of the polar projections or pole-pieces, and the depth of the body portion of the core is reduced at the rear of each polar projection in order to aid in reducing the cross-mag-

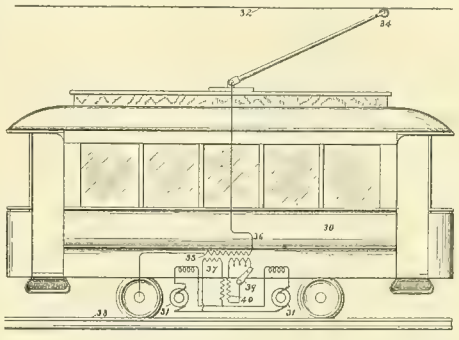


FIG. 2. CONNECTIONS OF LAMME MOTOR ON CAR.

netization, and consequently the armature self-induction. The slots are made comparatively shallow in order to keep the iron loss low and at the same time to insure the desired saturation of the adjacent iron when the current materially exceeds the rated amperes of the motor.

The field-magnet winding comprises eight coils of strap copper bent edgewise and connected in series and so insulated and supported as to perform the functions desired and at the same time be effectively insulated and occupy a minimum amount of space.

Referring to Fig. 2, a railway car is shown as equipped with two of the motors described, which receive energy indirectly from an alternating-current-supply circuit, one side of which is indicated as an overhead conductor and the other side as the rails. Obviously the well-known third-rail construction might be employed, if desired, and also completely insulated supply and return conductors, either both overhead or both beneath the car, might be employed. The energy from the supply circuit traverses the primary winding of the transformer (36). This transformer is provided with a secondary (37), which is of such dimensions as to provide the reduced voltage necessary for the motors, and, as shown, the two motors are permanently connected to this secondary in parallel. As has been heretofore stated, the motors may, if desired, be permanently connected together and to the supply circuit in series. The transformer is also provided with a secondary winding (38), the active length of which is variable by means of a suitable switching device (39). Included in circuit with the secondary is the primary of a series transformer (40), the secondary of which is included in the circuit of the motors and in the secondary of the main transformer. It will be readily seen that a high voltage suitable for long-distance transmission may be supplied from the main circuit to the primary of the transformer (36), and that a low voltage suitable for motors may be supplied thereto from the secondary (37). In order to vary the voltage supplied to the motor, the variable voltage of the secondary (38) may be impressed upon the circuit (37) through the series transformer (40), and by reversing the connections of the secondary this variable-impressed voltage may be employed to both subtract from and add to the voltage of the circuit through all of its varying values and thus provide the necessary variation of motor speed from zero to the desired maximum. It will be seen that with this combination and arrangement of apparatus the motors may be designed for such voltage and such current as are best adapted for their operation and that the controller may be designed for some other voltage and current which are best adapted for its operation and that they may then be joined together and to the high-voltage supply circuit so as to operate together harmoniously and effectively. Various arrangements of circuits and apparatus for securing a variable electromotive force for application to the motors may be employed. For example, instead of varying the active length of a portion of the main transformer winding the magnetic relations of the primaries and secondaries may be varied by adjusting one of the parts with reference to the other in a well-known manner, or such adjustment may be combined with means for varying the active length of a portion of the transformer winding.

At the annual meeting of the Albion (N. Y.) Electric Railway Company new directors were chosen and C. B. Hill of Buffalo was elected president and F. B. Griffith, Jr., of Buffalo, secretary and treasurer. It was decided that work on the extensions of the road, which is practically completed in Albion, to Rochester and Lockport, should be begun at once.

COMMUNICATION.

Alternating-current Working.

To the Editor of the Western Electrician:

In your paper of April 30, 1904, in Part III. of Mr. W. B. Gump's article on "Alternating-current Working," the following formula is given for the voltage generated in an alternator armature:

$$E = \frac{2.22\ \phi\ f\ c\ N}{10^8 \times 60}$$

where ϕ = flux per pole,
f = frequency,
c = number of conductors in series,
N = revolutions per minute.

The usual form of this equation is $E = \frac{4.44\ \phi\ f\ c'}{10^8}$, where c' is the number of turns or using conductors

$$E = \frac{\frac{4.44}{2}\ \phi\ f\ c}{10^8}$$

I believe there is a mistake in your equation in using both frequency and revolutions per second and would point out that, since the frequency in cycles per second $= \frac{\text{r. p. m.}}{60} \times$ half number poles, if you would make f in your equation equal the number of pairs of poles, then $\frac{f\ N}{60}$ will equal the frequency, and the equation will at once clear itself up.

I have followed this series of papers with much interest and offer this criticism in the best spirit of good-will. TERRY T. KING.

Fort Wayne, Ind., May 6, 1904.

Answering Mr. King, the writer of the article says:

I am glad indeed to have the evidence that my formulas have been scrutinized and I am grateful to Mr. King for having called my attention to an error which is indeed misleading to a student unfamiliar with the derivation of the equation. In regard to it I wish to say that in going over a number of formulas on the same sheet I thoughtlessly wrote f for p. My equation was intended to read:

$E = \frac{2.22\ \phi\ p\ c\ N}{10^8 \times 60}$ where p = number pairs of poles, which, as Mr. King states, is equivalent to

$$E = \frac{4.44\ \phi\ f\ c'}{10^8} \qquad (a)$$

or

$$E = \frac{2.22\ \phi\ f\ c}{10^8} \qquad (b)$$

Equation (a) is identical with the formula for the electromotive force of a transformer, and will be found in Part IV. of "Alternating-current Working."

It should be noted that none of these equations for electromotive force takes into account the factor known as the "distribution constant," wich varies according to the nature of the winding on the armature. The "distribution constant" ranges in different machines from 0.9 to unity. If K = this constant, as determined by the winding, then the exact equation is

$$E = \frac{2.22\ K\ \phi\ c\ f}{10^8}$$

where f is cycles per second.

I invite inspection of the remaining articles and will be grateful to any of the readers of these articles who call my attention to "slips" similar to this one. W. B. GUMP.

Niagara Falls, N. Y., May 9, 1904.

The Edison Medal Competition.

The American Institute of Electrical Engineers, through its president, Mr. Bion J. Arnold, is sending out letters to attract the attention of colleges and educational institutions in the United States and Canada qualified to compete for the Edison medal. The medal will be awarded to such qualified student as shall have submitted to the Institute, in accordance with the provisions of the deed of gift and of the regulations which may be prescribed by the Edison medal committee, the best thesis or record of research on theoretical or applied electricity or magnetism. The request is made that all institutions send their names to the Edison medal committee, 95 Liberty Street, New York city, on or before June 1, 1904, in order that the committee may have before it the names of all institutions which those in direct authority of them believe qualified to comply with the conditions as set forth in the various sections of the deed of gift. Not more than two students may compete in any one year from any one institution of learning; nor may any student compete unless duly presented for competition through the faculty of the particular institution at which he is a student.

Working Electrical Exhibits at St. Louis.

[*Continued from page 391.*]

has installed a beautiful booth in the southwest section of the building, resembling a small theater, and on the stage is located a complete telephone exchange of the latest Bell type. The long-distance lines of the Bell company are connected to this exchange, and exhibitors can have direct telephonic communication from their booths to their homes or headquarters.

The exhibit of the Weston Electrical Instrument Company, while not operative, was among the first complete. Occupying a position immediately in front of the southwest door, its pure Greek lines and proportions are strikingly attractive. On the walls and in cases are shown all standard types of electrical measuring instruments.

Just north is the booth of the Bristol Company, in which is shown a large number of recording instruments. A large recording voltmeter is connected to the supply mains, and keeps faithful account of the variations in pressure.

A number of other exhibits were in operation, and more or less complete, and since opening day the activities in the Electricity Building have in no wise abated. An inspection of the exhibit buildings indicates that, with the exception of Machinery Hall, practically all exhibits will be in place and complete by the middle of the month.

World's Fair Notes

None of the ordinary telephone cabinet work used for commercial purposes will be installed in the Chinese government pavilion at the World's Fair. Kee Owyang of the commission has decided that a different sort must be provided. The woodwork of the telephone will be painted red and gold to harmonize with the colors of the pavilion.

The first colored illumination of the cascades was not given on schedule time on account of a notice received by Mr. Ellicott that the colored incandescent lamps had been delayed in shipment. The colors are canary, emerald, crimson and opal. Twenty thousand of each color of lamp, except opal, have been ordered. Of the opal there will be 30,000.

The United States officers having the matter in charge refused to accept the Government Building because it developed that the electrical workers in walking across the roof while wiring the structure left small perforations in the roof as a result of wearing hob-nailed shoes. The architects had turned the building over to the officials as complete, but were ordered to remedy the damage.

The American Electrical Heater Company of Detroit, manufacturer of electric heating appliances, is located at the St. Louis Fair in southwest corner of the Electricity Building. President and General Manager B. H. Scranton have been on hand for several weeks and the company's exhibit is now in good shape. The company extends a cordial invitation to visitors to inspect the latest developments in electrical heating devices.

A new departure in the lighting of art galleries has been introduced in illuminating the Palace of Fine Arts at the World's Fair. Instead of using the incandescent lamp the Nernst lamp is employed. In the application of electric lights for the illumination of art exhibits many things have to be considered. The correct determination of color values, daylight quality, steadiness, downward distribution of light and uniformity are all important. A reflector is used with the lamp, which throws the rays downward.

On account of the large number of exhibits arriving last week and held on side tracks on the Exposition grounds, it was impossible to run the intramural cars on time, and the service was therefore abandoned for a week or 10 days. The conductors and motormen were transferred to duty on the staff of the Jefferson Guards and were stationed on The Pike. Thirty of the 55 cars ordered have arrived and are in shape to be put into service as soon as the track is clear of exhibit cars. While the exact schedule has not been made up, Superintendent Murphy says it will not be less than a five-minute service.

The Ewing-Merkle Electric Company has recently sent the trade a practical pocket guide to the St. Louis Universal Exposition. It consists of a map, 12 by eight inches, of the ground plan of the fair, giving the location of each building, including the Pike; also giving hotels and their location with the capacity of each; first-class boarding houses with their locations, etc.; restaurants with location, and all the attractive features within the great buildings, in the grounds and "down the Pike." One of these valuable little booklets will be mailed free of charge for the asking, or will be presented to anyone calling at the company's store, 1106 Pine Street, St. Louis.

The exhibit of the Mica Insulator Company of New York is an interesting object lesson, showing to what utility and extent mica can be put in the field of electrical insulation. It is to be seen in connection with the exhibit of the state of North Carolina in the Mines and Metallurgy Building. Micanite in all kinds of shapes and forms is shown. There are flat sheets of various thicknesses, generator and motor-commutator segments and rings of many of the standard types. Micanite tubes from one-eighth of an inch in diameter to the large tubes entering into the construction of induction coils for X-ray purposes are in the exhibit, each article exemplifying that electrical insulations to meet up-to-date requirements must be of a permanent and indestructible nature.

The hours for the illumination of the World's Fair have been set by the executive committee for from 7:30 to 9:30 p. m. On account of the small number of visitors to the fair during the month of May it has also been decided to curtail the hours previously prescribed when the water will pour over the cascades. These are to be limited to the following schedule: 11 a. m. to 12 m., 2 to 3 p. m., 5 to 6 p. m., and 8 to 9 p. m. This will give an opportunity to make any small alterations and repairs which may be found necessary to perfect the small working details. A solution of sulphate of iron will be used in the pumps, precipitating all earthy particles. The water filling the basin will then be pumped out into the grand basin through filters composed of a combination of charcoal and sand. It is expected that with these arrangements the water will be rendered absolutely clear.

The Electric Storage Battery Company of Philadelphia has at the St. Louis Exposition a particularly interesting and comprehensive exhibit, located in Block 20, Electricity Building. A conspicuous feature is a map about 30 feet in height by 45 feet in length which, by an ingenious arrangement, shows the distribution of Chloride accumulator installations throughout the United States. Illuminated glass jewels designate the locations and characters of the installations whether for railway, central-station, isolated-lighting and power service, yacht plants, telephone installations, etc. There is set up in a model battery house a complete operating installation of Chloride accumulators for railway service. Specimens ranging in size from a 61-H type of cell to the smallest laboratory cells are also shown, together with a complete exhibit of the Exide battery used for electric automobile work. In another section of the exhibit there are five types of switchboards, together with end-cell switches, storage-battery recording instruments, etc.

The Standard Underground Cable Company of Pittsburg and the McRoy Clay Works have a joint exhibit in Section 3, immediately adjoining the northwest entrance of the Electricity Building. The exhibit shows a cross-section of an actual conduit, consisting of 72 ducts, with a manhole at either end, one manhole being complete with a cover, the other being open. A trench seven feet deep and five feet wide extends the entire length of this conduit, enabling close inspection of the method of laying conduits, including the wrapping, concrete base and top, and the general construction of the manholes, showing hangers, pipes to poles, etc. At one end in the manhole is shown a capstan rigged up for drawing in cables and connected to a cable, which is mounted on a reel at the other manhole, the cable being drawn through the ducts and part of the ducts being split so as to show the method of fastening cables to ropes, etc. From the manholes cables go to distributing poles, showing the method of distribution to aerial cables for telephone, electric-light and street-railway work with various terminals used to protect the ends of the cable in such work. Samples are shown in handsome cases of all the various cables and appliances. An examination of this system will show, in very complete detail, the method of installing conduits and drawing cables into completed conduits. The McRoy Clay Works shows piles of clay as it is dug from the ground and the various processes through which the material goes to produce the finished duct.

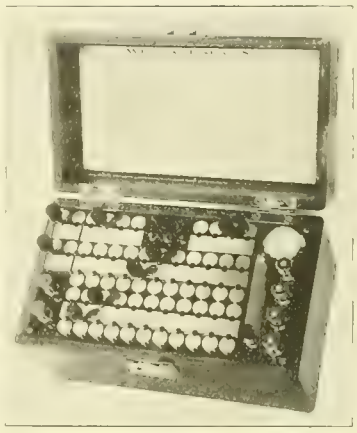
The City Council of Raymond, Ill., contemplates leasing the local electric-light plant and operating it as a municipal plant.

A New Testing Set.

Machado & Roller, the selling agents of the Whitney Electrical Instrument Company, are marketing a new form of testing set, which is illustrated herewith. It is of the decade pattern, in which the drawbacks incident to the great number of plugs necessitated by the old postoffice form of construction are eliminated, there being but four plugs in the rheostat itself. Fig. 1 shows the complete set. It will be noticed that the use of reversing blocks in the bridge arms has been done away with by adding an extra coil to each arm. This expedient eliminates two plugs and makes the operation of the set much more easy to understand. The keys are of a novel form which can be operated independently or like the conventional combination key, whichever is desired. Five large dry cells are built into the containing case and a flexible cord with plug is arranged, so that any number of them can be used at will.

An ingenious modification of the ordinary construction of decade and postoffice sets is used to shift the internal connections from those employed in making ordinary resistance measurements, and the Murray test to the connections for the Varley test, so that the two "X" posts common to every bridge are the ones to which the outside line is always attached, no matter what test is being made thereon. A pair of binding posts to which an external galvanometer of the reflecting form may be attached for high-sensibility work is also provided and by shifting one plug, either this external galvanometer or the one that is built into the set is brought into play. Another pair of posts allows of the use of an external source of electromotive force where this is desired.

Instead of following the conventional procedure of marking the ratio arm blocks "A" and "B," they are stamped "divide by" and "multiply by," respectively, the connections being such that, when a plug is inserted in the gap between the "divide-by" block and any one of the four circular blocks opposite thereto, the readings as indicated by the position of the plugs in the rheostat are to be divided by the number stamped on the circular block to get the correct reading. Similarly, the resistance plugged in in the rheostat is to be multiplied by the number indicated by the position of the plug in the "multiply-by" ratio arm block. The plug blocks for changing over the loop and galvanometer connections are marked with similar clearness, so that practically anyone can use the bridge without chance of confusion. The actual diagram of connections is shown in Fig. 2.



A NEW TESTING SET.

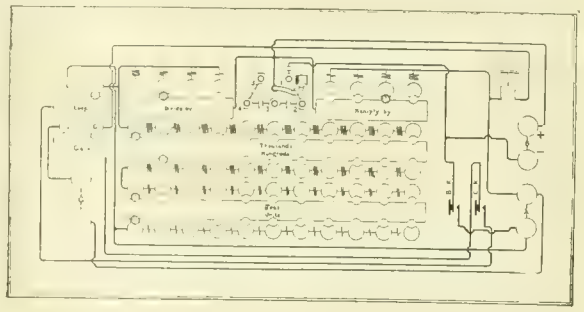


Fig. 2. Diagram of Connections.

An accuracy of adjustment of a tenth of one per cent. throughout is claimed, and it is also stated that the galvanometer is sufficiently sensitive to give a marked deflection with a tenth of one per cent. resistance variation when working with full battery power on a resistance of moderate value. The galvanometer is not affected by external fields, and can be used with the set in any position. It is thought that a moderate-priced set having the above characteristics will meet with considerable favor from a large class of users.

Public Works in Persia.

Writing from Teheran, Persia, Vice-consul General John Tyler states that for some years past in Persia works of considerable extent and importance, whether of a public or semi-public nature, have generally been undertaken and carried out by foreigners on concessions granted for a number of years by the government. The telegraph administration has been in the hands of and farmed by one Persian family almost ever since it was established, and hitherto the supplies have been procured from Germany and England. The telephones have been erected and the railways and tramways constructed by a Belgian company, and the materials obtained from Belgium and Russia. Roads where engineering skill and large expenditure of money have been required have been built by English and Russian companies, and such materials as could not be found locally have been imported from England and Russia. Mr. Tyler states, however, that the minister for foreign affairs has given assurances of his full sympathies and active interest in any species of public works which American merchants or capitalists might bid for or undertake in Persia.

Annual Reports of the Chicago Edison Company and the Commonwealth Electric Company.

The annual reports of the directors of the Chicago Edison Company and the Commonwealth Electric Company for the year ended March 31, 1904, to the stockholders have been published, and from the figures it will be seen that the business of both companies continues to show satisfactory gains.

The report of the Edison company shows that at the end of the year the total connected business (equivalent to 16-candlepower lamps) was 1,307,631, against 1,138,866 the previous year. The gross earnings of the company, including merchandise sales, were $3,837,659.79, and the expenses, including cost of merchandise sales, were $2,515,040.69, leaving a net income for the year of $1,322,619.10. Charged against income were interest on bonds and debentures amounting to $307,088.32 and dividends of $720,526, leaving a balance at the end of the year of $295,004.78. The balance sheet as of March 31, 1904, is as follows:

RESOURCES.

Plants, real estate, and franchises	$16,940,220.22
Work in progress and material (less collections on account)	326,408.15
Accounts and notes receivable	656,998.67
Cash	262,933.26
	$18,186,650.28

LIABILITIES.

Full-paid capital stock issued	$ 9,865,700.00
Fractional scrip	180.00
Six per cent. debentures	1,483,000.00
Five per cent. first-mortgage gold bonds	5,000,000.00
Accounts payable	250,130.03
Depreciation reserve	690,000.00
Insurance account	76,000.00
Undivided profits	797,088.82
Sundry open accounts	24,551.43
	$18,186,650.28

The Commonwealth company at the end of the year had a connected business (equivalent to 16-candlepower lamps) of 604,194, against 447,507 the year before. Against gross earnings of $1,350,999.59 (including merchandise sales) were expenses amounting to $834,734.97, leaving a profit of $516,264.62. Deducting $275,737.39, representing charges against income, there was a balance at the end of the year of $240,527.23. The condensed balance sheet as of March 31, 1904, follows:

RESOURCES.

Plants, real estate and franchises	$13,026,435.32
Work in progress and material (less collections on account)	136,117.21
Accounts receivable	135,537.08
Cash	135,739.61
Open accounts	14,131.20
	$13,449,958.42

LIABILITIES.

Capital stock	$ 6,250,000.00
Five per cent. first-mortgage gold bonds	5,500,000.00
Five per cent debentures	500,000.00
Real estate mortgages	180,000.00
Accounts payable	25,553.16
Depreciation reserve	93,500.00
Municipal compensation reserve	32,033.25
Undivided profits	568,872.01
	$13,449,958.42

The new central-station plant erected on the Chicago River at Fisk and Twenty-second Streets by the Commonwealth company is now in operation and is supplying the greater portion of the company's service. The erection of this plant largely augments the company's facilities and will, it is believed, result in increasing its business. The directors believed it advisable to purchase additional real estate adjoining that already acquired at Fisk and Twenty-second Streets, and also some on the opposite side of the Chicago River, and have accordingly made such acquisitions, the total real-estate holdings of the company at this point being now about 23 acres. The company has three generating stations and four substations, while the Edison company has four generating stations and 15 sub-stations.

Appropriations for Electrical Work.

The various appropriation bills enacted during the closing days of the last session of Congress contain the following items for electrical work: Army appropriation bill, for purchase of material and special apparatus for experimental purposes, etc., at Fort Totten, $6,000; sundry civil appropriation bill, for expense of lighting, and for electrical, telegraphic and telephonic service, etc., in Washington, D. C., $196,500; naval appropriation bill, extensions to electric power and light plants, telephone and conduit systems, and purchase of cranes, elevators, etc., for navy yards, $546,500.

The secretary of the navy is authorized, in his discretion, to consolidate the several power plants in any or all of the several navy yards and stations at each navy yard and station under the Bureau of Yards and Docks for the generation and distribution of light, heat and power for all purposes of the navy. To the above end all such plants may be transferred from other bureaus to the Bureau of Yards and Docks, and all appropriations heretofore made for power houses and power plants for bureaus other than Yards and Docks, are reappropriated and made available under the Bureau of Yards and Docks for the consolidation provided for; and to further carry out the purposes of this provision there is appropriated the sum of $300,000.

Chicago Street-railway Situation.

It is understood that arrangements are now completed for meetings of representatives of the Chicago traction companies with the new local transportation committee of the City Council to take up the preliminary discussion of franchise negotiations. These meetings, it is assured, will be held with a view to settling the entire transportation controversy.

Decision as to the validity of the 99-year act has finally been left in the hands of Judge Grosscup by the filing of the Union Traction Company's last brief on the subject. The document replies to the supplemental brief presented by Corporation Counsel Tolman. Attorney Gurley also filed an answer in the state court to the minority stockholders' suit against the Union Traction and its underlying companies in behalf of Jacob Miller of Germany.

At the last meeting of the City Council an order was introduced requiring the traction companies to secure a license for every car operated, the fee to be $50 a year. The order also asks that the transportation committee cease all negotiations with the street-car companies. Another order was introduced requiring the corporation counsel to draw up an ordinance condemning the street-car lines operating on Clark Street and Wentworth Avenue on the South Side and directing the city engineer to report an estimate for the construction of a double track along Adams Street from Clark to Desplaines Street and along the West Side. The fate of these orders will be decided at the next meeting.

The tunnel-lowering problem is receiving the attention of the traction companies and the local transportation committee of the council. The employment of an expert engineer to aid the city engineering corps in the solution of the problem has been decided upon by the committee. Samuel G. Artingstall, former city engineer and now employed by the Union Traction Company, has been at work for some months preparing plans for tunnel lowering. He was promised an opportunity to present his plans to the committee.

A New Primary Battery.

At a meeting of the Faraday Society held in London on April 13th E. G. P. Bousfield contributed a paper on "Experiments with a New Primary Cell." The cell consists of an inner-porous pot containing nitric acid and a carbon pole and an outer vessel containing sodium hydrate solution and a metal pole, preferably zinc. With a solution of from 12 per cent. to 15 per cent., using solutions of maximum conductivity with zinc and carbon poles on open circuit, an electromotive force of 2.6 volts may be obtained. Not only does the cell possess this comparatively high electromotive force, but it may be short-circuited far longer than most cells before it runs down. A cell short-circuited through a total resistance of 0.61 ohm gave a current of 4.18 amperes, which fell to 2.61 in an hour, 2.38 in 2¼ hours, and 1.75 in six hours. A smaller cell gave a fairly constant current of about 0.8 ampere for 20 or 25 hours. Discharge curves are given in the paper.

Acids other than nitrate were experimented with. Some of them gave higher electromotive forces than nitric acid, but no other acid possessed the same "lasting powers." The effect of using various metals instead of zinc was also tried; some of these gave higher electromotive forces than the zinc, but the high readings were quite transitory. Using two carbon poles, the electromotive force was about 1.35 volts. The cell is then similar to Becquerel's platinum cell, in which the plates are immersed in acid and caustic potash respectively.

W. R. Cooper referred to the disadvantages of both nitric acid and caustic soda as electrolytes. The high electromotive force of the cell was only apparent because it rapidly fell to a working value of 1.8 or 1.9. He would like to have seen comparative tests made, say with a bichromate cell.

J. Swinburne mentioned a suggestion made by Dr. Swan, that the cell would be improved if it were converted into a three-fluid cell with a neutral electrolyte (e. g., $NaNO_3$) in the mid compartment.

Chicago Transmission Convention.

The exact date of the Institute convention on electrical transmission, mention of which was made in the Western Electrician last week, can now be given. The meeting will be held in Chicago at the rooms of the Western Society of Engineers on June 21st and 22d.

"Introductions to discussion" similar to the "introductions" presented at the three meetings on high-pressure transmission held at New York, March 27, 1903; Niagara Falls, July 1, 1903, and New York, March 25, 1904, will be presented on the following subjects:

"Synchronous Motors for the Regulation of Power-factor and Line Voltage;" "Line Construction with Steel-supporting Structures and Long Spans;" "The Use of Ground Shields in Transformers;" "Protection of High-pressure Lines Against Static Disturbances;" "Protection of Cables from Arcs Due to Failure of Adjacent Cables;" "Conditions for Continuous Service Over Lines Operated in Parallel."

The names of the authors of the "introductions" have not as yet been announced. There will be a morning and an afternoon session each day, the work to be divided as nearly as possible equally among the four sessions. Out-of-town members expecting to attend this meeting should send word to that effect at an early date to James Lyman, Monadnock Building, Chicago. This request is made for the reason that the Republican national convention will be held at Chicago from June 16th to 20th, and it is therefore advisable that hotel accommodations be engaged in advance. When communicating with Mr. Lyman it should be stated what kind of accommodation is wanted—location, rates, proposed length of stay, etc.

Heating from Central Stations.

[From the Question Box of the Iowa Electrical Association.]

QUESTION.

Can any member of the association, operating a heating plant, give any detailed information as to the number of pounds of steam used per season to heat 1,000 cubic feet of space in buildings where consumers are charged by the meter system of charging in comparison to consumers heated on the contract system?

ANSWERS.

Brice Gas and Electrical Company, Mason City, Iowa: We are using the hot-water heating system and have adopted the following method of charging which we have found to be the most equitable in every case: We figure up the amount of radiation required according to the glass surface, wall surface and cubical contents and make a rate per season based upon the amount of radiation required. We insist upon this amount being paid, making no reductions for a portion of the season. If a consumer installs less radiation than the amount required, he is compelled to pay for the full amount, which nearly always insures his installing the amount specified. If this amount should be found to be insufficient, we make no extra charge for additional radiation installed, provided the normal temperature of the room does not exceed 70 degrees. We have never found it necessary to add radiation when the full amount specified was installed.

H. C. Eddy, American District Steam Company, Chicago, Ill.: This is a very modest little question and to answer it in detail would require an extended amount of data which I doubt if anyone has. I know that we have not, but perhaps I can give some information which will be of value to the association.

First—In a city in Central Illinois the heating business is for public buildings exclusively, all on a meter basis of charge. The highest rate of condensation per 1,000 cubic feet of space per season last year was 10,779 pounds. The lowest was 1,650 pounds, and the average of all the customers served 5,328 pounds.

Second—A city in Nebraska heating public and business buildings gives the following figures: Highest rate, 7,475 pounds; lowest, 1,302; average of all customers served, 4,522 pounds.

Third—A city in Kansas finds the highest rate 13,709 pounds; lowest rate, 1,278 pounds; average of all customers served, 4,693 pounds.

Fourth—A city in Colorado: Highest rate, 24,666 pounds; lowest rate, 1,611 pounds; average of all customers served, 8,653.

Fifth—In a city in Missouri the heating is for residences, churches, public library, factories, stores and business buildings, etc. The following results are for the meter basis of charging:

	Pounds.
Residence, average cond. per 1,000 cubic feet per season	9,400
Public library, average cond. per 1,000 cubic feet per season	5,800
Theaters, average cond. per 1,000 cubic feet per season	2,900
Hotels, average cond. per 1,000 cubic feet per season	5,410
Churches, average cond. per 1,000 cubic feet per season	2,840
Stores and office buildings, average cond. per 1,000 cubic feet per season	7,030
Average of all meter customers	5,503
Average of flat rate customers of the same general class of occupancy	19,72

Sixth.—In a city in Pennsylvania for the first four months of this year one customer on a flat rate used 7,800 pounds of water per 1,000 cubic feet space. Another customer under the same conditions used 7,250 pounds, and a third customer under the same conditions, but for three months instead of four, used 4,250 pounds. In the first instance, if the condensation used by this customer had been paid for on a basis of meter registration at the regular prevailing rates the cost for the four months would have been $1,065.42. The flat rate for the entire season was $1,200. In the second instance, if the condensation had been paid for at the regular prevailing rate, the cost would have been $848.16. The flat rate for the entire season was $720.00. In the third instance, the three months on a meter basis would have cost $305.22, while the flat rate for the entire season was $300. In another case which came under the writer's observation where the meter customers and flat-rate customers represent practically an equal amount of space in each case, it was determined that for the meter customers it required at the plant 712 pounds of coal per 1,000 cubic feet space heated per season, and for the contract customers it required at the plant 3,280 pounds of coal per 1,000 cubic feet space heated per season.

J. G. Boyd, Sioux City, Iowa: Plants making only night runs would better "keep off the grass." They have, ordinarily, sufficient grief without a heating adjunct.

Independents Gain Another Point in Cincinnati.

Judge Nippert has refused to dismiss the application of the Queen City Telephone Company of Cincinnati for a franchise on a motion made by the city solicitor and attorneys for the Bell telephone interests. This motion was made on the ground that the Queen City was not acting in good faith; that the corporation is not bona fide, because the money for the stock is not actually in the treasury, and that there is no testimony as to what would be a proper use of the streets. George W. Beers, treasurer of the Queen City company, said the subscriptions to the stock were subject to his draft whenever he needed the money. He stated that $100,000 could be secured on notice, $100,000 more within a week and $150,000 within 30 days. The money, he said, is ready as soon as needed.

The charges to be made for service are $72 a year for business telephones and $36 for residences. About 2,000 subscribers have been promised, of which half are business men. Judge Nippert has had Maxime Reber and other expert telephone men before him, with a view to satisfying himself of the possibility of using the streets for telephone purposes. Mr. Reber said that it was hardly possible that the streets were so full of pipes and wires that telephone conduits could not be built. Such conditions are not found in other cities.

Reports are in circulation that the other three Independent companies seeking franchises in Cincinnati are negotiating with a view to consolidating their interests. It is hardly probable that all four Independent companies will be able to operate in the city, in addition to the Bell, and they wish to take a step that will make their position more secure. The Fitzsimmons company is largely owned by Philip Fitzsimmons, who has a large amount of wire strung in various places. The Interstate is composed of well-known business men of the city, such as Eugene Zimmerman, Theodore Horstman, Sol. P. Kineon and others.

Cumberland Ouster Proceedings Said to be Unimportant.

In a statement concerning Chancellor Allison's decision in the ouster proceedings against the Cumberland Telephone and Telegraph Company in the state of Tennessee, President James E. Caldwell says: "The reports sent out concerning the decision in the Cumberland Telephone and Telegraph Company case are unwarranted. Our attorneys have appealed the case to the Supreme Court, where it will be tried denovo. The appeal vacates the decree, and there is now no decree of any kind against the company. It will be borne in mind that this is a fight between rivals and is not a suit involving money claims. The company never was more prosperous or better established than at present. It regards the occurrence as unimportant."

Use of the Telephone in Germany.

The total cost of the German federal telephone system, operated in connection with the German federal telegraph system, is $60,000,000 up to date. The kingdoms of Bavaria and Wurtemberg are not included, these having their own independent telephone systems. The longest telephone connection that can be made in Germany is the one between Berlin and Paris, 742 miles. Next is Berlin and Budapest, 612 miles; Berlin and Memel, 593 miles; Berlin and Basel, 577 miles. There are 11 other connections of over 300 miles each.

The line between Berlin and Frankfort is the most used, 485 communications being the daily average. In spite of the high fee not less than 65 communications daily take place between Berlin and Paris.

EXTENSIONS AND IMPROVEMENTS.

Aerial cable to the amount of $25,000 has been ordered by the Rocky Mountain Bell Telephone Company for the repair and improvement of its system in Salt Lake, which sustained severe damage during a recent snowstorm.

The Utah Independent Telephone Company is now installed in its handsome new building in Salt Lake, and its system will be ready for operation within the next few weeks. The work of connecting the 6,000-Independent cabled wires with the switchboards in the operating room is now in progress. This does not represent the capacity of the plant, but equipment for its enlargement will not be ordered until some time after it has been in operation. The plant is a thoroughly modern one in every respect.

The City Council of El Paso, Texas, has granted a telephone franchise to R. V. Bowden for the Southern Independent Telephone Company. The scale of rates contained in the ordinance provides that the minimum charge shall be $3 a month for business telephones and $2.17 a month for residences. This rate is to be charged when the company has from 1,000 to 1,500 telephones in use. The maximum rate shall be $4.70 for business telephones and $3 for residences, to be charged when the number of telephones in use is between 4,000 and 4,500. The contract for the construction of the new telephone-exchange building for the Southwestern Telegraph and Telephone Company in El Paso, Texas, has been let for $11,000.

Indiana Telephone Items.

The Stendal Home Telephone Company has been incorporated to establish a telephone system in the town of Stendal and throughout Pike and Warrick counties. The company's capital stock is $10,000. John W. Stillwell is among the incorporators.

The New Home Telephone Company of Bloomfield has authorized the issuance of preferred stock to the amount of $100,000, for the purpose of securing funds to extend the lines and improve the plant.

The Evansville Board of Public Works has granted a 30-year franchise to the Citizens' Telephone Company recently incorporated. The rental for the telephones shall not be more than $4 a month on full copper metallic circuit for business houses, and $2 a month for residences on full copper metallic circuit. All telephones used by the company are to be long-distance instruments. The city reserves the right to purchase the entire system at an appraised value upon written notice of six months previous to the tenth, twentieth or thirtieth year of the company's operation. It is provided that the work of constructing a plant shall be commenced within 60 days after the approval of the franchise by the council. A bond of $10,000 is required.

The Evansville Home Telephone Company, organized during the last week is seeking a franchise from the Board of Public Works. J. O. Baker, a wealthy banker, and other influential business men are backing the Home Telephone Company. The rates asked are $3.50 for business, $2 for residence and $1 for party-line service.

A new copyright toll system was installed by the Central Union Telephone Company in Logansport during the last week. The entire general district, including Indiana, Ohio and Illinois, has been fitted up with the new system under which the company is operating now. Service Manager Houghton, who has charge of the service in these three states, conducted a school at the Barnett Hotel during the last week. A number of local managers from cities in the first district were present.

A new telephone plant has been installed at Fortville. The company starts with 180 telephones in town and with direct communication with nearly 300 farmers' telephones. Owing to inability to make satisfactory arrangement with the Greenfield Independent company, it will give its long-distance business to the Central Union.

The Home Telephone Company of Ft. Wayne has connected its new exchange at Wallen with the toll lines, and for the first time the prosperous little village has telephone communication with Ft. Wayne and the rest of the country.

The Central Union Telephone Company is installing a fine multiple switchboard in its new exchange in the Gillette Block in Elkhart, which is to be equipped with 1,200 pairs of wires leading to the underground conduits.

The Home Telephone Company of Crawfordsville is now permanently installed in its new quarters. It has been thoroughly overhauled and many needed improvements made, and the service is quite satisfactory now. F.

Ohio Telephone Notes.

The capital stock of the Bucyrus Telephone Company has been increased from $30,000 to $65,000, in order to make improvements and extensions that have been under contemplation for some time.

At the annual meeting of the stockholders of the Mt. Vernon Telephone Company, held a few days ago, it was decided to reincorporate under the laws of Ohio, the business having been carried on so far under a West Virginia charter. The capital stock will be increased from $100,000 to $150,000.

Several amendments to the Independent telephone ordinance at Norwood, near Cincinnati, were defeated at a meeting of the Village Council a few nights ago. The Norwood Citizens' Telephone Company is seeking the right to operate in the village.

Representatives of the Independent companies at Jefferson, Madison, Painesville, Warren, Conneaut and Ashtabula met at the latter place a few days ago to discuss matters relating to the toll service. It is probable that an organization will be formed to promote mutual interests, but this was delayed because plans had not yet been completed.

The Cincinnati and Suburban Telephone and Telegraph Company has offered to install and maintain a modern police-call system in the village of Norwood, and to maintain a switchboard in the police and fire building free of cost, on condition that if another telephone company is granted a franchise or the village is annexed to Cincinnati, the company will be under no further obligations to the village.

An eastern syndicate is negotiating for a large block of the United States Telephone Company and has asked that a 90-day pool be formed to hold the bonds at 85 cents. It is said that 75 per cent. of the bonds have been signed upon this arrangement, but the owners of the remainder will hold their securities for investment. The object of the eastern people is to keep the bonds off the market until it is in better condition.

Through a miscalculation, it was announced last week that the operators of the Cuyahoga Telephone Company would receive an increase of eight per cent. in wages. Instead, the increase is 25 per cent. This addition to expenses was made in the face of trouble threatened by the city, which does not seem to be worrying the management to any appreciable extent.

The Preble County Telephone Company, formed recently by the combination of the West Alexandria Telephone Company and the Southwestern Ohio Telephone Company of Gratis, has completed its organization by the election of the following officers: President, J. S. Stewart; vice-president, J. J. Burtner; secretary and treasurer, A. M. Fudge. West Alexandria, Dadsville, Ingomar, Gratis, West Elkton and Greenwich will be connected.

A temporary injunction has been secured by the Central Union Telephone Company against the People's Telephone Company of Akron, to prevent the latter from stringing wires on the east side of Front Street at Cuyahoga Falls. The Central Union asserts that the plan will injure its lines and cause danger and inconvenience to the public by bringing two currents of electricity so closely together. C.

Telephone News from the Northwest.

The telephone operators at Yankton, S. D., have struck as a result of a cut in wages.

A new 200-capacity switchboard has been ordered at Wessington Springs, S. D.

A rural line will be built from Redwood Falls, Minn., to New Avon Township.

A company has been formed at Beaver Creek, Minn., to establish a local exchange. O. M. Page is president.

George H. Woodgate has bought the local exchange at Slayton, Minn., of the Southwestern Minnesota Telephone Company.

The Elgin (Minn.) Telephone Company, the Potsdam Telephone Company and the Greenwood Prairie Telephone Company have consolidated and will incorporate.

The Plattsmouth (Neb.) Telephone Company has bought the system and franchise of the South Omaha Independent Telephone Company. A new system will be put in at South Omaha.

The Northern Telephone Company of Minot, N. D., has purchased the property of the telephone, electric-light and water-supply company of Bottineau, N. D. The former company proposes to install a number of local exchanges during the season.

The council of Bismarck, N. D., recently voted to discharge the city attorney, because he is interested in the Bismarck Telephone Company, a corporation holding a franchise from the city. The mayor ruled that the law did not apply to a simple stockholder, but the council proceeded to vote as stated.

The following-named telephone companies have recently been incorporated: Cedar Falls Mutual Telephone Company, Cedar Falls, Iowa, capital $25,000; N. H. Harris is president and F. O. Jackson secretary. Conesville Telephone Company, Conesville, Iowa; capital, $10,000. Rogers Telephone Company, West Union, Iowa; capital, $25,000; C. H. Talmadge and others. Rothsay Telephone Company, Rothsay, Minn.; capital, $10,000; W. J. Breen and others.

Extensions or improvements are announced for the near future by the following-named telephone companies: Home Telephone Company, Ashland, Wis.; Harrisburg (S. D.) Telephone Company; Star Telephone Company, exchange at Farmington, Minn.; Cokato (Minn.) Telephone Company; Milton (N. D.) Telephone Company; Rural Telephone Company, Morgan, Minn.; People's Telephone Company, Chatfield, Minn.; Mutual Telephone Company, Des Moines, Iowa; Emmetsburg (Iowa) Telephone Company; Independent Telephone Company, Le Mars, Iowa; Northwestern Toll Line Company, to extend to Hayward, Drummond and Bibon, Wis. R.

Michigan Telephone Matters.

The Michigan State Telephone Company has given a first mortgage in favor of the Old Colony Trust Company to secure $10,000,000 of 20-year five per cent. gold bonds, expiring in 1924. This is merely carrying out the plan of the reorganization. The new company is capitalized at $10,000,000 in stock and $10,000,000 in bonds, but only about half of the stock and bonds are to be issued this year, the amount of bonds to be issued during 1904 being $4,466,000.

There is a telephone war on at Battle Creek between the Bell Telephone Company and the Citizens' Telephone Company (Independent). The former company lowered its rates some time ago and has made very extensive improvements. It now informs the public of a prospective raise. The Citizens' Telephone Company has leased two floors in a new building and proposes to install an entire new exchange throughout. W.

Southeastern Telephone Developments

N. G. Williams has closed a contract with the Bell Telephone Company to extend its lines from Winston-Salem, N. C., to different points in Forsythe, Surry and Yadkin Counties. A line has been completed to Lewisville and Williams, N. C.

The capital stock of the Sumter Telephone Manufacturing Company will be doubled, all to be issued to stockholders. New buildings have been completed and new machinery installed to the amount of $50,000, paid for out of the surplus profits.

GENERAL TELEPHONE NEWS.

The city of Laurel, Miss., has granted the Cumberland Telephone Company a 25-year franchise for the construction of a double metallic long-distance telephone system in the city.

The City Council of Spokane, Wash., has granted to the Interstate Telephone Company a franchise to operate in that city. This will complete a circuit giving Spokane telephonic connection with numerous cities in the Panhandle country.

The Ivey Telephone and Telegraph Company of Marshall, N. C., has been chartered with an authorized capital of $25,000. J. H. Baird and R. S. Gibb are interested in the company, and it is proposed to build telephone lines between Marshall and neighboring towns.

President Sherwin in the annual report of the New England Telephone and Telegraph Company for the year 1903 shows that the number of stations added to the exchange lists was 13,238, making the total at the end of the year 114,102. Including the subscribers connected with exchanges of the Southern Massachusetts, Northern, White Mountain and Vermont companies the exchange stations operated under the management of the company in Maine, New Hampshire and Vermont number 126,138 against 11,774 a year previous.

President Loubet of France knows perfectly well, of course, that he is not a fat hippopotamus, and yet when he was called one over the telephone the epithet was something of a shock to the presidential dignity. According to the story, Mr. Loubet was trying to telephone to some one, and had vainly waited for several minutes with the receiver at his ear. When at last an answer came it was startling. "You fat hippopotamus!" came over the wire in a feminine voice. The president put down the receiver, naturally a little shocked. The girl had obviously not been aware whom she was answering, but her language denoted small respect for the public. Subsequently she was compelled to call at the Elysee by the minister of posts. The president gave her a paternal and kindly talking to and obtained from her a faithful promise never to do it again.

BOOK TABLE.

TWENTIETH CENTURY HAND-BOOK FOR ENGINEERS AND ELECTRICIANS. With Questions and Answers. By C. F. Swingle, M. E. Chicago: Frederick J. Drake & Co. 1904. Pp. (4½ by 5½ inches), 207, with 110 illustrations. Price, $2.50.

For the operating engineer in an electric plant, or his subordinates, this is a book which will be found of great value. Especially is this true in the smaller plants, where the man must be at once the electrician and engineman. The successful operating engineer is the one who combines sufficient theoretical knowledge with his practical knowledge to enable him intelligently to make the necessary tests and calculations upon his boilers, engines and electrical apparatus to insure their efficient operation. Just this kind of instruction is to be found in the hand-book under review, given in a clear and simple manner The subject matter is treated in a logical manner, beginning with the boiler and auxiliary apparatus, then taking the engines, and finally the electrical side of the plant. All the necessary tests on the various apparatus are described, with carefully arranged tables of valuable data. The volume is divided into two parts—"Steam Engineering" and "Electricity for Engineers." After each chapter on steam engineering are questions completely covering the ground, so that anyone studying the different subjects may make himself master of all the matter contained. The book is of convenient pocket size, bound in leather, and as a reference book is one which the practical man who wishes to learn as much of the theoretical as possible without mathematical preparation, cannot well afford to be without.

ELECTRICITY AND MATTER. By J. J. Thomson. New York: Charles Scribner's Sons. 1904. Pp. (5¼ by 8 inches), 162, with 18 illustrations.

"Electricity and Matter" is compiled from the first annual course of lectures established at Yale College as a memorial to Mrs. Hepsa Ely Silliman and supported by a fund left by her to the college. In these lectures are discussed the bearing of the recent advances made in electrical science on the present theories of the constitution of matter and the nature of electricity. After taking up the representation of an electric field by lines of force the author passes on to a discussion of "Electrical and Bound Mass" and the "Effects Due to the Acceleration of Faraday Tubes," in which he considers the relation between momentum in an electric field and the Faraday tubes of force, and the behavior of tubes of force when their state of motion is changing. The last three chapters are given up to the "Atomic Structure of Electricity," "The Constitution of the Atom" and "Radio-activity and Radio-active Substances," and in this part there is much that is of interest to those who are interested in the recent new discoveries which cast a shadow on the old and tried theories regarding the nature of matter. These chapters are intended to furnish food for thoughtful study and suggestions for future experiment in this field of research, in which, as yet, so little is really known.

Electric Meters.[1]

By GEORGE S. CARSON.

I shall only attempt to take up the question of electric meters from the viewpoint of their usefulness to the central stations without going into the details of their construction, as it is conceded that there are several makers of reliable electric meters.

In the early days of electric lighting, when meters were unknown, light was sold on a flat-rate basis. This method proved unsatisfactory from the fact that it could not be controlled to receive pay for all current used. To make an average rate that would bring returns for all current used would under the flat-rate system make charges unreasonable for many cusomers, and from this demand for equitable charges the electric meter was evolved.

How much this meter has to do with the financial success or failure of the electric-lighting business we do not all realize. It is the measure of the finished product, and so much as the meter is inaccurate just that much less will be deducted from the gross receipts, and consequently be a loss. It is a loss, because experience has proved that electric meters will in time register slow. This error is far greater in the older type meters, many of which are still in use, but are more fit for the junk heap.

This loss is greater than it really appears, as current delivered at the meter has charged against it all boiler, engine, transformer and line losses that will amount to from 20 to 90 per cent., so that it is all the more important that the current delivered to consumer be accurately measured.

The first efforts in making electric meters were not very successful. The moving parts were heavy, causing undue friction, with the result that the meters proved unreliable. Experience and brains, backed by unlimited capital, have solved the problem, so that today we have electric meters that are accurate to even a 50 per cent. overload of their rated capacity. They are as far superior to the first meters made as the fine Waltham movement is superior to the Waterbury. From this we must not judge that all meters are perfect when received. The rough handling by transportation companies often causes inaccuracies, and it is therefore best to test all meters carefully on receipt. In installing meters care and good judgment must be used and directions of the makers carefully followed. Accurate registering cannot be expected if these directions are not complied with.

Notwithstanding the proved accuracy of the electric meters of the present day, I regret to say there are still many of the lighting companies operating on the flat-rate system. The question of extra investment for meters and trouble anticipated in changing to meter basis is holding back many from adopting their use.

On the first question of extra investment I would suggest a preliminary test to ascertain whether the installing of meters will pay interest on the investment. Let the companies who are in doubt install meters on the switchboard that will register the total kilowatt output of the station. This can be done at a reasonable cost. Then from the gross receipts of any given month the price received per kilowatt for all current generated can be figured. A test of this kind will convince the most skeptical that on the flat-rate basis of selling light the receipts per kilowatt are not much more than half what they should be.

From this it cannot be assumed that the consumer will pay double on the meter basis over the flat rate, but that he will use light only when needed, and that his economy in using light will reduce the peak load as well as the average load on the station. This will permit taking on additional consumers and will increase gross income one-third without increasing the peak load nor the kilowatt output above what it was on the flat-rate basis.

There is another most important reason why meters should be used, and that is to ascertain the transformer and line losses, and being able to locate them, so that the plant may be operated at a high efficiency.

We would not think of making a donation of 10 or 20 per cent. of the lighting receipts. Then why should we in an indirect way be donating these amounts and more to losses in operation which could be corrected by the use of electric meters, and a system of checking up leakages and knowing just "where we are at."

In a central station which I recently tested the switchboard meters on 2,000-volt two-phase alternating current for commercial lighting and power purposes registered for March 18,450 kilowatt-hours. The consumers' meters total registered 13,806, making the loss 4,644 kilowatt-hours, or 25 per cent., so that the current sold was 75 per cent. of all current generated. This was in a station operating a 24-hour service, with a stoppage of six hours on Sundays. In 1901 the system of selling light in this station was changed from flat-rate to meter, so that all meters are comparatively new. All meters are tested systematically, the meter testing being done at the companies' office.

Meter maintenance is now recognized as a most important question in the successful operation of the electric-lighting and power business. The usual custom is to have a regular testing department, so that all meters are taken down and tested at regular intervals, not waiting until they show inaccuracy. In this way the highest results are obtained, not only in meter accuracy but in testing transformer and line losses of the distributing system. These tests will not be an expense that will be felt, as the results obtained will be a certain gain in the net earnings account.

The time customary for changing to meter basis is in the spring or summer. By changing at this season the days are longer and your patrons will become familiar with using light on the meter system. Some tact must be used in making such a radical change, as it cannot be done in a month. Some will no doubt be reluctant to make the change, but after they learn that it permits those to economize who wish to do so, which is not so on the flat-rate system, the balance will soon fall in line and be satisfied to use the meter system.

A minimum rate of $1 or more a month is universally customary for 10 lights or less, and an increased minimum charge for all lights above 10 as a guaranty that the income for each meter will be $12 or more a year, depending on the number of lights wired up and the maximum demand from each consumer. Some companies require a guaranteed income of 30 cents a month during the entire year for each 16-candlepower light installed, while others encourage the installing of all lights needed, without limit, and regulate the bills by the maximum demand of each month or year as agreed. This is ascertained by installing a Wright demand meter in connection with the current meter. This latter system has many good features from the fact that if electric lights are available at convenient points, either in residence or store lighting, they will be burned more or less at points which would not necessarily increase the maximum demand of that consumer.

I believe from the experience of having operated stations on both the flat-rate and the meter system that the adoption of meters will increase the number of consumers and widen the field of electric lighting, making it possible to obtain customers that it would otherwise be impossible to reach; that it will increase the earnings without additional station capacity, and that your customers will be better satisfied in every way.

The rates to be charged for current will depend somewhat on local conditions, remembering that it is easier to lower rates than to raise them, but whatever rates are adopted they must be equitable to all. Unless this rule is observed and followed, harmony and good feeling cannot exist toward the corporation. Treating all alike with courtesy and consideration will lessen the cares and remove some of the thorns from the pathway of the "ever-blessed" central-station manager.

1. A paper read before the Iowa Electrical Association at Des Moines on April 20, 1904. Mr. Carson is general manager of the Iowa City Electric Light Company.

American Technical Training.

The report of the Mosely Educational Commission contains much to interest both Englishmen and Americans. It was prepared, as readers of the Western Electrician are well aware, by British educators sent by Mr. Mosely to study methods in the United States. Several references to this important undertaking have been made in this journal. In addition the following, which is an abstract from Professor Ayrton's report, will be interesting:

At the Westinghouse Electric and Manufacturing works, where some 10,000 men are usually employed, there are about 150 engineering apprentices, who must be first-class graduates of leading technical schools. They are paid 8d. per hour at the start. Officials of the company visit all the principal colleges, etc., every year, choosing the most suitable pupils; and, as appears from other reports, there is actually a fierce competition between the various engineering concerns to secure these lads. At Columbia, Professor Hutton has had 70 of the engineering students engaged before graduation. Professor Ayrton tells us of a young English graduate of Victoria University who had entered an English electrical works as a £150 premium pupil. At the end of the first year he had learnt so little that the contract was determined and he went to Pittsburg. The Westinghouse company also takes about 80 non-technical apprentices to be trained as machinists, "who correspond more with what the English apprentice has become." They are taken on trial for 685 hours at 2½d., and if worth keeping may be earning 7½d. in their fourth year, at the end of which they receive a bonus of £20 and a diploma. At Union College, Schenectady, lectures are given alternately by a member of the faculty and by one of the General Electric Company's staff. The students have the free run of the factory; the professor brings his whole class to the works for a forenoon or day, "using the factory as his lecture apparatus." During vacation time any engineering student can come into the shops and earn a moderate salary at armature winding, or in the testing room. Thirty per cent. of the General Electric Company's students are British, and within five months "they drop into step and hustle," according to Mr. Steinmetz. The engineering staff of the Rapid Transit railroad, New York, comprises 118 men: 100 of them, or 84.7 per cent., are college-trained. They are chosen by examination and receive £20 per month to start with. Having seen the papers, Professor Ayrton states that the examination does not unduly favor the college man at the expense of him who entered on practical work when quite young.

Electrolytic Iron.[1]

By C. F. Burgess and Carl Hambuechen.

A great deal of attention has been devoted of late to the application of electrical energy to the metallurgy of iron, and some of the results attained seem to point to developments of industrial importance. Most of the attempts to apply electrical energy have been through its transformation into heat for use in various smelting and reduction processes. That the electrolytic as well as the electrothermal effect might be utilized industrially does not seem to have been considered seriously, as it has been commonly held that the difficulties inherent in the deposition of iron are such as to preclude its playing an important part in the industrial electrometallurgy of this element.

It has, however, been shown as a result of recent experimental work carried on in the Laboratory of Applied Electrochemistry at the University of Wisconsin that electrolytic iron can be produced in such quantities and at such cost as to make it a material of commercial as well as of scientific importance should sufficient demand for it arise.

A survey of available literature on the subject of electrolytic iron leads naturally to the assumption that its deposition is difficult to accomplish and that there are few solutions from which it can be deposited. Moreover, it has been held that a satisfactory quality of deposit can be attained only by the use of very low current densities and an exceedingly slow rate of deposition. Practically the only uses to which electrolytic iron has been put are in the so-called steel facing of dies and electrotypes and as a material for investigating the properties of the pure metal. The hardness of electrolytic iron, which makes it especially suited to the facing of electrotypes, is due to the occluded hydrogen, which is practically the only impurity present. In fact, the term, electrolytic iron, is commonly assumed to be synonymous with pure iron. In just what manner the hydrogen is held by the metal is a matter of doubt, it being claimed by some that it is simply condensed, and by others that it forms a definite hydride. Such iron may contain this gas in quantities equal to several hundred times the volume of the metal, and it can be almost entirely freed from it by heating. Certain investigators have found that electrolytic iron contains carbon in appreciable quantities, while others have found that carbon is absent.

Dr. John A. Mathews (Alloy Steels, Mineral Industry for 1902) states that "Pure iron may properly be classed among the rare metals; thousands of tons of iron alloyed with impurities from a fraction of one per cent, upward, are produced annually, but not a pound of iron in its pure elemental condition has ever been made under ordinary smelting conditions. By pure we mean in a condition comparable with that in which the precious metals are produced or as pure as the best electrolytic copper and nickel. . . . Just as pure iron is a chemical curiosity, so also is an alloy containing only iron and carbon. In practice at least four other solid elements occur fortuitously in all steels, viz., manganese, silicon, sulphur and phosphorous."

Something over two years ago the authors of this paper undertook an experimental investigation of the conditions for electrolytically depositing iron, and this work has proceeded almost without interruption since that time. The primary object of the investigation was to produce, if possible, pure iron in such quantities and at such cost as to make it an available material for further inquiry into its properties. Since our attention has been confined almost exclusively to this phase of the problem the observations which have been made as to the physical and chemical properties of the product are by no means exhaustive, and indeed are considered only as preliminary to a more extensive research, which it is hoped to take up in the future.

The preliminary work consisted in testing the various electrolyte materials which had been suggested previously, and from these the most promising were selected as the basis for further trial. It is needless to record here the many hundreds of tests which were made, for most of them were unsuccessful. Nor it is necessary to recite the difficulties encountered. The investigation was necessarily a slow one, since many of the trials required days and even weeks of operation before conclusions could be drawn as to their success. A large number of iron salts were used and the effects of variations of densities of solutions, current densities, temperature, agitation of electrolyte and various other factors were noted. As a result of such observation, ferrous sulphate with a certain percentage of ammonium sulphate was chosen as affording the most satisfactory results, and the process, as it is now being operated on a small experimental scale, may be briefly described as follows: Electrolyte consists of ferrous and ammonium sulphates; the current density at the cathode is six to 10 amperes per square foot of cathode surface, and at the anode slightly less; the electromotive force for each cell is slightly under one volt; the temperature of the electrolyte is about 30° C.; the anodes consist of ordinary grades of wrought iron and steel; the starting sheets for the cathodes are thin sheet iron previously cleansed of rust and scale.

One of the most serious difficulties encountered was in obtaining a thick deposit of iron. While it was proved that there is a considerable range of conditions under which iron can be deposited uniformly and densely for a few hours, or perhaps for a few days, it was almost always found that the surface would become so rough or pitted, or that such a rapid treeing would take place, or that the deposit would curl up to such a degree that it was necessary to discontinue the experiment and start a new one under different conditions. But improvements have been gradually effected until at the present time it is possible to continue the run four weeks without replacing the cathodes. At the end of such time the cathode reaches an average thickness of about three-quarters of an inch and the surface is so rough and nodular that it is not considered desirable to continue the deposition further.

The current efficiency of deposition is very closely 100 per cent.—that is, there is a deposition of about one gram per ampere-hour. The electromotive force being one volt, gives about 2.2 pounds of iron per kilowatt-hour.

Since all the factors which go to make up the cost of large scale production cannot be accurately determined from a small scale experiment, it is impossible to state from our investigations what would be the cost of working on an industrial scale. For the last six months three tanks have been kept in almost continuous operation, these tanks having the dimensions eight by 13 by 15 inches and containing two anodes and one cathode. The finished cathodes from these tanks weigh about 20 pounds and constitute perhaps the largest pieces of electrolytic iron which up to the present time have been produced. The total amount of the material which has been produced from all of our experiments is about one-half ton.

A run of two months' duration was made to determine the extent of the deterioration of the electrolyte, resulting in the conclusion that the solution can be kept in good working condition with little trouble or expense. It would appear therefore that the cost of refining, aside from fixed charges on the plant, and with power at $30 per kilowatt-year, would be under one-half cent per pound of iron, thus placing it not greatly in excess of the cost of refining copper. Even with these figures realized, whether or not electrolytic iron can be profitably produced depends upon the uses which can be made of the refined metal. These in turn depend upon its properties, the most striking of which is its purity. Although our work was directed toward the production of electrolytic iron in a dense and massive condition rather than in a high degree of purity, analyses which have been made show the purity to be in excess of 99.9 per cent. Not a trace of carbon was detected, and silicon, manganese and other impurities commonly found in iron, appear to be absent. The only impurity which has been detected is hydrogen, which is present in appreciable quantities in the metal as taken from the electrolytic tanks. This gaseous element in its physical or chemical combination with iron influences, in a most striking manner, the physical properties of the metal. The hydrogen can be driven off almost completely, if not entirely, by heating to a white heat, the evolution commencing at a temperature below 100° C. and becoming rapid at a temperature below a red heat. Electrolytic iron heated in a Thomson welder, or even in a Bunsen burner, has been observed to give off hydrogen so rapidly that it ignites and continues to burn after removing the source of heat, presenting an appearance similar to that which would be produced by dipping the iron in alcohol and igniting it. The metal containing the hydrogen is so hard that it can be filed or sawed only with difficulty, and it is so brittle that it is readily shattered by a sharp blow from a hammer. After the expulsion of the gas it becomes softer, and after having been raised to a welding temperature it assumes properties of malleability and toughness similar to those of Swedish iron.

The iron when heated in a forge fire can be readily welded and forged into any desired shape, and various test samples were made in this way. During such working, however, impurities are introduced, analysis invariably showing the presence of a very small percentage of carbon. The cathodes, three-fourths of an inch in thickness, have a surface so rough that they cannot be rolled satisfactorily into sheets, though it is possible that improvements can yet be made in this respect which will enable smooth surfaces to be obtained. The deposit adheres so loosely to the sheets that it can be removed readily.

A considerable amount of work has been expended in the attempt to melt electrolytic iron without at the same time introducing impurities. The difficulties which lie in the way of doing this, however, are great on account of the high temperatures necessary and the affinity which the iron at such temperature has for many of the elements. The melting temperature of the pure iron seems to lie closely to that of pure platinum, though actual values have not as yet been determined from lack of suitable measuring instruments. Various forms of electric furnaces have been constructed for melting the metal, a furnace of the inductor type appearing to be the most suitable for preventing the introduction of carbon. Results which have been somewhat satisfactory have been obtained by heating a molten electrolyte between graphite electrodes to a suitable temperature and introducing the metal into such molten bath. The metal thus produced is tough and malleable, while it also has a fracture of coarse, crystalline nature. The affinity which the iron has for carbon is shown by the fact that it can be readily melted in a graphite crucible, while a silica crucible heated to a considerably higher degree melts before the iron in it begins to flow. The absorption of the carbon in the former case produces a fusible alloy of iron.

Experiments have shown that the hysteresis, permeability and electric resistance of electrolytic iron are greatly influenced by the amount of hydrogen in it. An iron ring was deposited in such form that a hysteresis and permeability loop could be determined by the Ewing method. It was found that by heating in boiling water the hystersis was lowered several hundred per cent. By further heating in an oil bath to 200° C., the value was decreased still further, but to a smaller degree than in the first heating, and upon attempting to heat it to 500° the ring cracked and the experiment was therefore interrupted. Certain samples of forged iron have shown permeability values equaling or even exceeding those of the highest permeability standard samples of Swedish iron. Other samples prepared under apparently identical conditions showed much poorer results, so that it is impossible as yet to draw definite conclusions as to the magnetic properties of electrolytic iron.

It having been shown that it is possible to produce electrolytic iron at a small cost, the question naturally arises as to what uses there may be for it. The first suggestion which naturally presents itself is that on account of its purity it should serve as a basis for investigating the properties of iron and its alloys. Investigations having for their object the determination of the influence of various elements alloyed with iron, as regards its electrical properties, have been unsatisfactory on account of the presence of other impurities which modify or mask the effect of the element which it is desired to study. Starting with the pure iron, therefore, alloys of a predetermined and definite composition can be produced, thus making the investigations of greater simplicity. Unless the difficulties encountered in the working of electrolytic iron on account of its roughness offer too serious an objection it should compete favorably with the purer grades of commercial iron which are used for various purposes and which sell for three cents and upward a pound.

Electrolytic iron naturally offers the means of manufacturing chemically pure iron compounds and for standardizing solutions in the analytical chemical laboratory. The electrolytic iron in addition to its purity has an advantage for the purpose just mentioned of rapidly dissolving in an acid solution. A test which was made to determine the rate at which electrolytic iron and iron wire sold as chemically pure for standardizing purposes dissolve showed a ratio of 1 to 12, the former being the more soluble. By reason of the brittleness imparted by the occluded hydrogen it can be readily broken up into grains of a desired size and even into a fine powder.

Although the investigations referred to in this paper have covered a considerable length of time, the work which has been done should perhaps be considered only as preliminary to a more extended investigation, which, it is hoped, may be taken up in the future.

Summing up the work thus far done shows that it is possible to obtain electrolytic iron in large quantities and at a reasonable cost and that, therefore, iron should be added to the list of metals to which the process of electrolytic refining can be applied satisfactorily. It has been demonstrated also that such iron possesses a high degree of purity, though just how closely it approaches absolute purity can be shown only by spectroscopic analysis or by other methods which are more accurate than those which have been available.

[1] Paper read before the Washington meeting of the American Electrochemical Society on April 9, 1904. A brief summary of the paper was given in the Western Electrician of April 16th as a part of the proceedings of the meeting, but as the subject is important it is thought advisable to print the paper in full.

Cost of Lighting in Westminster, England.

City Engineer J. W. Bradley of Westminster, London, England, recently had published some figures giving the results of tests on the different lamps employed in street lighting in Westminster. What are known as Sugg's high-pressure gas lamps, used in Parliament Street, came out cheapest, 15.30 cents per candlepower a year; the arcs on the Westminster Supply Corporation being second best, 17.46 cents per candlepower a year. As the average of six series of tests, however, this order is reversed, the arcs being cheapest, 17.4 cents, and the incandescent gas second, 19.70 cents. The cost of the arc lighting seems to vary considerably with the type of lamp and conditions of contract. There are three different sources of electricity supply in the city of Westminster, and the cost of the arcs on these three supplies is, respectively, 23 cents, 30.2 cents and 17.4 cents.

The programme of the next meeting of the National Fire Protection Association, to be held in New York, May 24th to 26th, has been issued. A large number of special committees will report at this meeting upon important questions relating to fire protection, such as "Signaling Systems," "Theater Construction and Equipment," "Electric Fire Pumps," "Installation of Automatic Sprinkler Equipments," etc. At present the association has 37 active members, one honorary life member and 390 associates. The secretary is W. H. Merrill, Jr., the office of the association being at No. 32 Nassau Street, New York.

CORRESPONDENCE.

Great Britain.

London, April 30.—With the introduction of electric traction on the heavy railway lines of the country the question of the rate of wages paid to the motormen is not without interest. The Northeastern Railway Company has formulated the following regulations: Engine drivers who feel disposed to apply for transfer from the steam engines to the motors shall be accepted and be paid the maximum rate for motormen. The terms of pay and service are as follows: First year, 32 shillings per week; second year, 34 shillings; third year, 36 shillings; fourth year, 39 shillings. Time forms will be supplied by the company and 10 hours shall constitute a day, time and a quarter being paid for overtime. Upon the Lancashire and Yorkshire railway a special schedule of wages and hours has also been drawn up a little less remunerative than the above, I believe, and many of the men were at first dissatisfied.

Just at present the question of tramway running powers is creating considerable interest in Great Britain. The cause of the trouble was the granting by a committee of the House of Lords of running powers over the municipal tramways at Newcastle-on-Tyne to a local company. Consequently a conference of local authorities interested in tramway matters was held and several resolutions were passed. The chief resolution was to the effect that the granting by Parliament of compulsory running powers and compulsory traffic facilities over municipal tramways would be fought with grave and undesirable consequences and prove detrimental to the working of large tramway systems. A committee consisting of representatives from Birmingham, Liverpool, Leeds, Manchester, Sheffield, Cardiff, Newcastle-on-Tyne and the London County Council was then formed to deal with the matter as it thinks best. A meeting of the Tramway and Light Railways Association is to be held next week specially to discuss this question.

A noticeable feature of municipal electrical enterprise this year is the large number of municipalities that are seeking to enlarge their areas for general municipal purposes and at the same time to secure the extended area for the supply of electricity and for the construction of tramways. For the most part, up to the present, the extensions are comparatively insignificant and have consequently been unopposed, but if this principle is to be acted upon year by year the local authorities will soon be in conflict with the large electric power-supply companies that have been authorized in the neighborhood.

A dispute is going on in Swansea between the local authority and the National Telephone Company upon the question of intercommunication between the subscribers to the municipal telephone system and the National company. After the corporation has a certain number of subscribers it can force the company to give the necessary facilities and the postmaster-general has certified that the requisite number has now been obtained. The National company, however, while not disputing its liability to give intercommunication facilities, claims the right to see the books of the corporation to verify the number of subscribers connected. But the corporation has refused, with the result that a deadlock has taken place. The corporation talks of taking the matter into the courts.

At the time of the death of Mr. McMillan, the late secretary to the Institution of Electrical Engineers, it was decided to invite subscriptions from the members in order to make some provision for those he left behind him. For the object in view it was deemed that a sum of $10,000 would be required. Up to date over $6,500 has been received.

Mr. Yerkes has got into bad odor with the radical press here in connection with one of his tube railways. At the time of the passing of the Baker Street and Waterloo Railway act of 1900 an agreement was come to with the Southwark Borough Council to build pedestrian subways on the site of one of the stations at a very busy thoroughfare. Since then, however, the company has found the cost of building a station upon the site almost prohibitive and obtained parliamentary sanction to abandon the site. The Southwark people now argue that the railway company should build the subways whether it builds the station or not, but having received the sanction of Parliament not to do so, it may be taken for granted that legally the subways were only to be constructed with the station.

Two Irish and one Scotch electric-power bills have been passed this week. All were unopposed. G.

Dominion of Canada.

Ottawa, Ont., May 6.—A contract has been signed at Bathurst, N. B., for putting in an electric-light plant for lighting the town and village. The plant will be run by waterpower, which will be obtained from the Tatamagouche River, 2½ miles from Bathurst. The work is to be completed and in readiness for July.

A deputation of Canadian electrical interests has waited upon the minister of inland revenue asking that the government establish an electrical standardizing bureau to be maintained independent of any other branch of the public service and placed in charge of a qualified electrical expert, at whose disposal should be placed trained assistants and proper facilities. The purposes for which a bureau is required are for obtaining absolute standards for the measurement of electrical quantities and to enable the electrical expert to make tests of instruments and materials. The delegation also asked that the law be amended for the punishment of persons having in their possession any device to prevent the proper registration of electric current.

The Metropolitan electric railway of Toronto (controlled by the Toronto Street Railway Company) has commenced laying tracks to its new yard. The company has started to lay temporary tracks through the burnt-out district on Front Street, and this section of the line will be opened to traffic in a few days. The city engineer reports that at present cars are crossing Yonge Street on King on an average of one every 12 seconds. The old rails on Front Street have been rendered useless by the action of the fire.

During the present season the Montreal Street Railway Company will expend many thousands of dollars on renewals of its lines in various parts of the city. New 96-pound rails will be laid on many streets. The new rails will be laid on steel ties and the stringers will be of concrete. Other improvements already in hand or planned for the immediate future include the double-tracking of a number of streets, the reducing of grades and the opening up of the Verdun line, which was damaged by the flood.

Notice is being given that an application will be made at the next session of the Northwest Assembly to build an electric railway from Strathcona to Fort Saskatchewan.

John MacNamara of New York is on his way to the Yukon and is representing a number of American capitalists who are interested in a project to build an electric railway to connect with Canadian and American Pacific ports. Mr. MacNamara proposes to supplement the service with boats that can navigate the rivers in summer. This line will be a rival of the Canadian Pacific White Pass Line.

J. Murphy, C. W. Jarvis and others are seeking power to build an electric railway from the West Fort to the Empire elevator at the mouth of the river in Fort William. The application is before the council, and they will submit a by-law to the ratepayers.

Attorney General Gibson, in the Ontario Legislature, has had incorporated in the statute law amendment act a clause providing that no company operating a street railway subject to the jurisdiction of the province shall run cars on Sunday. The amendment does not apply to companies in operation previous to 1897 which have been regularly running Sunday cars, nor to any special charters. W.

New York.

New York, May 7.—On Wednesday for the first time an electric train was worked from the elevated to the subway system, at the junction at Third Avenue and One-hundred-and-forty-ninth Street. It will be, however, some little time before passengers can be conveyed in this manner. With the completion of the subway and the publication of the routes of the projected second tunnel, it is interesting to note that the real estate likely to be affected by improved transit conditions has a tendency to rise in value. This even applies to property that it might be thought would be adversely affected by the vibration of the adjacent subway.

Application is being made by the Schmidt and Gallatin syndicate of Wall Street for the construction of a system of moving platforms on Thirty-third-Street and Thirty-fourth Street, between Second and Ninth Avenues. This plan, if carried out, will connect the new Pennsylvania depot with the East Side.

Governor Odell has signed the two transit bills recently passed by the state Legislature. One of them removes the $50,000,000 limit hitherto placed upon the issue of subway bonds, and leaves the amount loanable to be fixed by the Board of Estimate; and the other regulates the connection between the surface and subway lines. As a result of this removal of the financial restrictions, the civic officials are busily engaged on the plans of the projected second subway, and actual surveying will soon commence.

The struggle between the Westchester and the Port Chester people for the control of the new trolleys in the Bronx continues. It is now alleged that the Port Chester scheme is being deliberately held up in committee by unscrupulous aldermen for the sum of $300,000. Borough President F. V. Fornes announces his intention of probing these allegations.

The railroad commissioners report that for the year ended February 29th the enormous total of 1,036,834,773 passengers were carried upon the surface and elevated lines in the five boroughs which make up Greater New York. This is an increase of more than 65 millions over the previous twelvemonth. The total car mileage was 197,826,719, an increase of 18,220,829 miles. It is particularly interesting to note that as a result of the first complete year of the working of elevated lines in Manhattan under electrical conditions, these lines carried no less than 273,133,242 passengers, or an increase of $37,318,852 over the old steam-locomotion days. The official report also shows that the Union Railway Company operating in the Bronx carried 21,273,870 passengers, an increase of 1,998,543, or, with transfers, 21,698,501. In the Bronx all railroads carried 22,147,077, an increase of 1,988,636. In the recapitulation for Manhattan the total of 670,778,071 passengers is shown, an increase of 37,463,163, while on transfers all lines carried 166,310,453 passengers, an increase of 11,435,049. In Brooklyn the Brooklyn Rapid Transit system carried 285,725,986 passengers, an increase of 23,280,423. On transfers the road carried 55,146,001, a total net increase of 3,772,959. The Coney Island and Brooklyn Railroad Company carried 33,129,812 passengers, a net increase of 967,765. Passengers carried in Brooklyn on all lines numbered 320,107,163, an increase of 24,363,201. In Queens the total was 16,058,207, an increase of 762,354. In Richmond all roads carried 7,744,255 passengers, an increase of 498,610.

As an outcome of the revelations of Captain F. Norton Goddard as to the co-operation of the Western Union Telegraph Company with the local pool-room keepers, Colonel Robert C. Clowry, president of the company, has stated that since the law directs that a telegraph company must convey all messages not of an indecent character, they cannot refuse to supply sporting information to persons paying for the transmission of the same. Nevertheless, in all cases where the police supply evidence of gambling and announce their intention of taking legal action the company promises to stop the service of racing information.

The projected Manhattan Bridge—making the fourth big bridge for the city—is to be commenced on July 1st. This bridge will have a larger traffic capacity than any other in the world, for it is to have no less than eight tracks for electric cars, as compared with six tracks on the Williamsburg Bridge when the latter is completed. The estimated total cost of the Manhattan Bridge will be $12,000,000, of which half a million dollars is reserved for the car tracks.

The Edison company, among some of its recent work in this city, has installed electric-lighting system in the new skyscraper at Broadway and Forty-second Street, a triangular building not dissimilar to the "Flatiron." The same company has also completed a very elaborate installation in a new building at the corner of Fourth Avenue and Twenty-third Street, the very newest devices being used in both cases. As a means of announcing these facts to the general public a large electric sign has been displayed for several evenings on the respective buildings, and the several hundreds of incandescent lamps so utilized made an exceedingly brilliant display.

Copies of "El Rai Radio," a brochure by Adolfo Hess, E. E., of Turin, have reached New York. This book gives the latest word on radioactivity generally. Its author was for some time engaged in this line of research in Edison's laboratory at Orange, N. J. The book has for frontispiece a fine portrait of Mr. William J. Hammer, consulting engineer, of New York, and a considerable part of Mr. Hammer's own recent work on "Radium" has been translated into Italian with due acknowledgments in the course of the work. Mr. Hess also includes in his pamphlet the very latest results of Professor Becqueral and of Professor and Mrs. Curie, whom he saw recently in Paris. In a rather flattering manner, also, Mr. Hess quotes some researches upon the atomic weights of radioactive elements made by the present writer.

D. W. W.

Southeastern States.

Charlotte, N. C., May 7.—The Southern Brass Works Company will furnish the electric current for lighting purposes at Lexington, N. C., until the plants recently destroyed by fire can be rebuilt.

The W. T. Weaver power plant near Asheville, N. C., will install a second turbine wheel at once, this to be followed with a third, which will give the plant 3,000 horsepower. The Asheville Electric Company has contracted for a large portion of the power, and the remainder will probably be taken by the Biltmore estate.

The Hendersonville (N. C.) Light and Power Company has decided to move its plant. Having purchased a waterpower near the town, it will there build on a larger scale.

The Darlington (S. C.) Light and Water Company has contracted with the City Council to furnish an all-night incandescent electric-light schedule in place of the moonlight schedule now in force. The contract allows the town an option of purchase at the end of 10 years. L.

Kentucky.

Louisville, May 7.—The Lebanon and Columbia Electric Railway Company, which was incorporated a short time ago, will have an authorized capital stock of $1,000,000. The proposed line will be 42 miles in length, extending from Lebanon to Columbia, with a spur to Bradfordsville. The United States Trust Company has plans for financing the road under consideration, and the Tennis Construction Company will do the work. It is thought it will cost about $16,000 a mile. W. K. Azbill is the president of the company.

It now appears that there will be some trouble over the right-of-way between Lexington and Versailles. George B. Davis of the Bluegrass Consolidated Traction Company some time ago stated that work would be begun on the line on May 1st. The Fayette Interurban Traction Company received a franchise for a line over the same route, but de-

layed doing any work until it was seen what the other company would do.

The Henderson Street Railway Company of Henderson is preparing to extend the city lines and relay much of the track on the old lines. A contract has been signed with the Tennis Construction Company to do the work. It is probable that some suburban work will be done also, but this is not included in the present contract.

It is announced that the Lebanon and Franklin Traction Company will have its line in operation by the middle of May. C.

Mexico.

City of Mexico, May 4.—An electric plant at the mines of the Carrizal Gold Mining Company in the state of Michoacan, Mexico, will be installed by Rudolph J. Decker, a mechanical and electrical engineer of Salt Lake City.

An electric plant is to be installed at the Alferencia mine in the district of Santa Barbara, Mexico. Weisel & Kock of Parral, Mexico, are interested. Several other mines in the district are being electrically equipped.

General Pablo Rocha y Portee, governor of the territory of Tepic, Mexico, is at the head of a project to establish an electric-light and power plant for the city of Tepic. Bids for the installation of the plant will soon be called for.

The project of building a tramway from Huichapan, Mexico, to the railroad station of El Cuarto, a distance of several miles, has taken definite shape. Don Pedro L. Rodriguez of Pachuca, governor of the state, has subscribed $12,500 in cash and agreed to donate the rails, rolling stock and have the grade constructed for the road, provided others interested in the enterprise will provide the ties and mules.

The electric-power plant of the Federal District Street Railway Company at Indianilla, City of Mexico, is being increased from 4,000 to 5,200 horsepower. The building is also being enlarged.

Jose de las Munecas Zimavilla and W. E. Hermann of the City of Mexico have organized a company with a capital stock of $150,000 for the purpose of establishing an electric-light plant in the city of Campeche, Mexico. The concession for this enterprise was obtained from the state government by these men recently.

The new electric-light and power plant at Atlixco, Mexico, has just been inaugurated, the occasion being made one of general celebration on the part of the people.

The Mexican government is extending its telephone system in the state of Sonora to all of the towns and villages in the Yaqui Indian country. The object of this improvement is to facilitate the military campaign which is being waged against the Indians.

A new telephone line is being constructed between Monterey, Mexico, and the suburb of Topo Chico. H.

Ohio.

Cleveland, May 7.—Active work is now being done toward the combination of the Appleyard interests in this state. Arthur E. Appleyard, head of the syndicate has, within the last week, been in Cincinnati, Cleveland and other cities in consultation with bankers and railroad men in regard to the matter. The plans, it is said, have all been formulated, and Mr. Appleyard is arranging to put them into execution at as early a date as possible. A rumor to the effect that the Scioto Valley road might be consolidated with this system was heard on the streets this week, but it has not been confirmed at all.

Some rivalry has developed between manufacturers at Zanesville and the Zanesville Railway, Light and Power Company, over the use of water from the canal at that point. The water has been very low for some time and the manufacturers claim prior right over the railroad company in case of scarcity.

The Cleveland Electric Railway Company will inaugurate its city touring-car service again about July 1st and continue it until the cool weather of fall.

Contracts for the construction of the Lake Erie and Southern Traction Company's road will be let on June 15th, according to reports from Fostoria.

Arrangements will be made, if possible, to begin construction work on the Mansfield and Eastern traction line, between Mansfield and Ashton, by the first of June. It is said the road will be bonded for $450,000, one-third of which has already been placed.

J. R. Holcomb states that the Buffalo, Dunkirk and Western will be completed this summer and connections will be formed that will give a through route from Cleveland to Buffalo. The company has 23 miles of road in operation and 35 graded and ready for rails and overhead work.

The first merchants' excursion over electric roads at Columbus will take place on May 12th. The excursion association in that city now has more than 100 members, and the experiment bids fair to be very successful.

The Cleveland Electric Railway Company will build a storage-battery station in Newburg or at some point in the southern part of the city this summer, in order to better take care of the current operating lines in that direction. It already has a large battery at the Windemere barns that has proved of much benefit to the long lines that run to Euclid and Euclid Beach.

The Columbus, Newark and Zanesville Interurban Electric Railway Company has put its road in operation on a regular schedule. Five cars a day will be run each way.

In a case recently decided by the Supreme Court of Ohio, electric roads are held liable for accidents happening from wires which are not strung high enough over steam-railway crossings to allow the brakeman to pass under them while standing erect on a freight car.

The gross earnings of the Toledo and Western for April were more than $5,000 greater than for the same month last year. This is a pioneer freight-carrying electric road and has more freight business than it can take care of.

It is prophesied by some electric-railway men that building will be on a much more extensive scale in 1905 than for several years past. Cleveland people are considering a number of propositions, some of them in the West, and the matter will likely be taken up actively next spring.

The annual meeting of stockholders of the Cincinnati Gas and Electric Company was held last Monday, and directors were elected. The old officers were all re-elected at a meeting of the directors held later. The report of President Kenan showed that the business the last year had been very satisfactory. O. M. C.

Indiana.

Indianapolis, May 9.—The Chicago and Northern Indiana Railroad Company, which proposes to build an electric line from Indianapolis to Chicago, has filed articles of incorporation. The line will pass through 11 counties and parallel the Monon and Pennsylvania lines by occupying the middle of the territory between them. The preliminary capital stock of the company is $25,000, although it is said $3,000,000 is back of the scheme. The new road will transport freight in heavy freight cars drawn by electric motors. Sleeping cars will also be run between the two cities. The officers of the company are: President and general manager, Lester Soule; vice-president, H. E. Davenport; secretary and treasurer, A. L. Wheeler—all of Indianapolis.

There was a split among the stockholders of the Indianapolis and Eastern Electric Railway Company at their meeting on the 3d instant, and as a result the minority stockholders elected new officers and three directors, with R. C. Light as president. The majority stockholders adjourned to meet May 18th. The minority stockholders are threatening to bring suit to oust the present officers and to obtain possession.

The Indiana Union Traction Company has put into effect a new schedule affecting all the interurban passenger cars on the eastern division. The limited trains have been increased and fast time inaugurated. The change of time also means increased fares.

The Indianapolis and Cincinnati Traction Company has brought condemnation proceedings against Captain J. H. Mauzy for the necessary ground in Rushville upon which to build the road's general and division offices. An offer of $10,000 was refused by Captain Mauzy.

An election was held in Silver Creek Township on the 7th instant to vote on the question of a subsidy of $16,800 in aid of the Louisville and Indiana Traction Company. The rumor is that the subsidy was carried by a safe majority.

The Indianapolis Traction and Terminal Company paid into the city treasury last week $30,000, being the amount which the company must pay the city each year under its franchise.

The Greensburg Gas and Light Company has changed its name to the Greensburg Light and Power Company and increased its capital stock $30,000. The company proposes to install a new electric-light and power plant.

The city of Mount Vernon has taken steps toward the installation of a municipal electric-lighting plant.

The Evansville and Henderson Traction Company has filed a bill in equity in the United States Circuit Court at Louisville, Ky., against the Henderson Bridge Company, in which the court is asked to declare the bridge to be a public highway and determine reasonable rules and regulations for the traction company to observe in operating over it and determine what would be reasonable toll for its use. F.

Michigan.

Detroit, May 7.—The Detroit, Ypsilanti and Ann Arbor railway will equip two of its cars with a new ball-bearing truck to test the efficacy, and, if found satisfactory at the end of six months, the entire rolling stock of the road will be similarly equipped. The new system is supposed to save the current on curves and stops, as well as diminish the wear on bearings and rails.

J. O. Zabel and S. A. Foster have been granted a franchise for a new electric line from Petersburg to Jackson.

The Toledo and Michigan electric railway has filed a mortgage for $1,500,000 to the Security Trust Company of Toledo to secure bonds, the proceeds of which are to be used for the building of the road. The line will run from Toledo to Jackson, Mich., via Adrian.

Construction work has been commenced on the Coldwater-Quincy electric road at Coldwater. It is asserted that cars will be running in about two months.

The Detroit United Railway Company has issued an attractive folder, "Trolley Rides in City and Country," which shows not only the city lines but the topography of the section of Michigan, Ohio and Ontario which the interurban lines traverse.

The Goodrich Transportation Company, it is understood, has entered into a traffic arrangement with the Grand Rapids, Grand Haven and Muskegon electric railway to protect itself against the combination between the Grand Trunk and the Berry Transportation Company.

Owing to the shifting of the Kalamazoo River at Otsego, the Kalamazoo Electric Company has been forced to shut down its plant. The river has formed a new channel around the south end of the big dam, leaving the whole power plant high and dry. Most of the cities between Kalamazoo and Jackson, as well as the Jackson-Battle Creek interurban road, receive their power from the system of waterpower dams of this company, and business had to be suspended for a couple of hours while the Otsego dam was disconnected from the others. It will take about 10 days to bring the Kalamazoo River to its old channel.

The city of Sault Ste. Marie has invited proposals from firms or individuals who would like to secure the franchise for establishing a gas and electric-lighting plant in that city.

The Sommer Motor Company has been incorporated in Detroit, capitalized at $40,000.

The Detroit, Monroe and Toledo Short Line (electric) will begin on May 10th with hourly service between Sibley and Toledo, and about the 15th of August, it is expected, will run its cars through to Detroit, connecting with the Detroit United Railway Company's tracks at Woodmere Cemetery. A waiting room is being fitted up now in this city. The running time from the City Hall in Detroit to the business district of Toledo will be about two hours and 10 minutes. There are no grade crossings on the route. C. G. W.

Northwestern States.

Minneapolis, May 7.—Bids will be received by the council of South Stillwater, Minn., until May 28th for the construction of an electric-light plant from plans by Professor F. J. Flather of Minneapolis. The plant will cost about $15,000.

The Green Bay (Wis.) Light and Power Company is planning to remodel its plant so as to double its capacity.

The contract for wiring and lighting the public library building at Iowa City, Iowa, has been let to the Tri-city Electric Light Company of Davenport.

An interurban line is proposed from Forest City, Iowa, to Cresco.

The Electrical Construction Company of Rock Island, Ill., has secured the contract for the new machinery in the electric-light plant at Clarion, Iowa, for $4,900.

Work has been commenced on the construction of the new street-car line at Fargo, N. D., and Moorhead, Minn.

M. J. O'Neil of St. Paul, Minn., has been awarded the contract for electric wiring and fixtures at Fort Russell, Wyoming.

A three-per cent. tax has been voted at Marshalltown, Iowa, to aid the Marshalltown Electric Street and Interurban Railway Company in constructing its proposed line to Grundy Center.

The Garland Electric and Plumbing Company of Ashland, Wis., has been incorporated with a capital stock of $10,000. A. A. Braatz heads the list of stockholders. R.

Rocky Mountain States.

Salt Lake City, May 5.—The annual statement of the Montana Water, Electric Power and Mining Company, showing assets aggregating $500,000 and liabilities of $308,032.15, has been filed with the secretary of state.

The Johnson Electrical Manufacturing Company has been incorporated at Tempe, Ariz., with an authorized capital stock of $200,000. The incorporators are W. F. Nutt, Charles Johnson and others.

The large dam about completed by the Dewey mine at Harpster, Idaho, to be used for electrical and mining purposes, is almost a total wreck as a result of high water. The loss is placed at $60,000.

The Gamble-Shepard Company has been incorporated at Salt Lake City by J. B. Hoyt, J. W. Guild and others, for the purpose of establishing an electrical plating corporation. The company has a capital stock of $5,000.

California capitalists are pushing a project to connect Reno and Sparks, Nev., with an electric railroad, and work will be commenced in the next few weeks. G.

Pacific Slope.

San Francisco, May 5.—W. F. Hynes, who has been connected with the sales department of the Wagner-Bullock Electric Company's office, has left for Los Angeles to open a general engineering office.

The Visalia Electric Railway Company has been incorporated with a capital stock of $1,000,000. The incorporators are Harold Wheeler, B. M. Maddox, W. H. Hammond, C. J. Giddings and S. Mitchell.

Articles of incorporation have been filed in Washington by the Snohomish and Cherry Valley Electric Railway Company, with Fred S. Anderson, E. Colburn and others as directors. The company has an authorized capital stock of $120,000. It is the in-

tention of the company to construct an electric line from Snohomish through Cherry Valley. Franchises have already been secured.

The Seattle, Renton and Tolt Electric Railway Company has filed its incorporation papers in Seattle, Wash., for the purpose of constructing an electric road from Renton to Tolt, via Issaquah and Falls City. W. H. Goldson, P. J. Farley and E. S. Gill are the trustees. The company is capitalized at $75,000.

Frank Ross, assistant general manager of the Sacramento Electric Gas and Railway Company of Sacramento, states that new machinery will be installed in the power house.

The Mendocino Electric Light and Power Company of Mendocino, Cal., has been placed in full possession of the Mendocino Lighting Company's plant. J. Grindle is president of the company and Albert Brown secretary.

D. M. Drumheiler of the Palmer Mountain Company, with headquarters at Spokane, Wash., states that money is being raised to put in a large electric power plant on the Palmer Mountain tunnel property this summer. The proposed plant will be put in on Coulee Creek and will cost about $150,000. A.

PERSONAL.

William Marconi sailed from Liverpool for New York on May 7th on the steamship Campagnia.

H. A. Douglas, manager of the Citizens' Telephone Company (Independent) of Jackson, Mich., has been obliged to resign on account of ill health and will go to California.

George Dawson, for many years a railroad contractor and electric street-railway proprietor in Canada, died suddenly a few days ago and was buried in St. Catharines.

Edward Jones, manager of the Western Union Telegraph Company at Mankato, Minn., has been promoted to the position as manager of the company's office at Sioux Falls, S. D.

Arthur E. Appleyard has been chosen president of the Dayton, Springfield and Urbana and the Columbus, London and Springfield electric roads in Ohio to succeed John S. Harshman, resigned.

The friends of H. S. Gilkey of the firm of Pendleton & Gilkey of Minneapolis will be pleased to learn that he is again attending to business, after a severe attack of illness, which covered a period of three months.

Dr. F. A. C. Perrine, first vice-president of the Stanley Electric Manufacturing Company, whose main office is in Pittsfield, Mass., stopped in Chicago last week. Dr. Perrine is making a trip west in the interests of the company.

C. P. Weaver, special agent of the Philadelphia Rapid Transit Company and one of the best-known men in Philadelphia traction circles, died in Philadelphia on May 3d of acute Bright's disease. He was born in 1859 and had been connected with street-railway matters since 1880.

It is reported that Blaine Claypool, a former well-known telephone man of Youngstown, Ohio, committed suicide in Seattle recently. Besides being manager of construction for several plants in Ohio, Mr. Claypool built the Independent plant at Birmingham, Ala., and did other work in the South.

Putnam A. Bates and John Neilson of New York city announce that they have formed a partnership under the firm name of Bates & Neilson to practice consulting engineering. Their offices are at No. 42 Broadway. Mr. Bates was formerly with the Crocker-Wheeler Company and is one of the well-known electrical engineers of the country.

H. V. Croll, who has been in charge of the Salt Lake City (Utah) office of the Allis-Chalmers Company for several years and who was before that the representative of the E. P. Allis Company at Spokane, Wash., has been appointed to the charge of the Allis-Chalmers office in San Francisco, as the successor of George Ames, who has resigned. Mr. Croll's San Francisco office is 623 Hayward Building.

John Findley Wallace of Chicago, general manager of the Illinois Central Railroad Company, has accepted the appointment of chief engineer in charge of the construction of the Isthmian Canal. Mr. Wallace was born in Massachusetts and graduated as a civil engineer at Monmouth University, Monmouth, Ill. Since leaving school he has had to do with many important construction problems. He is prominent among railroad officials. After the preliminary work, which will require probably two years, he will go to the isthmus, to remain until the canal is completed.

ELECTRIC LIGHTING.

The city of New Haven, Ind., will receive bids until May 24th for the construction of an electric-light plant.

The plant of the Antigo Electric Light and Power Company at Antigo, Wis., has been destroyed by fire, causing a loss of $20,000.

Bids are asked by the city of Effingham, Ill., until May 17th for the contract for lighting the city streets for a period of five, 10 and 15 years from November 5, 1904. The minimum number of street lamps is to be 60; to be enclosed arc lights of 2,000 candlepower. The minimum total number of hours of light furnished to be not less than 129,600 hours a year.

The city of Elkton, Ky., has granted a franchise to E. L. Peck of Guthrie, Ky., for lighting the town with electricity for five years. Mr. Peck has a plant at Guthrie.

The Livermore (Cal.) Water and Power Company is preparing to extend its power line to Ruby Hill, where electricity will be used as motive power for the grape crushers.

A 90-kilowatt electric-light plant will be erected at once by the recently incorporated Pineville (Ky.) Electric Light, Power and Ice Company, of which R. L. Bowman is president.

At the recent meeting of the council of Sylacauga, Ala., a $20,000 bond issue was authorized, the proceeds of which will be spent in the erection of a water and electric-light plant.

Garff & Son of Logan, Utah, have submitted a proposition to the council of that city to build a light and power plant to furnish light and power to the city. The proposition has been referred to a committee.

John Frith & Son of Watseka, Ill., have been incorporated as the Watseka Electric and Heat Company and have secured a franchise from the City Council of Watseka for lighting the city for a period of 20 years.

The city of Thomson, Ga., has decided to construct the proposed electric-light plant at a cost of $12,000. J. B. McCrary of Atlanta, Ga., will have charge of the construction. The city will also install a system of waterworks.

The Southern Illinois Electric Railway Company has forfeited its franchise, which was granted to it by the Belleville City Council several meetings ago. The company proposed to build an electric railway between Belleville and Mount Vernon, Ill.

The Winona (Minn.) Railway and Light Company is asking the city for an extension of its franchise, which expires in seven years, to 40 years. The company has made extensive improvements and wishes to float long-term bonds to meet the expenditures incurred. The city holds one of the lowest contracts for light of any city of similar conditions, but thinks an extension of 20 years sufficient.

The Municipal Board of Estimates of the city of Baltimore, Md., has determined that as a franchise tax for its rights to use streets and subways for supplying power the Maryland Telephone and Telegraph Company shall pay 1¾ per cent. on gross receipts of its electric-lighting and power business to the city. The board also prohibited the Maryland company's consolidation with any other electric-light company.

ELECTRIC RAILWAYS.

An ordinance has passed first reading in councils of Pottstown, Pa., granting permission to the Pottstown and Reading street railway to lay tracks on King Street. The company agrees to pave several blocks of the street each year until the entire length of the street is paved and also to keep the street in repair.

The ordinance recently passed by the City Council of Springfield, Ill., granting a perpetual franchise to the Illinois Central Traction Company for street-railway privileges was vetoed by Mayor Devereux and a sub-committee was instructed to draw a new ordinance. The street-car company has its track finished, poles up and wire strung to the city limits, and awaits the action of the council.

The Kansas City, Burlingame and Western Electric Railway Company, which forms a link in the proposed large Kansas system, has been incorporated with a capital of $2,000,000. The road will connect with the Kansas City and Olathe line at Olathe. It will run through Baldwin, Overbrook and Burlingame to Council Grove, a distance of 100 miles. Spurs to connect with the main line will increase this mileage materially. Hugh A. Holmes is president of the new company.

The Northern Railway Company of France is at present installing a transformer sub-station at the Amiens railway station, where the direct current supplied by the power house is to be transformed into single-phase alternating current and transmitted over a distance of five kilometers to Longueau, where it will be utilized for the lighting of the railway station. The Amiens sub-station will contain two 35-kilowatt Westinghouse rotary converters and a 30-kilowatt Westinghouse transformer. At the Longueau railway station the pressure will be lowered to 115 volts by means of a 28-kilowatt Westinghouse transformer.

The city of West Seattle, Wash., has voted to bond itself for $18,000, the money to be used in the construction of an electric railway from the ferry landing to connect with the terminus of the local car line. The city has recently received a forfeit of $2,000 from the Seattle Electric Company on an unexpired charter and $4,000 from the Northern Pacific railroad on an uncompleted road in the same territory in which the city contemplates building. It is proposed to run the cars in connection with the West Seattle ferry, making a five-cent fare from the wharf at Seattle to the terminus of the West Seattle car line and vice versa. The five cents it is proposed to divide, giving three cents to the ferry and two cents to the car line.

POWER TRANSMISSION.

Congress has passed a bill granting permission for the construction of a dam in the Tennessee River at Chattanooga, Tenn., and the operation of a plant to develop electrical power. From 25,000 to 40,000 horsepower will be developed. The construction of the dam will also complete the improvements of the Tennessee River, which will render that stream navigable during the entire year from Chattanooga to Paducah. A company will probably be formed, with C. E. James of Chattanooga as president and J. C. Guild as engineer, for the construction and operation of the plant.

AUTOMOBILES.

A company has been formed to carry on an automobile service between Hochheim, Germany, a village of 1,475 inhabitants, and the city of Erfurt, which is a short distance away. At first efforts were made to induce the Erfurt Electric Street Railway Company to extend its tracks to Hochheim, but, the company refusing, it has been decided to establish this automobile service.

TELEGRAPH.

A unique accident prostrated the Western Union telegraph service along the Rock Island road recently. A few miles from Joliet a telegraph pole was blown across the tracks and the wires were struck by a freight train going at full speed. The tender caught up the pole and carried it half a mile. Thirty poles were dragged down before the accident was discovered.

The city solicitor of Philadelphia has recovered from the Western Union Telegraph Company $8,119.81, the amount of license fees for poles and wires under the ordinances of 1881 and 1883, for 1885, 1886, 1887, 1888, 1889, 1890 and 1891. This case has been tried in the United States Circuit Court three times. In the third trial the jury rendered a verdict in favor of the city for the full amount of its claim, with interest.

With 2,300 miles of cable on board for the completion of the New York-Fayal section of the German-American duplicate cable, the steamship Stephan arrived in New York from Bremen, and after coaling proceeded in search of the buoy marking the end of the 100-mile stretch of cable laid last fall. The end will be spliced on board and the steamer will then complete the connection with the Azores. The cable on board the Stephan was made in Germany and is valued at $230,000.

SOCIETIES AND SCHOOLS.

The Ohio Electric Light Association announces Sandusky and August 16th, 17th and 18th as the place and date of its next convention. Papers of a valuable character are promised.

The first dinner of the recently organized Magnetic Club of Philadelphia was attended by about 200 persons representing various branches of electrical work. The special guests were W. T. Westbrook, W. F. Jones, Thomas E. Fleming and M. J. O'Leary of New York. Speeches were made by some of the guests and the officers of the club.

The Massachusetts Institute of Technology of Boston offers summer instruction during the months of June and July, supplementing the regular work of the year, and a bulletin is issued outlining the courses of study. Entrance examinations for the regular college year will be held in Boston on June 30th and July 1st and 2d and a second series on September 20th, 21st and 22d. Entrance examinations will also be held in other cities June 22d to 25th, some of the principal points in the West being Chicago, Milwaukee, St. Louis, Detroit, Fort Wayne and Denver. Further information in regard to them may be had by addressing Dr. Thomas S. Fiske, secretary, college entrance examination board, Post-office sub-station 84, New York, N. Y.

President Edgar of the National Electric Light Association was in New York last week, making final arrangements for the Boston convention. Twenty-five papers and reports are now in type, and it is expected that copies will be distributed to those members who have announced their intention of attending the meeting, reaching them before they leave home, and thus enabling them to prepare themselves to discuss the papers intelligently. Mr. Hodskinson, chairman of the committee on hotel accommodations, has succeeded in getting replies from every member company stating whether or not a representative would be in attendance, and from these replies it is estimated that the representation will be far in excess of that at any previous meeting. Most systematic arrangements have been made for the reception and registering of delegates, and a plan of

distributing and looking after the papers has been formulated, which promises to make that part of the convention routine run very smoothly.

PUBLICATIONS.

The latest catalogue and price list of engines, boilers, etc., for sale by the Whitehead Machinery Company of Davenport, Ia., is being sent out. It may be had upon request.

The Emerson Electric Manufacturing Company of St. Louis is furnishing its friends with a neat pocket map of St. Louis and of the fair grounds, printed on opposite sides of the sheet. The map of the grounds contains also an index of locations.

The F. Bissell Company of Toledo, Ohio, has prepared a handbook of its switchboards "with quotations on the spot." All the various types of switchboards as manufactured by this company are described and also a list of standard switchboard parts.

Reconstructed granite for electrical insulation is manufactured by the Reconstructed Granite Company of New York city. A small catalogue from this company illustrates and describes the various forms of third-rail insulators, which are one of the most important of the company's products.

A carefully prepared catalogue on "Wire Rope and Fittings" comes from the American Steel and Wire Company of Chicago. Wire ropes for almost every purpose are listed; also wire-rope fittings, such as hooks and sockets, hooks and thimbles, etc. A clear description of how to splice a wire cable is one of the useful things given in the book.

Another of the handsome catalogues of the Murray Iron Works Company, Burlington, Iowa, has appeared and tells all about Murray Corliss engines and high-pressure boilers. The catalogue is an example of high-class typographical work and is profusely illustrated. It describes not only boilers and engines but also a line of air compressors.

"A Wallet-ful of Information" is an apt title for the little booklet issued by the Columbia Incandescent Lamp Company of St. Louis. It contains enough and not too much information about the company's lamps to make it a handy little reference book to be kept as a guide in ordering lamps. The booklet contains not a few neat illustrations and some "facts without fringe" about Columbia lamps.

Duncan integrating wattmeters for direct current are described in a bulletin from the Duncan Electric Manufacturing Company of Lafayette, Ind., which notes in detail the construction and working of these instruments. Something new in the construction is the visual bearing, which permits of the lower end of the shaft or spindle point and the jewel bearing being inspected while the meter is in operation.

The new catalogue of engines and boilers made by James Leffel & Co. of Springfield, Ohio, will interest anyone who has to do with steam power. It goes into the matter of the making of Leffel engines and boilers and indicates the advantages of this class of apparatus. The book is well gotten up, printed on heavy enameled paper, has numerous full-page and many smaller illustrations, and is filled with detailed information about engines and boilers. The catalogue will be mailed free to prospective buyers of engines or boilers.

A finely illustrated pamphlet devoted to theater dimmers comes from the Cutler-Hammer Manufacturing Company of Milwaukee. These dimmer devices, in the modern theater, have now become an important part of the stage-lighting equipment. The dimmer sets as manufactured by this company are thoroughly described and illustrated in the pamphlet, which will be of interest to those who have to do with theatrical apparatus. The catalogue is put together in a way that reflects credit on the company's literary bureau.

A synopsis which is intended to outline the products of the Stanley Electric Manufacturing Company is embodied in an interesting pamphlet just issued by that company. It begins with the great 2,000-kilowatt inductor alternators, followed by descriptions of the larger-type motors, revolving-field generators, transformers, and on down through the various smaller electrical apparatus. The pamphlet is comprehensive and gives a good idea of the scope of the company's undertakings in the line of electrical manufacture and is well illustrated and arranged.

MISCELLANEOUS.

The proposed electrical exhibition at Warsaw, Russia, recently announced in the Western Electrician, has been canceled owing to belief of the promoters that pending the duration of the Russo-Japanese conflict such an exposition would not pay.

Professor Alexander Graham Bell recently gave an exhibition of the tetrahedral kite, which he believes has solved the secret of aerial navigation. The demonstration was made in a suburb of Washington, D. C., to the members of the National Geographic Society, of which Professor Bell was formerly the president. Professor Bell said the motor would eventually take the place of the kite string, and that when this had been accomplished aerial navigation is established.

The latest departure in the slot-machine line is the automatic electric fan. Anyone wishing to raise the wind has merely to insert a penny in the slot, whereupon he is greeted by a cent's worth of breeze—after which the fan stops and is ready for the next customer.

Subscriptions of small amounts are being solicited in many countries for the purpose of erecting a memorial statue to James Watt in Greenock, Scotland, on the site of the humble cottage in which Mr. Watt was born. Andrew Carnegie is president and Theodore Dwight secretary of the American committee having the matter in hand. Contributions may be directed to the latter at 99 John Street, New York city.

When it was decided to build the new royal palace for the crown prince in Japan engineers were sent to all the capitals in the old world to select from each the best and most beautiful effects. It was found, however, that the palaces of the old world were painfully far behind in the matter of lighting, heating and ventilation. Engineers were then sent to the United States, with the effect that American boilers, engines, piping and heating, lighting and ventilating systems were installed.

In the report of the directors of the Philadelphia Bourse for the year ended December 31, 1903, in relation to the substitution, which has been made, of electrically driven power pumps for three of the steam pumps used for boiler-feed and house service, the committee states: "The pumps were installed and put into service during the month of March at a cost of $1,826.66, and we have every reason to believe that the large saving of coal effected during the latter part of the year was due in a great measure to the use of these pumps."

William Jones, assistant foreman of one of the shops of the General Electric Company at Schenectady, recently received a charge of 2,300 volts when the coils of an armature grounded. He was removed to the hospital, where he recovered. Jesse Resseguir, also employed at the General Electric works on the same day, received only 600 volts while working on one of the electric "mules" to be tested for use on the canals of the state shortly, and died after being removed to the hospital. The circumstances connected with the shocks, as the location and duration of contact, strength of current, etc., and the physical condition of the men, are not given in the newspaper dispatches. These facts would doubtless explain why the man receiving the shock at the lower voltage died while the other one lived.

TRADE NEWS.

Mr. F. W. Broiles, who has conducted an electrical-supply establishment in Fort Worth, Texas, has sold his stock to C. C. Dickson, who will continue the business.

J. W. Johnston and C. G. Du Bois are at the head of the Carolina Pole Company, recently incorporated at Wilmington, N. C., for the purpose of manufacturing telephone and telegraph poles. The company is capitalized at $25,000.

The supervising architect of the Treasury Department, Washington, D. C., will receive sealed proposals until June 15th for the construction (including electric wiring and conduits) of the postoffice and custom house at Traverse City, Mich.

Lorenzo J. Haddock, formerly foreman of the Salt Lake Electric Supply Company, has gone to Boise, Idaho, where he will open up a large electric-supply house. A number of Salt Lake men are interested and it is stated that a $20,000 stock has been ordered.

The Canadian business of the Allis-Chalmers Company, which recently acquired the Bullock Electric Manufacturing Company of Cincinnati, will hereafter be conducted by a new organization bearing the name Allis-Chalmers-Bullock, Ltd. The works and principal offices of this important new Canadian company are in Montreal.

The Toledo Electric Storage Battery Company, capitalized at $100,000, has been reorganized, with J. Grasser as president. The inventor, George J. Miller, and Messrs. Tyler Greene, Louis Alexander and Mr. Dick remain with the company. The business contemplated is the manufacture of a storage battery for general purposes as well as for use in automobiles.

Wellman Bros. will open an electric-supply wiring and repair business in Ashland, Ky. They will also manufacture arc headlights for electric-railway cars, locomotives, and for marine service. These headlights are the patent of Harlan Wellman, one of the firm. The company is to be incorporated under the laws of Kentucky, with H. F. Wellman as manager.

It is reported that the Crocker-Wheeler Company of Ampere, N. J., is about to open a branch office in the Hibernian Bank Building, New Orleans, to accommodate the growing demand in this territory for light and power generators and for motors to drive machine tools in all sorts of industrial plants, milling machinery, printing presses, etc. The Crocker-Wheeler Company has 15 branch offices in the United States and the present announcement exemplifies the constantly increasing importance of the southern market to manufacturers.

The Rolfe Electric Company of Chicago gives notice that the license to manufacture under its patents heretofore held by the American Electric Fuse Company of Chicago has been revoked. Frank B. Cook, 240 West Lake Street, Chicago, now has, the Rolfe company says, an exclusive license to manufacture and sell all self-soldering heat coils and other circuit-protecting devices and apparatus covered by the Rolfe patents and applications for patents, as well as any devices of that kind which may hereafter be invented by Charles A. Rolfe or owned and controlled by the Rolfe Electric Company.

The Fibre Conduit Company of Orangeburg, N. Y., reports that last month proved to be the busiest April in its history. Some of the larger orders received are those from the Edison Electric Illuminating Company of Brooklyn, Edison Illuminating Company of Detroit, Edison Electric Illuminating Company of Boston, Citizens' Telephone Company of Grand Rapids, Mich., Merchants' Heat and Light Company of Indianapolis, and the Electrical Commission of Baltimore. The western office of the company is at 1760 Monadnock Building, Chicago, and is in charge of W. W. Smythe, Jr., western manager.

President F. J. Alvin of the American Electrical and Novelty Company, New York, states that foreign business in American electrical supplies and novelties is growing rapidly. The company has factories and selling agencies in Paris, Berlin and London. Mr. S. Stern, European manager of the company, has arrived in the United States and is arranging the company's exhibit at the St. Louis fair. He has brought with him several new ideas for electrical devices. A feature of the exhibit will be a new clock, standing eight feet high, recently brought out by the company. Another feature of the exhibit will be a peacock, the body of which will be composed of colored glass, illuminated from the inside by 21 16-candlepower lamps. Mr. Stern says that since establishing the factory in Berlin in 1900 for the manufacture of portable electric lights, many competing factories have been started there for the manufacture of electrical novelties. Other countries offer less competition.

BUSINESS.

W. T. Reynolds, the popular cedar-pole dealer of Minneapolis, has just returned from an extensive business trip.

Roy E. Salls, electrical broker of Burlington, Vt., makes the announcement that he is prepared to buy or sell anything in the shape of electrical machinery or plants on commission.

A. E. Whitmore, the Minneapolis cedar-pole dealer, states that he is doing an excellent business and anticipates even a greater volume of business during the next few months.

The Minnesota Electric Company, maker of the Chapman lightning arrester for telephone circuits, so extensively used throughout the country, announces a constantly increasing demand for its product.

Edward P. Burch, the consulting engineer of Minneapolis, so well known throughout the Northwest, has just returned from a business trip. Mr. Burch anticipates a greatly increased business in his line during the next few months.

Winn, Milmoe & Porter, electrical and mechanical engineers of 1105 Stock Exchange Building, Chicago, have prepared a table of gauges which will be mailed to anyone upon receipt of postage. They also have for sale a "fractometer," a convenient device for the solving of problems involving the addition and subtraction of fractions and decimals.

The Squire Electric Company of Kansas City, Mo., reports that business in spring construction work is extremely satisfactory. The company's work has been extensive in this line, it having recently completed large contracts on several of the largest office buildings in Kansas City and in Leavenworth, Kan.; it has done work on over 50 different buildings.

The Automatic Electric Company of Chicago is now installing 4,000 automatic telephones and complete switching equipment for the Home Telephone Company of Los Angeles, Cal., and 1,200 for the Auburn Telephone Company, Auburn, N. Y. It has also received orders for the equipment of San Diego, Cal., with 1,200 automatic telephones, and Lewiston, Me., with 1,500.

The Page and Hill Company, lumber exchange, Minneapolis, announces that it has added to its already large assortment of poles, Idaho cedar poles from 55 to 65 feet. This particular assortment will be kept at the company's Minnesota transfer yards, thus enabling the company to fill orders promptly for this class of poles. The Page and Hill Company is doing an excellent white-cedar-pole business, and states that the outlook for a good summer trade is encouraging.

The Jandus Electric Company of Cleveland has this season improved upon its already popular fan

and is now ready to supply a combination mounting which makes the fan adaptable for desk, bracket, trunnion or bracket-trunnion use. The journals are carried on a one-piece ring, which maintains the bearings in rigid relation. The company is also exploiting the merits of the Jandus enclosed arc lamp. The Chicago office is at 1537 Monadnock Building.

Superintendent W. H. Hornberger and Manager O. C. Irwin of the Crawfordsville Electric Company of Crawfordsville, Ind., were visitors in Chicago last week. Messrs. Hornberger and Irwin were en route to Milwaukee on special business. Mr. Hornberger reports an excellent business for his company and states that the Crawfordsville company recently closed several deals for large transformers. The company is making a specialty of large transformers.

Marshall H. Coolidge, president of the Marshall H. Coolidge Company of Minneapolis, producer of cedar poles, reports a very satisfactory business in his line. Mr. Coolidge is one of the best-known cedar men in the Northwest, and the company's excellent facilities for doing a large business, coupled with the ability and energy shown by Mr. Coolidge and his associates, have enabled it to build up an excellent trade.

The Dielectric Manufacturing Company, St. Louis, is now energetically pushing its latest production, the "W. D." paint. This paint should prove valuable to almost every electrical construction man. It can be furnished in one color only—jet black. It is asserted to be electrolysis, rust and damp proof, and a permanent insulating protection for wood or metal. It is, too, a quick-drying, moisture-proof coating for either metal or wood and will not soften by heat. Incidentally, it may be explained that this paint is a product directly from under the hand of J. J. Kessler, an experienced chemist of St. Louis and one whose skill is well appreciated and patronized particularly by St. Louis electrical and other manufacturing companies, which value the services of a chemist with long practical experience.

ILLUSTRATED ELECTRICAL PATENT RECORD.

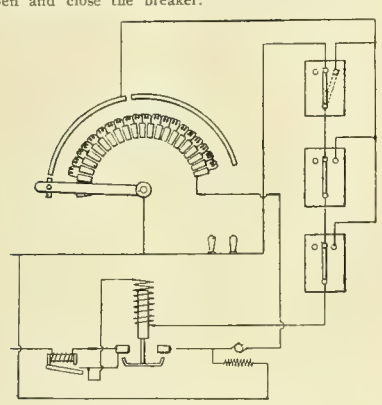
Issued (United States Patent Office) May 3, 1904.

758,610. Controller for Electric Motors. Thomas E. Barnum, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Application filed February 7, 1902.

Several switches are connected in series and situated at a distance from the motor rheostat for stopping and starting the motor independent of the rheostat. (See cut.)

758,621. High-tension Circuit-breaker. Harry P. Davis, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 13, 1902.

Associated with the circuit-breaker is an electromagnetically operated mechanism for opening and closing it, and toggle-levers for locking the breaker in its closed position. An automatically operated switch and a manually operated switch control the mechanism to open and close the breaker.



NO. 758,610.—MOTOR CONTROLLER.

758,623. Telephone System. William W. Dean, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed May 11, 1901. Renewed September 24, 1903.

The cut-off relay has two windings with means for shunting one of the windings. A line-signal-controlling electromagnet is operated by a battery, the electromagnet and battery being in series in the line circuit. Means are supplied to operate the cut-off relay to render the electromagnet inoperative.

758,631. Collector Rings and Brush Holders. Karl F. Elers, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 26, 1903.

Brushes co-operate with a number of concentric collector rings each adapted to support several brushes. A circumferentially adjustable, annular plate carries the collector rings. Means for clamping the plate in any position to which it may be adjusted and means for locking the plate in an invariable position for service are further provided.

758,635. Direct-current Generator. William H. Foot, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 16, 1903.

Mechanically connected to the commutator is a set of conducting rings. Pins are tapped into the outer ends of the commutator bars and wires connect the pins to corresponding rings of the set.

758,638. Lightning Arrester. Louis R. Gaw, Asbury Park, N. J., assignor to Daniel Killion, Hoboken, N. J. Application filed June 3, 1903.

An insulator adjacent to each end of a casing carries a conducting block, each having a socket electrically connected with the corresponding side of the circuit. A holder is provided with a number of passageways extending from end to end and through the metallic plates, through which insulated wire extends into the holder and has its ends secured to binding-posts on the end plates of the holder.

758,644. Electric Arc Lamp. Thomas Hamilton-Adams, London, England. Application filed August 29, 1903.

A pair of coils are wound in the same direction and connected in series. Coils form the only coils of the lamp for controlling the movable carbon. An armature core controls the movable carbon adapted to move longitudinally through the coils. When current is passed through the coils they operate in conjunction to bring the core into a state of equilibrium.

758,646. Fuse Block. John A. Heany, York, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va. Application filed October 12, 1903.

A fuse-block of dielectric material consists of a base and two end extensions, carrying two tubular metal pieces, each traversing an end extension of the block and arranged to receive the terminals of the block.

758,647. Electric Safety Fuse or Cut-out. John A. Heany, York, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va. Application filed October 12, 1903.

A safety fuse or cut-out contains a spool of dielectric material having an eccentric, longitudinal bore and channels extending from the bore at the ends of the spool.

758,648. Electric Safety Fuse or Cut-out. John A. Heany, York, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va. Application filed October 13, 1903.

A spool of dielectric material has a longitudinal bore for the reception of a fuse wire, and metallic caps arranged to form a closure for the bore of the spool, the caps adapted when advanced upon the spool to first shear off the fuse wire and then clamp the ends of the fuse wire.

758,649. Electric Safety Fuse or Cut-out. John A. Heany, York, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va. Application filed October 14, 1903.

A tube or casing of dielectric material is lined with a protective layer of non-conductive material. Two tubular metallic plugs are arranged wholly within the tube or casing, and a fuse wire traverses the tube and plugs.

758,650. Electrode for Vapor Electric Apparatus. Peter C. Hewitt, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed January 13, 1904.

In a gas or vapor electric device having a liquid negative electrode are steadying means at the negative electrode comprising a solid wetted material in contact therewith, the general surface of the solid being in a different plane from the general surface of the liquid.

758,655. Magnetic Ore Separator. William L. Imlay, Philadelphia, Pa., assignor to Adolph Segal, Philadelphia, Pa. Application filed October 2, 1899.

A rotating drum contains a magnet, the magnet having a hub carrying two sets of segments, forming a drum. Wire is wound on the drum. Certain of the segments are of magnetic material and form the pole pieces of the magnet, and the others are of non-magnetic material and serve to retain the wire in position.

758,667. Single-phase Alternating-current Power System. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed December 26, 1901.

In a single-phase alternating-current motor of the series type having a laminated field magnet core provided with polar projections of reduced cross-section adjacent to their ends is an armature having a closed-coil parallel winding. A commutator and leads situated between the armature coils and the respective commutator bars, the resistance of which is sufficiently high to reduce to a non-sparking limit the secondary currents which are set up in the short-circuited coils by the alternating magnetic field, make up the principal features of the invention.

758,668. Single-phase Alternating-current Motor. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed October 31, 1902. Renewed September 24, 1903.

A commutator, an armature core provided with slots, a parallel closed circuit-winding and high-resistance leads connecting the winding with the commutator bars, the coils constituting the winding and the high-resistance leads being located in the core slots, are the essential parts.

758,669. Brush Holder for Electrical Machines. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 16, 1903.

The invention embodies a carbon brush and a casing in which the brush is mounted to move edgewise, a metal plate attached to the outer edge of the brush and projecting laterally at both sides, a pair of spiral springs, the planes of which are parallel to that of the brush, and blocks fastened to the free ends of the springs and resting upon the ends of the metal plate.

758,683. System of Electrical Distribution. John S. Peck, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed August 8, 1903.

Conductors for transmitting energy of an even number of phases contain reactance coils in series. A rotary converter has the middle points of the various portions of its armature winding connected together and is supplied with shunt and series field-magnet windings.

758,692. Storage Battery. William J. Redmond, Cleveland, Ohio. Application filed September 29, 1902.

An electrode for a storage battery consists of a metallic plate having its surface provided with a multiplicity of hairlike projections formed integral with the plate and arranged to project beyond the body of the plate.

758,701. Electric Burglar and Fire Alarm. Solomon Schwarzschild, Rochester, N. Y. Application filed February 24, 1902. Renewed October 8, 1903.

A telephone circuit, leading from a premises to be protected to a telephone exchange, co-operates with a local alarm circuit located on the premises. A common actuating device, controlled by the local circuit, both operates the line-call at the exchange and produces a characteristic signal in the exchange indicating the nature of the call.

758,702. System of Alternating-current Distribution. Charles F. Scott, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 13, 1902.

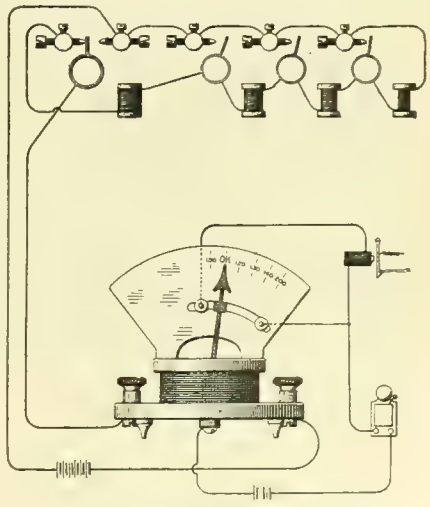
Together with a source of alternating currents and a transmission circuit are two parallel lines of track and two connected transformers for transferring energy from the transmission circuit to the two work circuits, the transformers having a single connection to two of the corresponding sides of the work circuits.

758,703. Apparatus for Telephone Lines. Charles E. Scribner and James L. McQuarrie, Chicago, Ill., assignors to the Western Electric Company, Chicago, Ill. Application filed April 2, 1900.

A visible signal is connected between the ground return and one line conductor. A telephone at the sub-station is in a bridge of the line circuit, and a switch is adapted to break the line conductor containing the signal and to connect the corresponding terminal of the telephone with the ground return, whereby battery may be supplied for exciting the transmitting telephone independently of the signal when required. (See cut.)

758,710. Titanous Compound and Process of Making Same. Howard Spence, Manchester, England, assignor to Peter Spence & Sons, Manchester, England. Application filed September 11, 1902.

Titanous sodium sulphate compound is produced by the electrolytic reduction of titanium sulphate in the presence of sulphuric acid, with the addition of sodium sulphate.



NO. 758,819.—TEMPERATURE INDICATOR

758,724. Signaling System. Joseph Weatherby, Jr., New Cumberland, Pa., assignor to the Weatherby Electric and Manufacturing Company, New Cumberland, Pa. Application filed June 1, 1903.

A single-wire closed circuit contains a series of signaling devices, each having a make-and-break device and a ground connection. The circuit also has a pair of batteries, an open circuit containing an indicator and having a battery and a signaling device therein, and an automatic switch included in the closed circuit and adapted when the circuit is opened to close the open circuit. A manually operated switch at the central office disconnects the switch from the open circuit.

758,730. Electric Lamp. Alexander J. Wurts and Edward Bennett, Pittsburg, Pa., assignors to George Westinghouse, Pittsburg, Pa. Application filed January 10, 1901.

Exposed metal conductors [illegible] a non-conducting holder [illegible] The holder is provided with a readily removable coating of non-conducting [illegible] ing particles given [illegible]

758,732. Printing Telegraph. John C. Barclay, New York, N. Y. [illegible]

Details are described [illegible]

758,730. Automatic Fire and Burglar-alarm Telegraph. Robert G. Callum, Washington, D. C. Application filed March 1, 1902.

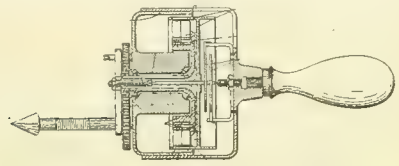
Closed electric floor-section circuits, a house circuit including a double-balanced relay, a normally open circuit looped in the floor-section circuits, an annunciator, a device for successively closing the loops and maintaining them in closed condition, and means for actuating the annunciator and device adapted to be set in motion by the breaking of one of the floor-section circuits, are specified in the invention.

758,756. Electrical Recording Device. James H. Johnson, Louisville, Ky. Application filed July 15, 1903.

A laterally movable frame carries a carriage movable on the frame, and an electromagnetic marking device is placed on the carriage. Mechanism moves the carriage each time the marker is actuated. A record holder is placed beside the frame, and selective devices shift the record holder.

758,785. Electric-railway Trolley. David M. Shaler, Stryker, Ohio. Application filed August 6, 1903.

The trolley wheel has a two-part hub, the hub having closed ends formed with oil-retaining flanges projecting into the bearing sleeve and with spring-pressed packing adapted to prevent the escape of oil from the chamber.



NO. 759,041.—MAGNETIC SPEED INDICATOR.

758,795. Telephone Receiver. Ernest H. Strauss, Chicago, Ill. Application filed July 25, 1902.

Arranged within the ordinary shield or casing is a cup and a series of magnetic poles, including a central pole. The cup has elongated slots and means connecting the magnetic poles and the cup extend through the slots to effect the adjustment of the poles with relation to the sound-transmitting diaphragm.

758,819. Electric System for Indicating the Temperature of a Distant Point. Robert G. Callum Washington, D. C. Application filed October 28, 1902.

A system for automatically indicating the temperature of a distant point contains a normally closed electric circuit, a current-measuring device included therein, and two or more thermostats connected in series in the circuit and adapted to establish shunt circuits at different temperatures for decreasing or increasing resistance in the main circuit. (See cut in preceding page.)

758,842. Wireless Telegraphy. James F. King, Washington, D. C. Application filed December 17, 1902.

Improvement in wireless telegraphy consists in creating an arc in a normally closed generator circuit and simultaneously connecting around the arc a capacity in a vibratory circuit.

758,855. Railway Signal. Edward T. Ryman and Edward W. Stevenson, Wilkesbarre, Pa.; said Stevenson assignor to said Ryman. Application filed October 19, 1903.

Upwardly projecting, vertically acting apparatus is located in the line of motion of the locomotive. An automatically actuated contact shoe is supported by the locomotive, an electric-circuit closer is operated by the shoe and a manually operated registering device controls the action of the shoe and signaling device.

758,861. Note Sheet for Self-playing Musical Instruments. Charles A. Shaffer, Philadelphia, Pa. Original application filed July 21, 1903. Divided and this application filed December 9, 1903.

An imperforate music sheet consists of a body of conducting material having insulated surfaces on both sides, the insulation being cut away to form notes.

758,883. Method of Generating Gaseous Mediums from Air. James N. Alsop, Owensboro, Ky. Application filed May 29, 1903.

Generating a gaseous medium from air is accomplished by continuously bringing in contact and separating in the presence of air, to form arcs, two electrodes connected with a source of electricity, and then short-circuiting the arcs.

758,884. Apparatus for Generating Gaseous Mediums from Air. James N. Alsop, Owensboro, Ky. Application filed May 29, 1903.

A pair of electrodes connected with a suitable source of electricity and means whereby one of the electrodes is reciprocated into and out of contact with the other to form arcs capable of modifying air, are supplied.

758,922. Signaling on Electric Traction Systems. Thomas H. Jones, Portsmouth, England. Application filed July 7, 1902.

Two series of lengths of trolley conductors are insulated from each other and correspond to the portion of track to be protected and to adjacent portions at each end. Connections bridge certain insulation gaps at each end of the protected portion of the track and other connections from certain of the bridging connections to a supply cable, together with signal-operating mechanisms and locking and unlocking devices for each series in the bridging connections at respectively opposite ends of the protected portion of track, make up the apparatus.

758,938. Automatic Magnetic Circuit-breaker. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical and Manufacturing Company. Application filed July 31, 1903.

Separable co-operative contacts with means for restraining the contacts in normal position are associated with fixed magnetic cores and a movable magnetic member. An exciting coil for the latter has its axis approximately coinciding with the axis of movement of the magnetic member.

758,946. Electroheater. Edwin R. Waterman, San Francisco, Cal. Application filed July 13, 1903.

An electroheating apparatus is provided with a body formed into a number of interspaced inner cylinders combined with a continuous liquid passage formed within the cylinders, and having an up-and-down course.

758,954. Automatic Cut-off in Time of Storm. Frank P. Bell, Fairfield, Wash. Application filed April 24, 1903.

A fuse upon melting releases an arm, which grounds the line.

758,977. Guard Covering for Third Rails of Electric Railways. John Kress, New Rochelle, N. Y. Application filed December 30, 1903.

Upright plates at both sides of the rails and insulated from them, form side walls. Flanges at the upper ends of the side walls carry guard plates. Curved outwardly extending flanges are attached to the guard plates.

758,986. Tubular Insulator. Fred M. Locke, Victor, N. Y. Application filed November 11, 1901.

An insulator comprises shells arranged within each other, each of the shells being inclined inwardly from it ends.

758,995. Annunciator. David H. Marshall, Kansas City, Mo. Application filed May 16, 1903.

A motor operates the shaft and gearing of the annunciator.

759,004. Alternating-current Motor. Burton McCollum, Lawrence, Kan. Application filed April 4, 1903.

The field is in series with the armature, and an auxiliary field winding is in parallel with the main field winding, adapted to produce a magnetic component in phase with the main component in space and out of phase therewith in time.

759,007. Storage Battery. Job T. Niblett, Greenwich, England. Application filed February 5, 1903.

An inner electrode for a battery comprises a receptacle, a conductor centrally arranged therein, active material surrounding the conductor, and upper and lower clamping plates mounted on the conductor and holding the active material between them.

759,026. Electric Clock. Herbert Scott, Bradford, and Alfred Loebl, London, England. Application filed June 10, 1903.

Electrically controlled propelling means are provided for the pendulum.

759,041. Magnetic Speed Indicator. Simon B. Storer, Syracuse, N. Y. Application filed April 16, 1903.

An inductor is rotatable in the field of a magnet and provided with sectional teeth or poles, one of the sections of each tooth being adjustable circumferentially relatively to the other to vary the form of the tooth. An apertured conductor is actuated by the drag of the field. (See cut.)

759,047. Electric-signal System. George L. Vannais, Hartford, Conn. Application filed June 20, 1903.

Combined with a signal mounted for oscillation is a pair of oppositely effective magnets for moving the signal in opposite directions.

759,058. Storage Battery. Vincent G. Apple, Dayton, Ohio. Application filed June 5, 1901.

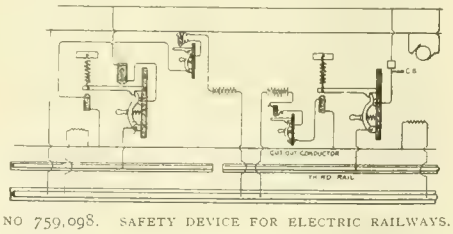
A battery-containing conducting case is divided into two compartments, the inside surfaces of each compartment electrochemically active. A series of liquid-tight conducting cases, one within the other and insulated one from the other, their respective interior and exterior surfaces electrochemically active, contain a central element.

759,060. Electric-railway Switch Point and Operating Means Therefor. Arthur J. Backer, Syracuse, N. Y. Application filed July 8, 1903.

An interior chamber in the switch-point contains an electric operating device.

759,065. Method of Accumulating and Using Electrical Energy. Anson G. Betts, Troy, N. Y. Application filed August 17, 1903.

Improvement in the art of accumulating and using electrical energy consists in depositing from an electrolyte by electrolysis peroxide of lead upon one electrode and lead, or equivalent metal, upon the other electrode, and afterward generating electrical energy by redissolving the peroxide and metal in the electrolyte.



NO 759,098. SAFETY DEVICE FOR ELECTRIC RAILWAYS.

759,066. Electric Storage Battery. Anson G. Betts, Troy, N. Y. Application filed August 17, 1903.

In contact with suitable electrodes is a solution of a lead salt and a non-oxidizing and non-oxidizable acid, which forms a readily soluble salt with lead.

759,094. Telephone Transmitter. James I. Gemmill, Cleveland, Ohio. Application filed August 28, 1901.

The mechanical details are set forth.

759,095. Telephone Receiver. James I. Gemmill, Cleveland, Ohio. Application filed December 22, 1902.

In a telephone receiver is a metal cup, a metal block, electromagnet spools attached and a permanent horseshoe magnet secured to the block.

759,098. Safety Device for Electric Railways. George Gibbs, New York, N. Y. Application filed December 24, 1903.

Combined with an electric-railway system, including a working conductor and feed wires normally connected therewith, is a closed auxiliary circuit including means for controlling the feed circuit, and means whereby on the rupture of the auxiliary circuit the feed circuit is interrupted. (See cut.)

759,119. Electrical Conductor. Percy A. McGeorge, West Hoboken, N. J., assignor of one-half to William McGeorge, Jr., Philadelphia, Pa. Application filed September 10, 1902.

Current-conducting, electrically equivalent members are provided with means for maintaining the members in geometrical parallelism, means between the members connecting the latter magnetically, and material between the means and members insulating the latter electrically.

759,120. Electric Inductive Conductor. Percy A. McGeorge, West Hoboken, N. J., assignor of one-half to William McGeorge, Jr., Philadelphia, Pa. Application filed March 17, 1904.

A central core or wire of magnetic material is combined with a pair of wires providing a metallic circuit, the wires being insulated from each other and from the central core or wire and coiled in the same direction and in juxtaposition around the latter.

759,121. Pole Changer. Roger M. Newbold, Birmingham, Ala. Application filed August 19, 1903.

A rotating element, a pivoted pawl carried thereby, a recessed contact piece which is directly engaged and shifted by the pawl upon each reversal of the rotation of the element, and means to hold the pawl out of operative engagement with the contact piece at other times are the principal parts.

759,122. Electric Dynamo. Roger M. Newbold, Birmingham, Ala. Application filed November 3, 1903.

A dynamo machine comprises a casing, an armature, commutator and brush holder, all suitably mounted therein, together with an oil reservoir and a pole changer adapted to change the circuits upon the reversal of direction of rotation of the armature.

759,148. Electric Attachment for Rocking Chairs. Gaines M. Allen and Samuel M. Cawker, Denver, Colo. Application filed November 3, 1903.

Combined with a rocking chair is an electrical generator, a spring connected with the generator for operating it and having a predetermined tension, and means connected with the rocking chair and operated by the rocking movement of the chair for winding the spring simultaneously with the operation of the generator, and whereby the tension of the spring is continually maintained.

759,150. Motor Starter. William Baxter, Jr., Jersey City, N. J. Application filed February 9, 1904.

The essential features are a main switch, a rheostat switch, means to throw these switches to the stop position, means to hold the main switch in the running position and a magnet adapted to hold the rheostat switch in the running position and to release the main switch when the motor current becomes too strong, and to release the rheostat switch whenever the motor current dies out.

759,183. Method of Utilizing Single-phase Alternating-current Energy. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Original application filed December 26, 1901. Divided and this application filed July 16, 1902.

The method of adapting a series alternating-current motor to a circuit of a given rate of current alteration consists in so proportioning the motor that with a given ratio of electromotive force of self-induction to counter electromotive force the ratio of the field ampere turns to the armature ampere turns will have a definite value and the product of the poles by the revolutions will sustain a definite relation.

759,210. Support for Field Windings. Bernard A. Behrend, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company, Cincinnati, Ohio. Application filed December 7, 1903.

A field frame, a divided field winding on each pole and a support for the winding, comprising an inner portion located between parts of the winding and an outer portion engaging the exterior of the winding, are described.

759,216. Wireless Signaling Apparatus. Lee De Forest, New York, N. Y., assignor to the Greater New York Security Company, New York, N. Y. Original application filed May 14, 1902. Divided and this application filed March 14, 1903.

In a receiving apparatus for space signaling are a syntonic and a non-syntonic receiving system, each containing a wave-responsive device. An indicating device is connected with both wave-responsive devices, to be oppositely affected thereby.

REISSUE.

12,216. Switching Mechanism. George L. Mansfield, Chicago, Ill. Application filed November 24, 1903. Original number 695,467, dated March 18, 1902.

Combined with an operating shaft is an actuating bar, an actuating arm pivotally connected with the operating shaft and means for guiding the actuating arm in an upward, lateral and downward direction during the movement of the operating shaft.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on May 10, 1904:

362,510. Regulator for Dynamo-electric Machines. Enos T. Higham and Daniel Higham, Philadelphia, Pa.
362,531. Voltaic Battery. August F. W. Partz, Philadelphia, Pa.
362,584. Electric Battery. David Misell, New York, N. Y.
362,639. Method of Working and Forming Secondary Batteries. Washington I. Ludlow, Cleveland, Ohio.
362,640. Secondary or Storage Battery. Washington I. Ludlow, Cleveland, Ohio.
362,652. Testing Apparatus for Telephone-exchange Switches. Joseph U. O'Connell, Chicago, Ill.
362,682. Loop Insulator. Horace Van Sands, New York, N. Y.
362,739. Automatic Electric Danger Alarm. John J. Ghegan, Newark, N. J.
362,798. Electrodynamic Motor. Charles J. Vandepoele, Chicago, Ill.
362,847. Electric Battery. Oranzio Lugo, New York, N. Y.
362,859. Variable Electric Resistance. J. M. Stearns, Jr., Brooklyn, N. Y.
362,872. Insulating the Terminals of Sheathed Electrical Conductors. David Brooks, Philadelphia, Pa.
362,902. Circuit Controller for Self-winding Clocks. Chester H. Pond, Brooklyn, N. Y.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, MAY 21, 1904 No. 21

The Central-station System of the Edison Electric Illuminating Company of Boston.

By John S. Browning.

Extensions and consolidations in the last decade, and more particularly in the recent years of that period, have made of the Edison Electric Illuminating Company of Boston and its various stations in the city and suburbs a vastly different entity from the organization that started in 1885, on the 26th of December, with a capital of $100,000 and a field of operations limited to an area of about 70 acres in the business section of Boston. The main station of the company's earlier years has been relegated to the position of an auxiliary sub station; many other auxiliary and battery stations have been added; a fine plant is in operation on Atlantic Avenue, supplying direct-current service; and at L Street, in South Boston, where the plant of the absorbed former Boston Electric Light Company is located, there is now under construction an alternating-current station of the most advanced and approved type, planned with a view to future expansions and additions which shall meet the prospective growth of the company's business in a thorough manner.

A resumé of the remarkable development of the system during the era of unbroken prosperity which the company has enjoyed, with a description of its essential features, including the equipment and scope of the new main station now approaching completion in South Boston, are of timely interest in connection with the convention of the National Electric Light Association, to be held in Boston next week.

Growth of the Business.

Nothing else shows so effectively the growth of a commercial enterprise as the accretion of capital during the period under review. On the 1st of January, 1886, the Edison company was capitalized at the original $100,000 with which it embarked in business. By the close of 1887 an additional $400,000 had been issued, and the year 1890 was signalized by an increase of $660,000. Annual increases were the rule thereafter, except in 1898, when no new issue was authorized, and the outputs were as follows: 1891, $103,500; 1892, $762,300; 1893, $50,000; 1894, $444,700; 1895, $590,300; 1896, $130,000; 1897, $503,200; 1899, $176,000; 1900, $390,500; 1901, $2,522,000; 1902, $1,017,900; 1903, $1,648,700; 1904, $950,000. The company, therefore, at the present time has a capitalization of $10,449,100, and is correspondingly established upon a sound and substantial financial basis in the community that is served by its output of light and power.

The natural growth of the company was supplemented during the last three years by successive absorptions of other light and power concerns in Boston and the outlying cities and towns. When propositions were made a few years ago by New York capitalists to consolidate the existing Boston Electric Light Company, the Edison company and other important plants in the vicinity, the officials of the Edison company came to the conclusion that such consolidations under their own control would be advantageous, and the Suburban Light and Power Company was acquired in 1901, the Boston Electric Light Company in 1902, and six more companies in 1903, the latter group comprising the Milton Light and Power Company, the Blue Hill Electric Company of Canton, the Dedham Electric Company, Natick Gas and Electric Company, Framingham Electric Company and the Somerville Electric Light Company. This year the Greendale Chemical Company of Needham has been added to the list.

The original Edison station in Head Place is still designated as Station No. 1, but is rated now as an auxiliary sub-station. The auxiliary station next built, on Hawkins Street, retains its enumeration as No. 2, and remains an auxiliary steam station. The Atlantic Avenue station, now known as No. 3, for which ground was broken in October, 1891, on a site partly covering the location of the famous historical wharf where the Boston Tea Party of Revolutionary days accomplished its notable exploit, and to which extensive additions were made in the year 1900, is a main station for the business section of the city. The L Street station in South Boston, on the harbor front, formerly the plant of the Boston Electric Light Company, where extensive additions in buildings and equipment are now in progress, and future concentration of productive energy is contemplated, is designated as Station No. 4. There are no less than 20 other stations—some of which, however, are to be dismantled, while others will be utilized as auxiliaries—in the entire system now under the company's control. It is in the two main stations, however, the L Street alternating-current station primarily and the Atlantic Avenue direct-current station, secondarily, in which interest is centered in connection with a survey of the facilities of the company for the production of light and power to meet present and prospective demands upon its resources.

Coal-handling Apparatus. Old Station. New Turbine House and Boiler House.

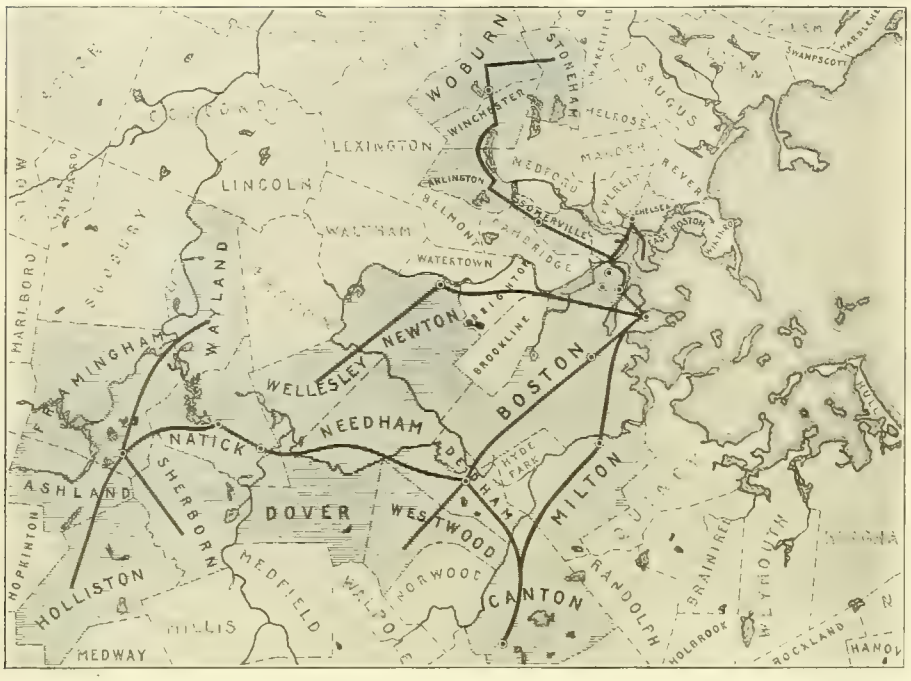
L STREET STATION OF THE EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON. (PICTURE TAKEN FROM SEA WALL OF BOSTON HARBOR.)

Atlantic Avenue Station.

The Edison Electric Illuminating Company's property on Atlantic Avenue comprises about 100,000 square feet, exclusive of some 30,000 feet of wharf area. There is a water frontage of somewhat over 550 feet. The older portion of this station, built in 1891, has a frontage on Atlantic Avenue of 60 feet and a depth of 230 feet. The engine room is 160 feet long, and beyond it, separated therefrom by a thick brick wall, is the boiler room. Beyond these, toward the harbor line, are the coaling facilities and wharves. At right angles to the older engine room is the one built in 1900, so located that an extension of the boiler room was feasible, and the latter was continued parallel with the side wall of the newer engine room, which is 150 feet in length, thereby making the entire boiler room upward of 200 feet long. It contains 19 boilers, of which seven are hand-fired, while 12 are equipped with Babcock & Wilcox chain-grate stokers, motor-driven. Four of the furnaces are equipped with forced draft, and the

application of this improvement will be extended. There are the usual pumps, one set supplying the surface condensers with water from the harbor and the other the feed water from the city mains in the street.

In the corner of the new building, farthest from the old structure, and at the rear of the System of Distribution Building, which runs toward Atlantic Avenue at right angles with the new engine room, is the condenser room of the central condensing system, with its pumps, which take the water and condensed steam from the jet condensers, and discharge it into the harbor through a 48-inch discharge pipe, located on top of the intake sluiceway. The salt water from the harbor flows in through this sluiceway, which is 245 feet long and extends out into the water with its lower part eight feet below mean low-water level, the inflow being met in the jet condensers by the exhaust steam from the engines, which has passed through the 50-inch condenser pipe, running around the engine room under the gallery, and also through Goubert feed-water heaters.



MAP OF BOSTON AND VICINITY, SHOWING TERRITORY AND STATIONS OF EDISON ELECTRIC ILLUMINATING COMPANY.

A space is set apart in the earlier structure, adjacent to the two engine rooms, as the switchboard room, 26 feet wide by 70 feet long, and carried up 14 feet higher than the rest of the old engine-room roof. This contains a feeder-switchboard gallery, a regulating room and a motor-operated switchboard. These various adjuncts of the plant are the contributing factors to the efficient work of the generating rooms, the older of which contains seven engines and two boosters, while the newer one contains four engines, with a recently installed motor-generator, which is run by a current supplied from the L Street station.

The engine equipment demonstrates by the different kinds installed the growth of the company's requirements. Four of the machines are 660-horsepower, vertical, triple-expansion engines, each driving two 200-kilowatt generators; one is a 1,200-horsepower engine, driving two 400-kilowatt generators; two are 1,200-horsepower engines, each driving one 800-kilowatt generator, and the remaining four, which are in the new engine room, are 2,400-horsepower engines, each driving one 1,600-kilowatt generator. Nos. 1, 2, 3 and 4 were built by the J. Morton Poole Company, after plans by the Edison General Electric Company, and are of the triple-expansion vertical type, running at 120 revolutions. No. 5 is of the vertical cross-compound type, designed and built by McIntosh, Seymour & Co., and runs at 100 revolutions. Nos. 6 and 7 are also of the vertical cross-compound type, built by the same concern, and run at 100 revolutions. Nos. 8, 9, 10 and 11 are the quartette of 2,400-horsepower engines installed in the new engine room. Each drives one 1,600-kilowatt generator. These four units are placed at the end of the room nearest the old engine room, two on a side. They are McIntosh & Seymour engines, of the vertical cross-compound type, run at a speed of 100 revolutions, weighing 500,000 pounds. Overhead in the new engine room is a 50-ton traveling crane, built by the Morgan Engineering Company. It is operated by four 220-volt General Electric enclosed multipolar electric motors, controlled from a cage suspended from the crane.

The motor-generator recently installed on the lower level in the new room and connected with the L Street station is a direct-current generator, giving 1,850 amperes at a speed of 400 revolutions per minute at a full-load voltage of 270-315. It is coupled to a synchronous motor of 710 horsepower, actuated by a current of 131 amperes at 2,200 volts, 60 cycles.

In the System of Distribution Building, to which reference has been made, are the offices of the distribution and generating departments; also the drafting room, lamp department, laboratory and other essential offices. Two of the seven floors are occupied by storage batteries.

L Street Station.

That portion of the L Street station of the Edison Electric Illuminating Company which is now in operation, and which will be known henceforth as the old section—although it is still comparatively new and exceedingly effective for the present needs of the company, the first engine in the plant having been started no longer ago than the year 1898, when four other stations were superseded by its construction, under the Boston Electric Light Company's regime—is one of the most compact and at the same time commodious stations in the country.

The building which houses the productive plant has two parallel portions, separated by a brick wall, the boiler room on one side and the engine room on the other. There are six batteries of boilers, two boilers to each battery, and six generating units on the other side of the wall in the adjacent engine room. The boilers are of the triple-drum, Babcock & Wilcox type; and Hawley down-draft furnaces, hand-stoked, do the heating. A brick smoke flue, back of the boilers, six by 10 feet in section, connects them with a giant stack, located midway in the boiler tier, and this stack rises to the height of 225 feet from a base 22 feet in diameter. Adequate piping arrangements, including feed-water connections for the boilers, a sluiceway from the harbor front through which water is taken for the condensers, the pumping outfit and other customary auxiliaries, are installed contiguously.

The six engines are of the vertical cross-compound side-crank type, built by McIntosh, Seymour & Co., of 2,400 horsepower each, and run at 120 revolutions per minute. They are direct-coupled to General Electric three-phase, 2,250-volt, 60-cycle generators of the revolving-field type. These generators are operated in parallel, feeding into one main set of bus bars, from which all feeders, both for lighting and motor service, are supplied. A duplicate set of bus bars is in reserve. The governors of the engines are motor-controlled, and the speed is brought under control of the switchboard attendant in such a manner that the load may be shifted from one machine to another or distributed in any desired proportion among them.

In the same large room with the large generators are the arc-light sets, 21 in number, each of which consists of one synchronous motor of 150-kilowatt capacity, running at 514 revolutions per minute, taking its current direct from the main bus, coupled direct to two Brush arc dynamos of 8,500 volts capacity, 6.6 amperes current. These are used principally for operating street lights of the city of Boston, with which the company has a lighting agreement. The fields of both generators and motors are furnished with exciting current by 375-kilowatt, 125-volt machines, direct-connected to three synchronous motors, running at 600 revolutions per minute. There is one steam-driven unit (50-kilowatt, 125-volt) in reserve. These sets are all operated in parallel also.

The switchboard is on the opposite side of the room from the engines and generators. It is a most excellent arrangement in its adaptation to the needs of the station, although destined to be superseded in the near future by the fine new switchboard house which is going up between the walls of the old building and the new turbine-engine house, wherein will be installed eventually the switches of both the old and new sections. The board is two-storied, the lower part having panels for the controlling of the arc machines and circuits and the upper part being utilized for the main machine panels. The switches in all the motor leads are of the oil-break type, and are protected by oil circuit-breakers. All feeders from the system are protected similarly. The main generator switches are also of the oil type, operated pneumatically. There are also the usual recording outfits. The switchboard is upward of 100 feet in

Taller Building, with Taller Stack, is Newer Generating Station. System of Distribution Building
Lower Building, with Three Arched Windows, is Old Power House.

GENERAL VIEW OF ATLANTIC AVENUE STATIONS AND OFFICE BUILDING.

length. Midway on each story are convenient telephone booths.

Overhead in the engine room is an electrically operated traveling crane, running the entire length of the building, having a capacity of 25,000 pounds for each trolley. It is of the Morgan Engineering Company's make.

The company delivers from this plant nearly 60 per cent. of the current output to sub-stations, to be transformed. All feeders enter by underground ducts. In all there go out from the station at present 14 three-phase feeders to sub-stations and nine single-phase, the latter for house-to-house lighting.

The dimensions of this old section of the plant are as follows: Length of building, 244 feet; full width, 173 feet; width of boiler room, 52 feet; width of engine room, 80 feet eight inches.

New Turbine Plant at L Street.

Serviceable as the two main stations of the company have been, all achievements in electric-light and power production hitherto credited to the Boston Edison Company will be eclipsed in the modern and perfected system now in process of installation in the new section of the L Street station. And a beginning, merely, will have been made when these installations are completed, for the plans that have been drawn are projected for future development on a broad and comprehensive scale.

The land area of the L Street property permits of such extensions as the company may see fit to make for many years to come. It embraces 24½ acres, counting in the possibilities in reclaimable flats out to the harbor commissioners' line, and three-fifths of this acreage is solid ground or filled in at the present time. Bounded by the harbor line, L Street and East First Street, on three sides, and by mercantile property on the fourth side, the site is most advantageously located.

Accordingly the new turbine-engine room, 63 feet wide and 220 feet long, and calculated to provide the necessary floor space for four turbine units, with adjoining furnace and boiler room, is only one-third the length of the great structure for which designs have been made and space allotted. It adjacently parallels the old engine-room building, and although built for four units will have an initial installation of but two units, with the corresponding boiler and furnace adjuncts. These two units and their auxiliaries are comprised in the following details of equipment:

There will be two 5,000-kilowatt Curtis turbines, each four-stage, with surface condensers and 60-cycle, three-phase, 6,900-volt generators, running at 514 revolutions per minute.

Three tunnels, direct from beyond the sea-wall at the water front, provide the circulating-water conduits for the entire system of turbines. Two of these tunnels are the suction intake conduits, and the third is the discharge conduit. They run beneath the turbine room for its entire length, and there is a set of manhole conneections up from the tunnels between each pair of turbine machines. The top of the intake tunnels is six feet below mean low water, so that they are always filled, regardless of tidal conditions, and the salt water rises and falls in the manholes just as it does in the harbor.

Capacious subways, with cemented flooring and side walls, have been constructed below the flooring level, and provide accommodations for such piping and sub-surface connections as can be conveniently so disposed of.

Located between the turbines and the manholes are the auxiliaries. For each turbine there is a 24-inch volute centrifugal pump, direct-connected to a horizontal side-crank steam engine. The vapor of condensation is handled by an 18-inch dry-air pump, steam-driven. The water condensation is removed by a four-inch volute centrifugal pump, motor-driven. The boiler-feed pump is regarded locationally as one of the auxiliaries, in the general scheme of arrangement, and is placed in the turbine room also. In addition to the pressure pump for handling the oil that is used for lubrication of the turbines, the pump being steam-driven, there is an accumulator (not an electric accumulator, of course) maintaining an even pressure for the delivery of the oil, and having sufficient storage capacity to run the turbine for 10 minutes in case the pump is stopped. There is a relay oil pump also for emergency use, in case the motor pump breaks down. This is a triplex pump, motor-driven.

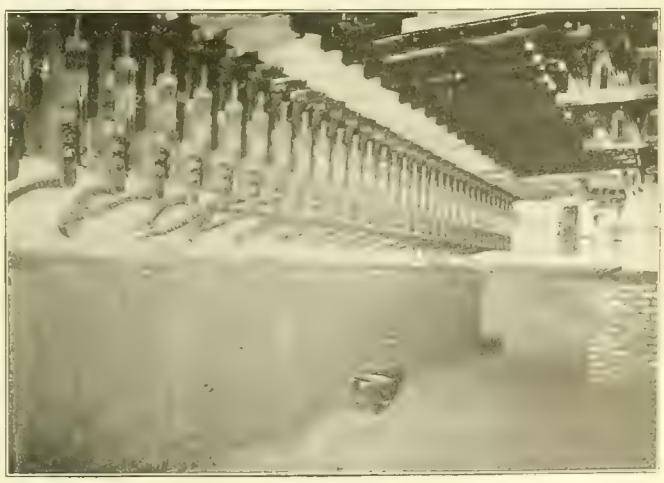
The boiler room adjoins the engine room and runs toward East First Street, 153 feet, the plans calling for an ultimate extension to an aggregate length of 650 feet. The width of this building is 150 feet. Running at right angles with the engine room are the boiler batteries, eight boilers to each unit. Each boiler is rated at 512 boiler horsepower, and runs at 175 pounds pressure. They have Babcock & Wilcox attached superheaters, which superheat 150 degrees Fahrenheit. The furnaces are equipped with Roney stokers, operated by motors. The boilers are set on the second floor of the building, and underneath the furnaces, in the lower portion of the structure, big brick ash chambers have been constructed, so arranged that teams or tram cars can be run under them and take away the ashes. Such are the fuel-handling facilities that not a shovel needs to be used from the time it is brought alongside the wharf until the refuse goes to the dump. Conveying belts take the coal on the wharf as it is raised from the vessel's hold, and carry it to the storage yard alongside of the old building, or direct to the furnaces by an arrangement for conveying it over the tops of the old and new buildings. The storage yard and its reclaiming bridge and conveying apparatus are important factors in the economizing of time, labor and cost. The stack for the new section is 250 feet in height, with 16 feet interior diameter at the top, and 24 feet at the bottom.

Each boiler is of 18-tube width and 14-tube height, or 252 tubes, and has two 42-inch drums. The boilers are designed for 225 pounds pressure, and run provisionally at 175 pounds pressure. There are two complete systems of feed, one that takes the hot water delivered by the feed pumps through a main going back of each line of boilers, with branches leading to the front ends of the drums, and controlled by valves from the floor; the other is connected to the city mains, from which a main extends along the lines of boilers at their rear, and a branch at each battery connecting with a three-inch Lee injector delivers into the rear ends of the drums.

A pipe room has been constructed around the stack in the basement, and the steam-conveying pipes are kept free from drafts by the enclosing walls. The main steam line, the main and auxiliary feed lines

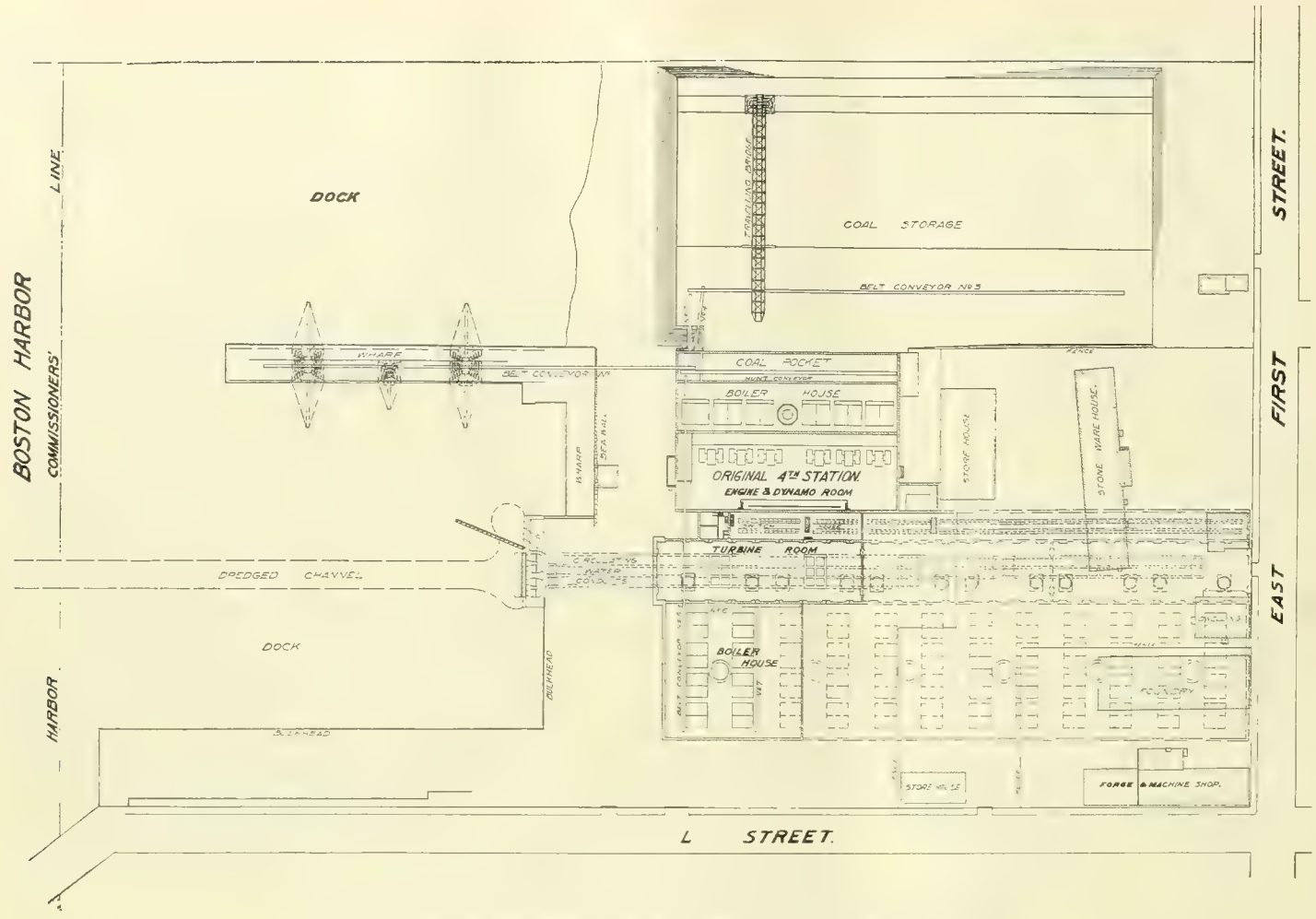
SWITCHBOARD ROOM IN ATLANTIC AVENUE STATION, BOSTON

Boiler Room.



Feeder Vault.

VIEWS IN ATLANTIC AVENUE STATION, BOSTON.



PLAN OF L STREET STATION PROPERTY, BOSTON, SHOWING PROPOSED FUTURE INSTALLATIONS.

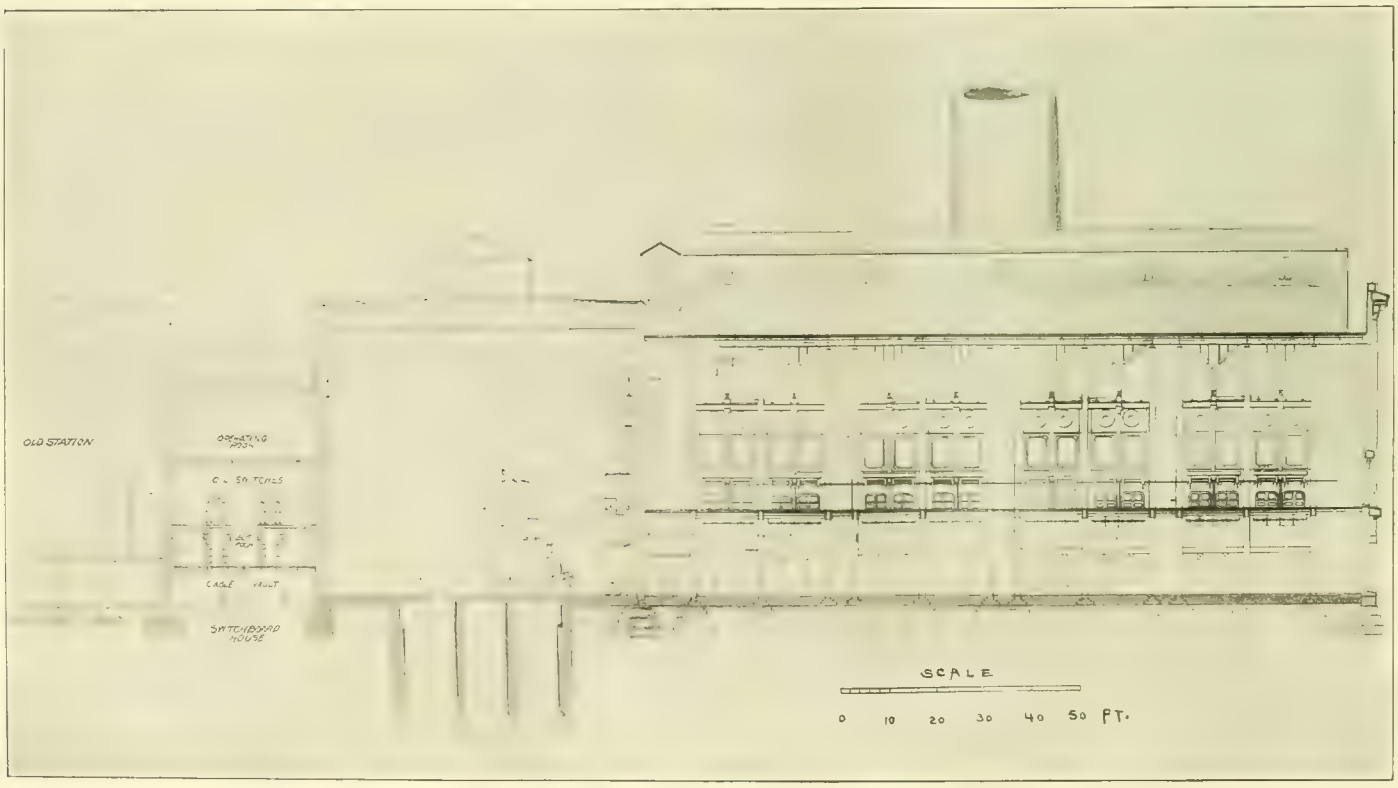
and the blow-off lines for two groups of boilers are all in one room.

The large valves are all electrically controlled. The dampers for each group of boilers are all controlled from one point. A shaft runs back of each row of boilers and connects with regulating apparatus in the middle of the room. Air for combustion is obtained not only in the regular way through the ash doors in the furnace front, but that part of the basement which is not included in the pipe room is at all times in communication with the outside air, certain of the large windows being provided with iron grills instead of glazed in the usual manner. Air from the basement can be admitted below the furnace grates by a system of dampers in the fronts of the air chutes.

Regulation of the coal supply on a weighed basis is obtained by the construction under each bunker spout of a hopper of somewhat over two tons capacity, attached to a Howe scale. Here the coal is weighed and fed down through swinging chutes into each stoker hopper.

Each turbine will be set 27 feet from the boiler-room wall, and grouped around it, with ample floor space, will be the accessories, conveniently arranged for economical operation. The turbine unit is really generator, turbine and condenser combined, having the condenser in the base, the bottom of the turbine opening directly into the top of the condenser, and in connection with the condenser there is also provision for a free atmospheric exhaust through a 36-inch Crane exhaust valve.

The cooling water from the harbor front, taken



SECTION OF BOILER HOUSE, TURBINE HOUSE, SWITCH HOUSE AND PART OF OLD STATION AT L STREET BOSTON.

in through the tunnels to which reference has been made, when forwarded by the 24-inch Worthington centrifugal pump located just beyond the turbine, makes a four-pass circuit through the condenser's cold-water tubing. The Fleming engine which drives this pump is direct-connected, side-crank, running enclosed, with throttling governor. The piping is made 28-inch for the purpose of reducing friction. There are no foot valves on the pump. It is primed at starting by a four-inch Schutte ejector.

On the vacuum side the air is taken off by a Blake pump, having a 10 by 18-inch steam cylinder and a 24 by 18-inch vertical air cylinder. The wet vacuum pump, located in the pit below the condenser, which is a volute, four-inch, driven by a 500-volt induction motor, delivers into a National heater, where the exhaust from the combined auxiliaries is met. This heater is supported at about mid-length from the observation gallery on the boiler-room level. From it there is a system of piping that leads to both the main feed pumps and a spare feed pump; a hot well, or storage tank, being connected in between the heater and feed pump, to correct irregularities in the supply.

The feed pumps are 17-inch cylinder, 12-inch plunger, 15-inch stroke, duplex, center-packed. In addition to the feed pump for each turbine unit and its sets of boilers, there is also to be a spare feed pump to each four units, and the spare pump is included in this first installation for two units at the present time. These pumps are set close to the wall on the boiler-room side, under the observation and heater-support gallery.

Make-up water for the condensers can be taken from the city mains, and admitted to the bottom of the condenser through a valve controlled by the water level in the hot well. This arrangement provides for the supplying of any water deficiency which may occur.

The feed lines, the steam lines and the oil system for the different units are complete in themselves, and not interdependent, but they are tied together to a limited extent, to provide for emergencies.

The new switch house occupies the space, about 30 feet in width, between the old engine house and the new turbine section. It will form a connecting link, structurally and electrically between the two buildings. For a depth of 30 feet it will be used for office purposes; the balance, to a depth corresponding with the length of the turbine house, will be a switch house. In the basement are the cable rooms. The floor above contains the bus bars and instrument transformers. On the second floor are the high-tension oil switches. The third story, starting about half-way back, is the operating room.

All these buildings, like the old section building and the Atlantic Avenue station buildings, are of fireproof construction. The interiors are finished in white and green tiling, and the effect is an agreeable one. The walls of the turbine room are relieved by panels of pleasing proportions, and the lofty arched windows at either end light up the interior very effectively.

In the basement of the switch house the cables enter in two directions, in ducts running lengthwise of the structure, a special type of end-bell being adopted for their termination. On the floor above are two sets of main buses, the current and potential transformers for instrument and relay circuits and certain knife-blade disconnecting switches. The second floor is occupied by the H-type General Electric oil switches. The knife-blade switches are so placed as to isolate the oil switches from the bus bars on one hand and the lines coming into the station on the other. All this apparatus is built in light cream-colored pressed-brick compartments. The horizontal shelves in the compartments are of artificial stone, concrete, with granolithic finish. Provision is left for static dischargers to be installed in the basement.

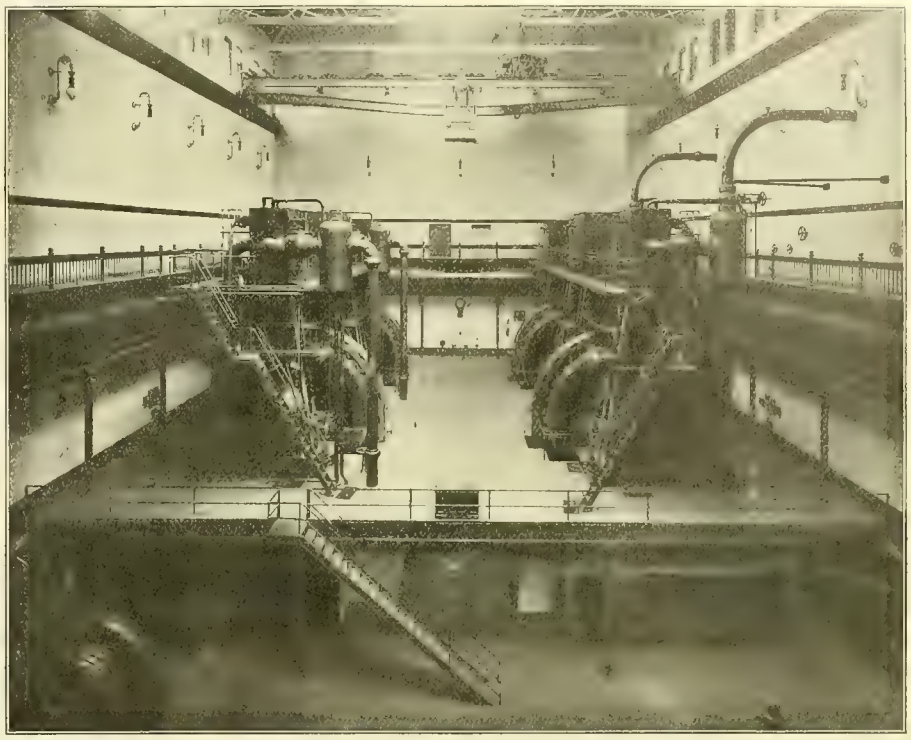
Starting at the bell-end, the cable belonging to the switching gear proper makes a T-connection into three horizontal cables placed about 18 inches apart. These cables lead up through the floor to the set of line knife-blade switches, thence through the current transformers to a link between the two selector switches, which are connected, respectively, to a set of bus bars through two knife-blade switches.

The generator connection is similar, except that there is no knife-blade switch between the oil switches and the generator. There is, however, another oil switch inserted between the selector oil switch and the generator.

All the main high-tension cables used in the station are either of rubber-covered or cambric-covered wire, with a serving of flame-proof braid on the outside. Insulation for the cable is further insured by resting it upon porcelain supports, sufficient for the purpose, independently of the covering.

Above the floors devoted to the switchboard gearing is the operating room, where all apparatus is controlled. Here are panels with instruments and controlling apparatus around the walls of the room.

The company has installed transformers in a room built at the rear end of the old engine room, to connect the old section of the station with the new. It is also the intention to step up some of the long-distance lines to 15,000 volts.

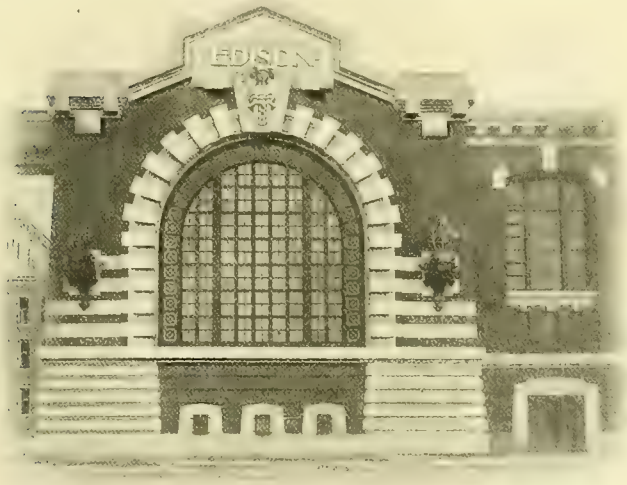


Recently Installed 710-horsepower Motor-generator Operated by Current from L Street Shown in Lower Left-hand Corner of Picture.
VIEW IN NEWER ENGINE ROOM IN ATLANTIC AVENUE STATION, BOSTON.

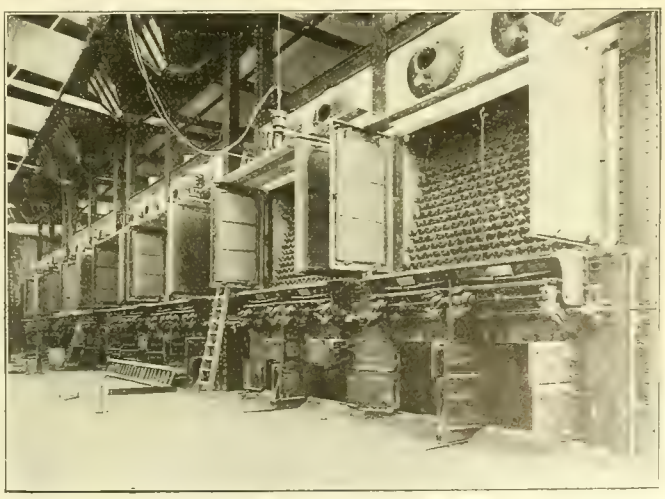
The large traveling crane overhead in the turbine-engine room of the new section has been in place and in operation for some time. It is a Niles crane, electrically controlled, of 50-ton capacity.

The pumping outfit is of the Worthington make, and the electrical appliances are chiefly from the General Electric Company. The coal-transmission apparatus is furnished by the Robins Conveying Belt Company, and the bridge in the coal-storage yard was built by the Brown Hoisting Machinery Company.

Architecturally, the buildings are all admirably adapted for the purposes to which they will be devoted. They have not only the beauty of utility but the appearance of elegance and stability. Winslow & Bigelow of Boston made the designs after plans by the company. The construction work is also in the hands of a Boston concern, Whidden & Co. being the contractors.



This Arched Window is the Chief Architectural Feature of the Building.
FRONT OF NEW TURBINE HOUSE AT L STREET STATION.

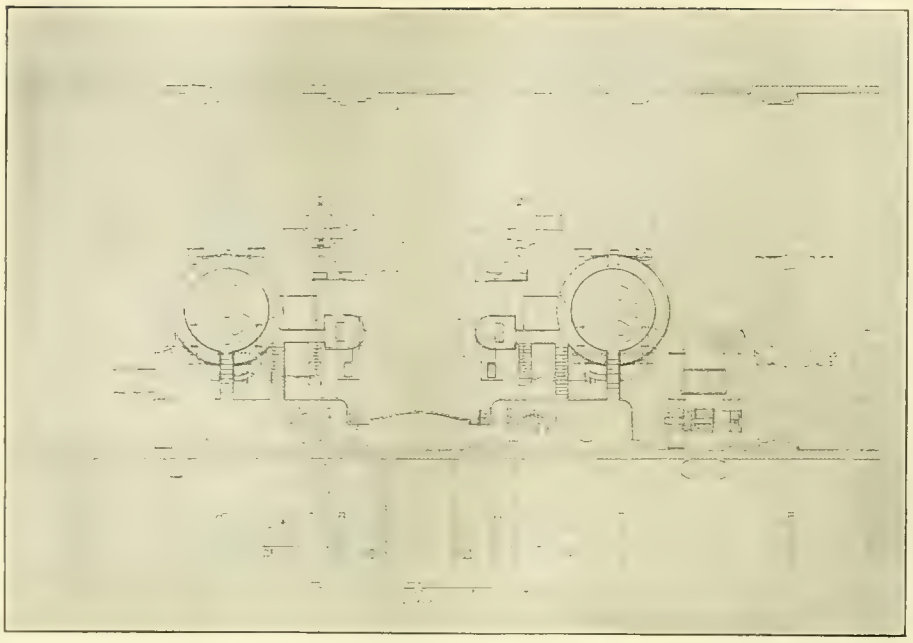


VIEW IN NEW BOILER HOUSE, L STREET STATION, BOSTON.

Several of the newly acquired stations in the suburbs, which came into the company's possession when it absorbed the plants of its consolidated companies, are still in operation, just as they were prior to that

event. The Milton plant is now under process of dismantling, and the territory served by it is receiving current from Boston. The Dedham station becomes a distributing station; so does the station at Canton, and the Natick and Framingham stations have been connected with Boston, although retaining their equipment and remaining in commission.

The Head Place station, No. 1 of the company's list, where the original headquarters were established, is an auxiliary steam and storage station, and No. 2, at Hawkins Street, similarly equipped, retains its essential features as an auxiliary steam and storage station. No. 5, at Canton Street; No. 6, on Pittsburg Street, South Boston; No. 7, on Scotia Street, Back Bay district, together with the battery outfit at the System of Distribution building on Atlantic Avenue, are storage-battery stations. Over in Central Square, East Boston, is No. 8, a distributing station, with motor-generator equipment. No. 9 is on Zeigler Street, in the Roxbury district of the city, and is also a distributing station. No. 10, on Buzzey Place, near Summer Street in Boston proper, is not yet in commission. Nos. 11 and 12, like the Milton station, which is No. 19, together with No. 14, are not at present listed among the active ones. No. 13 is a distributing station on North Street in the Market district. Nos. 15, 16, 17, 18 and 22, which are, respectively, the Charlestown, Somerville, Newton, Woburn and Needham plants, retain their old-time character for a time. Later on innovations will be introduced in these to adapt them to the new conditions which will be met by the enlargement of the L Street main station's capacity.

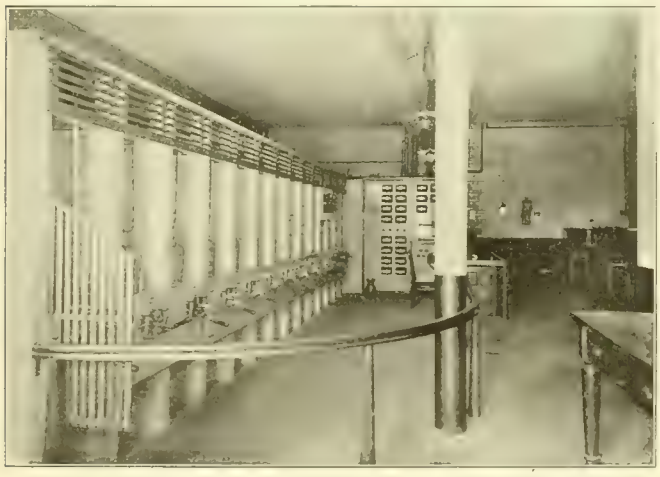


PLAN OF 5,000-KILOWATT VERTICAL TURBO-GENERATORS AND AUXILIARIES AT L STREET STATION, BOSTON.

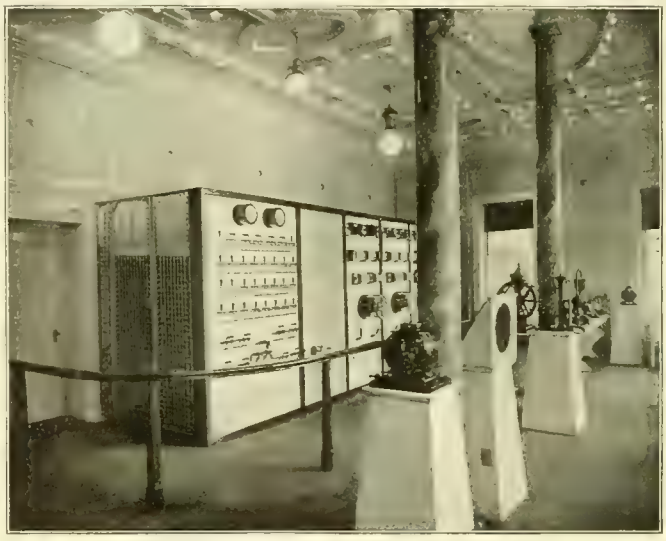
Statistics.

The total number of the Edison Illuminating Company's customers is 19,551. On the system, as a whole, there are 697,044 incandescent lamps and 10,103 arc lamps. Power is supplied with 6,806 motors, having a motor horsepower of 24,715. The total capacity of the combined load is 1,178,900 in 16-candlepower equivalents. There is upward of 20,000,000 feet of wire in use.

In Boston the feeders and mains contain 4,926,703 feet in underground cables, all sizes from No. 6 to 1,000,000 circular mils, including three conductor lines as large as 300,000 circular mils. On the Edison tube system there are 145,000 feet of feeder tubes and 339,000 feet of main tubes, including 495 junction boxes. The conduit system has 418,400 feet of conduit lines, including manholes, sizes ranging from one-duct to 54-duct. The approximate number of transformers installed on the system in Boston proper is 1,100.



Interior of Sub-station No. , Ziegler Street, Roxbury.



Show Room at Sub-station No. 8, East Boston.

VIEWS IN SUB-STATIONS OF EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

Personnel of the Company.

The directors of the Edison Electric Illuminating Company of Boston are: Charles L. Edgar, president; Walter C. Baylies, vice-president; Henry B. Cabot, treasurer, with Charles W. Amory, Robert Bacon, E. Henry Barnes, Everett W. Burdett, Isaac T. Burr, T. Jefferson Coolidge, Jr., George Dexter, Frederick P. Fish and C. Minot Weld. The clerk of the company is J. Otis Wardwell. Messrs. Baylies (chairman), Cabot, Dexter and Weld are the executive committee.

Mr. Edgar, the president of the company, is also president of the National Electric Light Association and a former president of the Association of Edison Illuminating Companies. He is one of the most prominent and successful of the electric-light men of the United States. He has been with the Boston company since 1887, beginning as general superintendent and becoming successively general manager, vice-president and president. After leaving college and before going to Boston Mr. Edgar was with Thomas A. Edison and the parent Edison company. His training and experience have been exceptionally thorough, practical and complete, and he is well fitted to administer the many and important trusts committed to his hands. With it all, he is still a young man, having passed but 43 of the milestones of life.

The general superintendent of the company is W. H. Atkins, and Sidney Hosmer is superintendent of construction, having supervision over the new work that has been in progress. I. A. Moultrop is the mechanical engineer, and has been in touch continually with the details of the new station from its inception. William P. Hancock is the superintendent of stations, to whom the new building will be turned over for its operation upon completion.

BATTERY ROOM IN SUB-STATION NO. 6 (PITTSBURG STREET), BOSTON.

The citizens of Kilbourn, Wis., are considering the proposition of installing an electric-light plant to be operated in connection with the water plant owned by the city.

Boston Convention of the National Electric Light Association.

The twenty-seventh annual convention of the National Electric Light Association will be held in the Hotel Vendome, Boston, next week, May 24th, 25th, 26th and 27th. No efforts have been spared to uphold the high standard of excellence attained for the meetings of this association, and with the experience of previous meetings as a guide, coupled with the earnest endeavors of President C. L. Edgar and the other officers, assisted by a competent corps of department chiefs and committeemen, the convention this year promises much. An outline of the elaborate programme to be presented, together with other features of the meeting, is given below:

CHARLES L. EDGAR, PRESIDENT OF THE EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON AND OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Papers.

"The Sale of Electrical Energy," by W. F. White.

"Economy Test of a 5,500-horsepower, Three-cylinder Compound Engine and Generator," by J. D. Andrew and W. F. Wells.

"A Hundred-mile Transmission Line," by Robert Howes.

"The Mechanical Stoker and the Human Operator," by Edwin Yawger.

"The Organization and Equipment of an Arc-lamp Department," by Samuel G. Rhodes.

"Practical Notes on Steam Turbines," by Francis Hodgkinson.

"Electric-light and Power Plants in Connection with Ice Plants," by C. L. Wakefield.

"Single-phase Power Motors for Electric-lighting Stations," by W. A. Layman.

"A Three-wire, 500-volt Lighting System," by Walter I. Barnes.

"Notes on the Internal-combustion Engine as Applied to Central-station Service," by E. E. Arnold.

"A Proposed System of Standard Instruments for Operating Companies," by H. P. Davis.

"Remote Control of Electrical Apparatus," by William H. Cole.

"Economy in Minor Station Supplies," by Edgar B. Greene.

"Luminous or Flaming Arc," by Welles E. Holmes.

"Grounding the Neutral of High-voltage Generators," by George N. Eastman.

"Types of Large Waterpower Installations" (with stereopticon), by Dr. F. A. C. Perrine.

Reports.

"Progress," by T. Commerford Martin.

"District Heating," by E. F. McCabe, chairman.

"Lost and Unaccounted-for Current," by C. W. Humphrey.

"Purchased Electric Power in Factories," by W. H. Atkins, chairman.

"Office Methods and Accounting," by Frank W. Frueauff.

"Advertising," by La Rue Vredenburgh.

"Sign and Decorative Lighting," by Arthur Williams.

"Analysis of Flue Gases," by Henry L. Doherty, chairman.

"Standard Candlepower of Incandescent Lamps," by Louis Bell, chairman.

"Legislative Policy," by Samuel Insull, chairman.

"Photometric Values of Arc Lamps," by Henry L. Doherty, chairman.

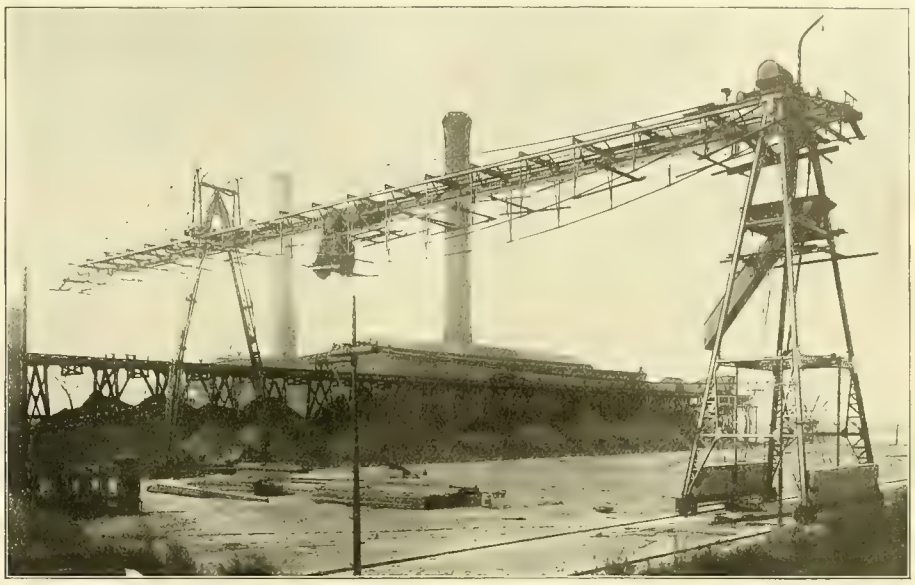
"Uniform Accounting," by Guy L. Tripp, chairman.

"Award of Doherty Gold Medal," by Schuyler S. Wheeler, chairman.

"Investigation of Steam Turbines," by W. C. L. Eglin, chairman.

Departments.

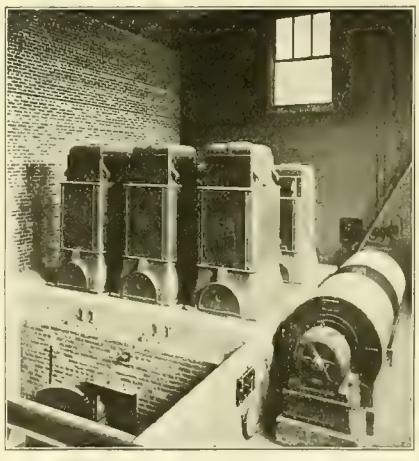
The "Question Box" and "Wrinkles" Department, edited by H. T. Hartman and Charles H. Williams, respectively, are very complete and offer a wealth of useful and timely information. There are 100 or more "wrinkles" submitted, and the Question Box contains nearly 450 questions, nearly every one of which has been answered.



TRAVELING BRIDGE AND OTHER COAL-HANDLING APPARATUS AT L STREET STATION, BOSTON.

Entertainment.

The local entertainment committee, composed of 64 gentlemen and headed by James I. Ayer, has provided an entertainment programme for the guests attending the convention. The programme will be about as follows:



A CORNER IN THE TRANSFORMER ROOM AT L STREET STATION.

On Tuesday afternoon the ladies in attendance will take carriages and drive through the Fenway and possibly to some points of interest about Boston. They will be in charge of a committee composed of Charles J. Hatch, W. E. Holmes and D. P. Robinson. In the evening there will be given at Hotel Vendome a lecture on "Historical and Electrical Boston," under the charge of La Rue Vredenburgh.

On Wednesday morning H. S. Potter, F. S. Wilson and F. S. V. Sias will conduct the ladies through the shopping district of Boston, and in the afternoon Sydney Hosmer, Percy Hodges, W. C. Woodward and Professor H. E. Clifford will have charge of a trip down the harbor, and on return a visit to the L Street station of the Boston Edison Company. Wednesday evening will be spent at Symphony Hall attending a popular concert. All the space within the rail has been reserved for the use of the guests and their friends. The committee having in charge the concert consists of R. L. Warner, Thomas C. Wales, R. N. C. Barnes, George C. Ewing and F. W. Lord.

On Thursday there will be provided for the ladies a trip in automobiles to Wayside Inn, Lexington and Concord, in charge of C. B. Davis, George H. Berg and F. S. Wilson.

Friday will be given up entirely to personally conducted trips in and about Boston. The business sessions of the association will close on Thursday evening, leaving Friday to be devoted purely to entertainment.

A general information bureau will be established at Hotel Vendome, in charge of Messrs. Vose and Peasley. It is intended to have during the week lists made of those desiring to take any particular trips or see any particular points on Friday, so that adequate arrangement may be made for properly personally conducting the visitors to such places as they desire to go. Mr. W. H. Atkins will have general charge of the entertainment on Friday, and the following committeemen have been selected to arrange details for the excursions listed: Institute of Technology, Professor H. E. Clifford; Harvard University, Professor C. A. Adams, Jr.; Bunker Hill Monument and Navy Yard, P. J. Kennedy; Fore River Ship and Engine Company, Charles H. Parker; Simplex Electric Company, Everett Morss; Holtzer-Cabot Electric Company, C. W. Holtzer; power stations in Boston, I. E. Moultrop; trolley trips, Paul Winsor; New England Gas and Coke Company, George H. Finn.

Hotel Accommodations.

The Hotel Vendome, corner of Darmouth Street and Commonwealth Avenue, one block north from Copley Square, has been chosen as the convention headquarters, but arrangements have also been made with the Hotel Brunswick, Hotel Victoria, Hotel Lennox and Hotel Westminster, all within two blocks of the Vendome, so that accommodations for at least 1,000 guests are assured. The Hotel Vendome and Hotel Brunswick are under the same management and conducted upon the American plan. Rates vary from $5 to $7.50 a day, according to location of rooms and whether bathroom is required or not. The hotels Victoria, Lennox and Westminster are conducted upon the European plan and rates vary from $2 to $5 [illegible] of rooms and whether bathroom is required or not.

MILTON SUBSTATION POST N.

Owing to the growth of the association during the last four years the question of hotel accommodations at the conventions has become a serious one, and President Edgar, realizing how important it is, for the comfort and convenience of the members, to have their accommodations ready and awaiting them upon arrival in Boston, has this year, as an innovation, appointed a committee to assume control of the assignment of rooms and parlors, with a hope of relieving the members of much of the attendant care and inconvenience. Applications for rooms should be sent to Charles H. Hodgkinson, chairman committee on hotel accommodations, 70 State Street, Boston.

Careful attention will be given to each application, with a desire of pleasing every one. In this manner it is hoped that every member, upon arrival at the railway station, can proceed directly to his hotel, the name of which he will be previously notified, and find everything there ready for his occupancy and comfort.

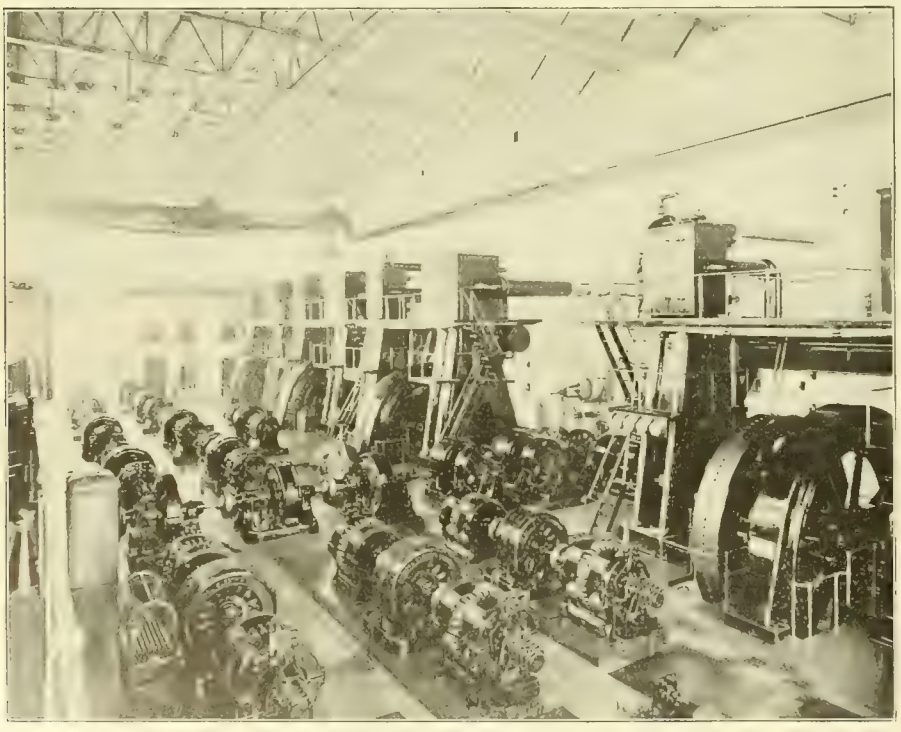
TRANSPORTATION.

The New England Passenger Association, the Trunk Line Association, the Southeastern Passenger Association, the Central Passenger Association and the Western Passenger Association have granted a special rate of a fare and one-third on the certificate plan, for the round trip, from all points in their territory for delegates and their friends attending the convention. This rate is good for three days (not counting Sunday) preceding the opening of the convention, and the three days following adjournment.

The Southwestern Excursion Bureau has granted a rate of a fare and one-third on the certificate plan from all points in its territory to Boston and return to delegates and friends attending the convention. This is the first time the concession has been made in this territory and is additional evidence of the geographical as well as the numerical growth in membership.

For the exclusive use of delegates and their friends who will attend the meeting going from Chicago and its vicinity the Lake Shore and Michigan Southern railway, in connection with the New York Central and Boston and Albany railways, will provide special sleeping cars, which, with dining and buffet library cars, it is proposed to run as the first section of the New England express, leaving Chicago at 2 p. m. Sunday, May 22d, and arriving in Boston at 5 p. m. on the following day. Tickets will be good going on any train, including the Lake Shore limited.

In order to obtain reduced rates of fare, it is necessary when purchasing tickets to state to the ticket agent that it is for the purpose of attending the meeting of the association, and to ask for a certificate showing that full fare has been paid. This certificate, when vised at the office of the association in Boston, will enable the purchaser to return at one-third the fare paid going.



VIEW IN OLDER ENGINE ROOM IN L STREET STATION BOSTON.

The "Noisy, Noiseless Court" in the Palace of Electricity, St Louis.

Several weeks ago Professor W. E. Goldsborough, chief of the Department of Electricity of the World's Fair, in an address before the alumni of the Massachusetts Institute of Technology in Chicago, outlined briefly the results that have attended the research of Mr. M. R. Hutchison in the field of wireless telephony, and of his promise to equip the court of the Palace of Electricity with such of his apparatus as would enable it to be used and tested by the public at large. The "Noisy, Noiseless Court," as Professor Goldsborough termed the quadrangle within the walls of the Palace of Electricity, would be so arranged that, although to the visitor, as he walked therein, no sounds would be audible, the placing of a small telephone receiver to the ear would enable him to enjoy the music of a phonograph played in a nearby booth, a vocal or instrumental solo, or one of Sousa's stirring marches, played by the famous band by that name in one of the exposition bandstands.

Although at the time of this announcement little could be learned aside from the bare facts, the Western Electrician is now able to give some of the details of the installation; in connection with the accompanying photographs of Professor Goldsborough and Mr. Hutchison, showing the former testing the installation a few days after the opening of the exposition.

Several years ago Mr. Hutchison gave an electric-chafing-dish party to a number of scientific friends at his laboratory in New York. When called upon for a speech, Mr. Hutchison handed each guest a curious arrangement, consisting of a pair of telephone receivers attached to a small coil of wire, asking each visitor to place the telephones to his ears. He then withdrew from the room and delivered his speech into a transmitter of special construction, those sitting at the table receiving every word, although connected in no way to the transmitter. Mr. Hutchison then started a phonograph before the transmitter, and with his friends walked about the laboratory, hearing perfectly the sounds emitted by the instrument.

During January last the system, greatly improved, was installed in Mr. Hutchison's home at New Rochelle, N. Y., where it has afforded no little pleasure. In February Professor Goldsborough visited Mr. Hutchison, and was greatly astonished by the remarkable distinctness of the transmission. No matter in which part of the house he stood, the sounds were reproduced with exquisite clearness and volume. The instrument worked as well in the cellar as in the library, and a trip to the stable was made, during which the phonograph could always be heard.

Soon after this test Professor Goldsborough made the announcement that in the Palace of Electricity at St. Louis the public would be afforded an opportunity of receiving telephonic communications without wires, and, as noted in the Western Electrician, the installation was tested and found perfect on opening day, April 30th.

The transmitting station is located in the booth of the Hutchison Acoustic Company in Block 23 of the Palace of Electricity. It consists of a large graphophone and one of Mr. Hutchison's heavy-current transmitters. This transmitter is in itself a marvel, as it operates with a current of 15 amperes, which would, of course, destroy an ordinary carbon transmitter. As it is, the heat generated is so intense that the transmitter is kept cool only by the use of water, which is circulated through it. Without the water, it would become redhot almost instantly, and even when working under the best conditions, all of the heat cannot be dissipated. Strange to say, the transmission is equally good when the transmitter is red-hot, although it cannot be used in this condition, as it would melt the wax of the graphophone record. Current is supplied from a storage battery of 15 cells in series, and approximately one-half horsepower is required to produce the best results. Connected to the transmitter is a large coil buried in the ground of the court.

PROF. W. E. GOLDSBOROUGH, ACCOMPANIED BY M. R. HUTCHISON, LISTENING TO MUSIC IN THE "NOISY, NOISELESS COURT."

The receiver, as shown in the picture, consists of two ordinary watch-case telephone receivers, attached to conducting spring supports, which pass through a handle, and terminate in an attuned receiving coil. When this coil is held in a horizontal position, magnetic waves, emanating from the transmitting apparatus, induce similar currents in the receiving coil, producing in the receivers an exact reproduction of the music in the graphophone.

It is, to say the least, weird to receive, through space, the words spoken into the transmitter, while walking about the court, with no connection whatever to any exterior system, the sounds vanishing instantly when the ear-pieces are removed. It is, of course, obvious that any number can listen to the music at one time.

Another interesting point is that the music reproduced by the receivers is even sweeter than that produced by the graphophone, the harshness being clarified, as it were, by the transformation into magnetic waves, thence through the ether to the receiving coil, where it is retransformed into an electric current, which in turn produces sound by the vibration of the diaphragms. Mr. Hutchison believes that practical application of his system is well within the range of its possibilities, as he has, in a short time, developed it from a laboratory experiment to a scale where it now operates successfully over an area of several acres.

American Railway Mechanical and Electrical Association.

Secretary Mower of the American Railway Mechanical and Electrical Association, which will hold its annual convention in the Festival Hall Building, World's Fair Grounds, St. Louis, Mo., on October 10th and 11th, states that a limited number of rooms will be reserved at the down-town hotels if applied for before June 1st. The rates range from $5 to $15 a day. No exhibits will be displayed in connection with the convention. The banquet will be held Thursday evening, October 13th. The practice of issuing two banquet tickets gratis to each company represented has been abandoned, and hereafter tickets will be purchased by the delegates at actual cost.

ALTERNATING-CURRENT WORKING.

By W. B. Gump, Asso. Mem. A. I. E. E.

Part V.

Alternating-current Motors and the Rotary Converter.

The great advantages of the alternating current for power transmission have naturally brought about the development of a motor which can be operated from the same source, thus dispensing entirely with the transforming apparatus which must of necessity be interposed when a direct-current motor is operated on such a system. The type of motor which has met with the most general use is the polyphase induction motor, the advantages of which will be discussed further on.

The single-phase motor, although not new, has had such serious drawbacks that but little has been done with it in connection with very large installations. The necessity for an efficient single-phase motor, however, has been a realization to the engineer for many years, and this necessity is especially

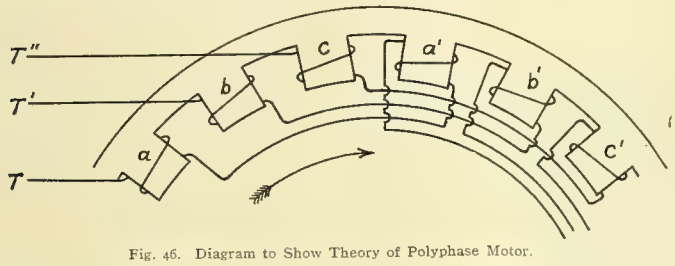


Fig. 46. Diagram to Show Theory of Polyphase Motor.

emphasized in railway work. Within the last year great strides have been taken to develop a single-phase railway motor, and an epoch-making period in the history of the single-phase motor will, without doubt, take place in the near future. In a recent issue of the Western Electrician the single-phase motor was discussed in a very comprehensive manner. It will therefore be superfluous to dwell upon it here, further than to compare it to the polyphase and the synchronous motor, taking up (as this description shall) the advantages and disadvantages of each type.

The Single-phase Motor.

It is well known that a series direct-current motor may be operated by an alternating current, the nature of the motor being such that the direction of rotation is fixed, regardless of the alternating flux, since both the field current and armature current reverse simultaneously. Suppose that instead of passing the current directly through the armature, we short-circuit its coils, and excite the field with an alternating current. An electromotive force will then be induced in the armature coils, which may be compared to the secondary of a transformer. The self-induction of the armature (secondary) will, on account of the iron core, be highly inductive, and consequently the current will lag behind the impressed electromotive force of the armature by a phase difference of more than 90°. Now, if a curve be plotted by taking the product of the current and magnetism in the armature, it will represent the torque, and it will be seen that the positive lobe of the curve will be less than the negative throughout each cycle, a repulsion being set up between the field and the armature, greater than the attractive force. This arrangement constitutes what is commonly known as a "repulsion motor."

A repulsion motor is not self-starting unless an arrangement is made whereby the flux induced in the armature (or a part of it) has a fixed relative position which will produce a starting torque. Normally, the repulsion of the armature coils are all balanced against that of the field. If, however, the armature is once started, a differential effect occurs which changes the relation between the field and armature, maintaining a continuous torque.

Single-phase motors are not highly efficient, and are large for their output. They are much cheaper, however, than polyphase motors, and are quite satisfactory in small sizes; hence they have an important place in small installations.

The Polyphase Induction Motor.

The polyphase motor, unlike the single-phase repulsion motor, is self-starting; it is more efficient and more compact for the same output. It may be well before proceeding with the theory to review the elementary principle upon which this theory is based. Observing Fig. 46, suppose that the inner pole pieces (a) (b) (c) and (a') (b') (c'), respectively, be connected as shown, and three-phase currents be supplied to the terminals (T) (T') and (T''). Starting at the terminal (T), let the current of the first phase magnetize poles (a) and (a'), these poles being connected opposite to each other. In the same way the current of the second phase will magnetize (b) and (b'), and finally current from the third phase will magnetize (c) and (c'). Since the poles (a) (b) and (c) are wound for the same polarity, and (a') (b') and (c') for the opposite polarity, it will be observed that the poles of each group will change places with each other during each half cycle, and as there are three poles in each group there phase difference will be one-sixth of one cycle. Now it is evident that if the adjacent poles change regularly from phase to phase, the result will be a rotating magnetic field in the direction of the arrow. If in such a field an armature be placed whose coils are short-circuited, currents will be induced in these coils, and the current will react on the field, causing a "drag" upon the armature which will thereby cause it to rotate. The stationary part of the motor is called the "stator" and the part which rotates is known as the "rotor."

If f be the frequency of the electromotive force supplied at the terminals, P be the number of pairs of poles per phase, and V be the velocity in revolutions per minute, of the field, then: One revolution is made in $\frac{P}{f}$ seconds, and $\frac{f}{P}$ revolutions per second $= \frac{V}{60}$

Therefore,

$$V = \frac{60f}{P}$$

If V' = the speed of the rotor, and, as before, V = speed of the rotating field, then the relative speed between any given armature inductor and a fixed point on the stator will be V — V' revolutions per minute. The ratio of this difference to that of the field velocity is called the "slip," and its equation becomes $S = \frac{V - V'}{V}$. The slip is generally expressed in per cent. of the synchronous speed. If the flux from a single pole of the stator is Φ maxwells, the effective electromotive force in a rotor inductor will be expressed by the equation,

$$E = \frac{2.22 \Phi P S V}{60 \times 10^8}$$

when P = number of pairs of poles on rotor,
when S = slip.

The electromotive force thus induced will not have the same frequency as the impressed electromotive force of the stator, but will have a frequency S times the frequency of the stator. This condition is made use of in cases where change of frequency becomes desirable, especially that of changing from a low to a higher frequency. Such an apparatus is known as a "frequency changer," and operates in the following way: A synchronous motor is direct-connected to the rotor of an induction motor which is made to rotate in a direction opposite to its rotating field. The stator windings of the induction motor and the terminals of the synchronous motor are connected to the low-frequency mains. Slip rings on the rotor of the induction motor lead off current at the higher frequency. The power required to drive a frequency changer is the same percentage of the output as the ratio of the low frequency to the higher frequency.

Suppose that an induction motor is being operated without any load. The armature will revolve but a trifle slower than the field. This difference in speed will just be sufficient to induce the necessary electromotive force which will cause the required current in the rotor to make up for the losses due to friction, windage and the copper and iron losses of the rotor. If now a load be put on the motor its speed will be lowered, and consequently the slip will increase. This will cause an increase of electromotive force and current in the rotor, and an increase in power thereby, which will meet the requirements of the load. In this respect the induction motor operates in a similar manner to the direct-current shunt motor.

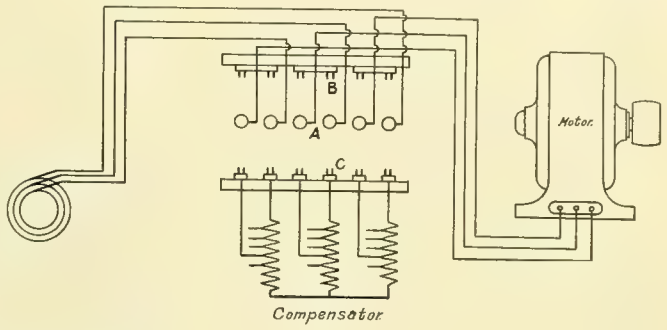


Fig. 48. Starting Compensator for Induction Motor.

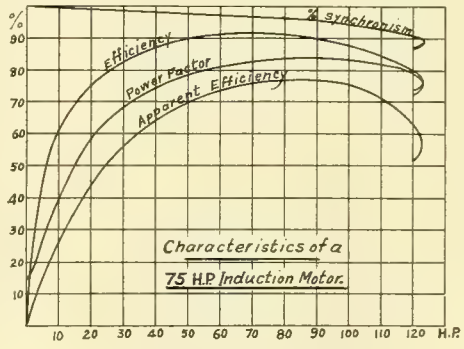


FIG. 47. INDUCTION MOTOR CHARACTERISTICS.

If the flux of the rotor, and, as before, V = speed of the rotating field, then the relative speed between any given armature inductor and a fixed point on the stator will be V — V' revolutions per minute. The ratio of this difference to that of the field velocity is called the "slip," and its equation becomes $S = \frac{V - V'}{V}$. The slip is generally expressed in per cent. of the synchronous speed. If the flux from a single pole of the stator is Φ maxwells, the effective electromotive force in a rotor inductor will be expressed by the equation,

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If the rotating magnetic field of an induction motor were constant at all loads, the slip, rotor, electromotive force, and rotor current would vary directly as the torque applied. This, however, is not the case, for the following reasons: Upon increase of slip, a greater proportion of flux passes between the stator and rotor windings without interlinking them. The cause of such leakage is due to cross-magnetization, which increases with the increase of current in the rotor. The decrease in useful flux therefore lessens the torque for a given value of current, and requires a greater amount of slip to produce the same current. The relations between speed, torque, power-factor current and efficiency for an induction motor running normally, are shown in Fig. 47. Torque depends upon the product of the field flux and the rotor ampere-turns. Therefore, the torque varies as the square of the impressed voltage. It follows from this that the power of an induction motor will change if it is operated on a circuit of a different voltage.

The power factor of induction motors is quite low, due to the magnetic leakage between the windings. This leakage is, of course, increased by an increase in the air gap. It is of the highest importance, therefore, to have the gap as small as possible, and also to have rigid bearings which will maintain perfect alignment. On account of a low power factor, induction motors should have a lower rated capacity than transformers from which they are operated. In practice the capacity of the motor in horsepower is made equal to the transformer in kilowatts. It is evident that this rating will provide for an extra supply of current from the transformer to make up for all losses.

Methods of Starting Induction Motors.

In order to prevent excessive rush of current on starting a motor of the "squirrel-cage" type, it has been found necessary to employ some form of starting compensator. The construction of such a compensator consists essentially of a combination of auto-transformers (one for each phase) which are interposed between the supply mains and the motor terminals. In this way the voltage is reduced on starting; hence the starting current is also reduced.

The form of compensator just described is shown in Fig. 48, and is typical of the starting arrangement for m[illegible] motor is not running, the switch stands at the "off" position on the hinge clips at (A). To start the motor the switch is brought upon the contacts at (C) and held until the motor reaches normal speed. The switch is then quickly raised and placed upon the run[illegible] the mom[illegible]

compensator, which makes it adjustable to the peculiar demands of the motor and the voltage employed. When once it is adjusted correctly it should be made permanent and the connections not disturbed afterward unless special conditions demand a new adjustment.

Another method of starting is to use a centrifugal friction clutch on the motor, starting it without load. When the motor reaches normal speed the clutch acts automatically, throwing the load upon

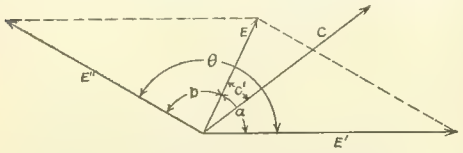

FIG. 49. RELATIONS OF SYNCHRONOUS MOTOR AND GENERATOR.

the pulley. In this way the starting current is practically the same as the working current.

The direction of a three-phase motor may be reversed by reversing the connection of any two of the terminals. A two-phase motor may be reversed by reversing the connections of either phase.

Means of Varying the Speed.

The problem of varying the speed of induction motors has been given considerable attention, since there are certain classes of machines which demand changes of speed to accomplish the work to which they are put. It is evident, therefore, that unless some simple means is devised which will alter the speed of an induction motor, its range of usefulness will be limited. It becomes necessary also to maintain a moderately high efficiency with variation in speed. The means of speed variation of induction motors under present conditions resolve themselves into four ways, namely:

(a) Altering the voltage impressed upon the stator.
(b) Altering the rotor-circuit resistance.
(c) Altering the number of poles on the stator.
(d) Altering the frequency of the impressed electromotive force.

Of these methods the second has been found to be perhaps the least complex. The variation in speed by this method, however, is accomplished only at

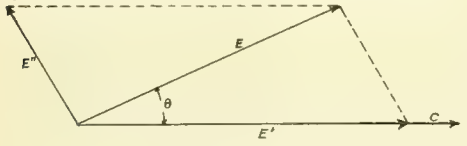

FIG. 50. VARIATION IN ELECTROMOTIVE FORCE OF SYNCHRONOUS MOTOR.

the expense of the accompanying losses through the resistance inserted. As to efficiency, the last two are the more desirable, but they have other drawbacks in the way of control which incur considerable expense and a rather complicated system. In the fourth method it is evident that some form of frequency changer must be used, and hence a great additional expense is necessary to make the installation.

The Synchronous Motor.

An alternating-current motor whose phase difference from the alternator driving it is zero is said to be running in synchronism. Any alternator, either single-phase or polyphase, may be connected with a source of alternating current and be operated as a synchronous motor if its speed is first brought up to a value corresponding to the frequency of the source. The speed necessary to attain synchronism will be the frequency divided by the number of pairs of poles, or $V_s = \frac{60\,f}{P}$

In order to analyze the condition which takes place in a synchronous motor, suppose that we consider the

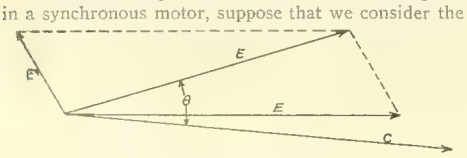

FIG. 51. VARIATION IN ELECTROMOTIVE FORCE OF SYNCHRONOUS MOTOR.

relation between the motor and the generator to which it is connected.

Let E' = electromotive force of generator.
E'' = electromotive force of motor at the time it is connected with the generator.
θ = angle between E' and E''.
R = resistance of generator armature, motor armature and connecting line between.
R' = reactance $= 2\pi f L$.

The electromotive force which is effective in sending current through the motor is evidently the resultant of E' and E'', their angular difference being $\theta°$. If these are drawn at their proper phase distance, they will oppose each other at an angle somewhere between 90° and 180°, as shown in Fig. 49. The effective electromotive force in sending current through the circuit is E, analytically: $E = E' \cos.\ a + E'' \cos.\ b$. This electromotive force will send a current through the circuit which will be

$$C = \frac{E}{\sqrt{R^2 + (2\pi f L)^2}}$$

Now

$$\text{tan. c.} = \frac{\text{Reactance}}{\text{Resistance}} = \frac{2\pi f L}{R}$$

This expression therefore determines the angle of lag between the impressed voltage E and the current C.

A careful observation of the vector diagram will show that when the value of the power factor is at

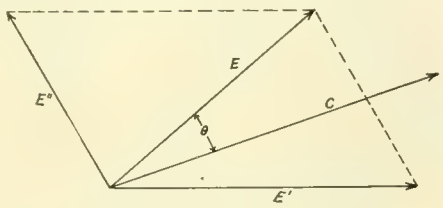

FIG. 52. VARIATION IN ELECTROMOTIVE FORCE OF SYNCHRONOUS MOTOR.

any value but unity pulsations will be given to and received from the generator.

If $P' =$ power given by the generator
and $P'' =$ power given by the motor,
then $P' = E' \cos.\ (a - c')$
and $P'' = E'' \cos.\ (b + c')$

It should be noted that during each cycle there will be four power pulsations. This fact will at once become evident if sine waves are plotted having the same phase relations as those in Fig. 49.

If an alternation in phase between the motor and generator results in the motor receiving increased power the motor is "stable," but if a change in phase has the opposite effect it is "unstable." There are certain limits of the phase angle θ beyond which if a load be increased the motor will fall out of synchronism and finally stop. There are several causes for this. Among them are variations in the frequency of the generator and suddenly applied loads on the motor. Variations in the speed of the alternator are productive of an oscillating movement known as "hunting." It is often caused by the failure of the engine governor to respond promptly to changes of load. If a means is not used to overcome hunting it may become quite serious, especially when generators are operated in parallel. It is obvious that the inherent cause of hunting is due to the inertia of the armature, consequently it may occur in a synchronous motor as well as an alternator.

It was shown in the foregoing that the current

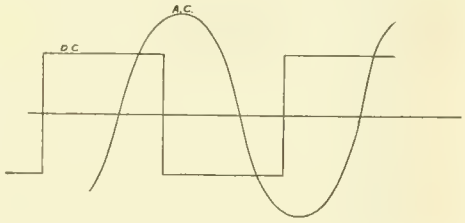

FIG. 53. WAVE FORM OF ROTARY.

sent to the synchronous motor lags behind the electromotive force E by a certain angle, C. This angle of lag is necessarily dependent upon reactance ($2\pi f L$) and R. If, therefore, E'' be altered, it will change the angle C, which may be either lagging or leading. A variation in E'' is made through the field excitation of the motor. Its various effects are shown in Figs. 50, 51 and 52. From the diagrams it may readily be seen that if the motor field E'' be overexcited it will cause a leading current, which produces the same effect as a condenser in the circuit. In this way the synchronous motor may be used to neutralize inductance and thus keep up the power factor. Synchronous motors are often employed in this way on transmission systems, since inductive disturbances may be overcome and good regulation thereby maintained. When synchronous motors are used for this purpose they are generally run without any load, or with but a light load, and their fields are excited to meet the particular conditions under which they operate.

The description and diagrams given have referred to the single-phase motor. The facts stated, however, are equally applicable to polyphase synchronous motors.

Synchronous motors are generally started by some outside source of power. On polyphase systems an induction motor is generally employed. The capacity of such a motor need be but one-tenth the size of the synchronous motor. It is possible and sometimes feasible to start synchronous motors without any outside source. This may be done by opening the field circuit and supplying polyphase current directly to the armature. Current from the armature is induced in the field poles to the extent of producing a starting torque and causing the armature rapidly to approach synchronism. When synchronism is attained the field is excited and the motor continues to run. The load may then be applied through a friction clutch or similar device.

When starting a synchronous motor by the method first described great care is necessary because of danger of rupturing the insulation of the field coils. The cause of this danger is due to the high voltage brought about by the rapidly varying flux in the pole-pieces. The danger may be lessened by separating all of the field spool connections, confining the difference of potential to that of one spool instead of several.

The Rotary Converter.

A rotary converter is a machine having one field and having one armature from which connections are led in two directions. On one end are the usual connections, which lead to a commutator; on the other are slip-rings, to which taps are led from equidistant points on the armature winding.

When brushes are placed upon the slip-rings and an alternating current conducted to the armature it will revolve at the same speed as a synchronous motor, and while revolving a direct current may be taken from the commutator on the opposite end. The windings on the armature of a converter are closed; thus the alternating-current side is necessarily delta-connected. The winding is such that each slip-ring must be connected to as many taps leading to the armature as there are pairs of poles.

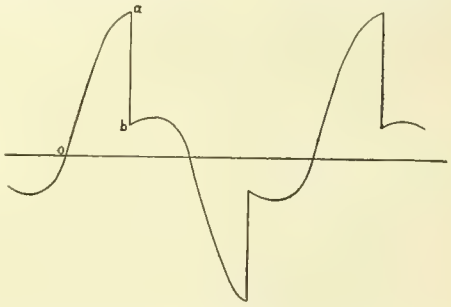

FIG. 54. WAVE FORM OF ROTARY.

A converter may be supplied with direct current through the commutator and an alternating current be led from the slip-rings. When thus used it is termed an "inverted converter." The name "rotary" is usually applied to a converter when it receives alternating current and supplies direct current. Converters have a variety of uses. They may be used in distributing installations in connection with the charging of storage batteries; to charge them during light loads, and discharge them during periods when heavy loads are demanded. They are also used in connection with electrolytic processes. Chief among the uses of the rotary converter is its application to electric-railway systems. The success which is promised by the single-phase railway motor, however, will no doubt place a limitation on the number of rotary installations.

Wave Form of Rotaries.

The wave form of a rotary converter is peculiar, in that the effective current flowing through the armature is composed of two currents—one superimposed upon the other—as shown in Fig. 53. One is the alternating current which is supplied to the armature, and the other is that due to the current taken from the commutator or direct-current side. The result of this condition will be a flat top or a rectangular lobe on the direct-current side, and a sine wave on the alternating-current side. Since both of these flow through the armature, curves may be plotted separately for each.

These currents will not be in phase, the zero value of that on the direct-current side taking place before the alternating current supplied to the slip-rings passes through zero. This condition causes an irregular wave form which has a peak top. When plotted it gives a wave, shown in Fig. 54. It will be noticed that when the alternating current has reached the value (a), there is a sudden drop, which nearly reaches zero. At this point the alter-

nating current which is entering through the slip-rings (except a small portion of it), passes directly to the commutator brushes.

The effective value of the current which is taken from the direct-current side is evidently made up of maximum values of the alternating-current wave. The effective value of the alternating electromotive force supplied is therefore .707 times that of the direct current. This relation does not hold true for a three-phase machine, but will have a value .613 times the direct-current side. These values are not always found to be exact in practice, the cause being due to a number of inherent conditions, such as

(a) Irregular wave form of alternating-current supply.
(b) Position of direct-current brushes on commutator.
(c) Field excitation.
(d) Distortion of field flux.
(e) Drop in armature.
(f) Conditions of regulation.

INFLUENCE OF FREQUENCY.

Rotary converters cannot be built for high frequencies except very serious mechanical difficulties be removed. The limit of frequency is due solely to these mechanical difficulties, which apply particularly to the commutator. When a machine is designed for a certain frequency there must be a limiting value for the peripheral speed of the commutator. The nature of the commutator is such that the speed limit must be kept well within the range of safety.

The general dimensions of a commutator are determined by the voltage and the output. The voltage between segments in well-designed machines is limited to about 15 volts. The greater the frequency the greater will be the number of poles, and (other things being equal) the greater also will the voltage of the machine become. Therefore, more segments will be needed in order to maintain a safe difference of potential between segments. This of course will increase the peripheral speed of the commutator beyond its safe limit.

Rotary converters are built for frequencies as high as 60 cycles, but they are large for their output, and hence costly. High-frequency rotaries would therefore be so costly as to prohibit their use, not considering the mechanical objections involved. Rotary converters may be started in exactly the same manner as synchronous motors. They may also be started from the direct-current end, and after synchronism is attained may be put into normal condition with the supply circuit by means of suitable switches.

[To be continued.]

New General Manager of Chicago City Railway.

The directors of the Chicago City Railway Company have unanimously chosen Mason B. Starring as general manager of the company to fill the place made vacant by the resignation of Captain Robert McCulloch some two months ago. Mr. Starring is not a technical man; he is a lawyer; but his 16 years' experience with the company of which he has been chosen general manager has made him familiar with its needs and its possibilities. He will make no sudden changes, but will attempt gradually to place the company's system on the most efficient basis possible under existing conditions. Should a satisfactory franchise ordinance for the company be passed and accepted, he says it would be but a short time before he would have a modern power plant in operation, equipped with the best and most improved machinery.

MASON B STARRING.

Mr. Starring was born in Chicago in 1859. After graduating from high school he entered steam railroading and was general baggage agent at different times for both the Pennsylvania and Burlington roads. In 1895 he opened a banking and mercantile business for himself in Calmar, Iowa, but was only moderately successful. After two years he returned to Chicago and on January 15, 1888, entered the employment of the Chicago City Railway Company as clerk in the office of Charles B. Holmes, who was at that time president, superintendent, general purchasing agent and several other things.

When the late George H. Wheeler was made president of the company in January, 1891, Mr. Starring was transferred to the office of Julius S. Grinnell, general counsel of the company. Here he studied law under Mr. Grinnell and William J. Hynes and was admitted to the bar. Upon the death of Mr. Grinnell in June, 1898, Mr. Starring remained as counsel for the company. On May 12, 1904, he was elected general manager and assumed the duties of his office at once. Mr. Starring has been with the company through a number of administrations. He has a keen, active mind, and his knowledge of the company's affairs, long experience, personal popularity and executive ability justify the confidence which the directors have placed in him.

Mr. Starring is a member of the Chicago Club, Chicago Athletic Association, Washington Park Club, Calumet Club, Lake Geneva Country Club and a local yacht club. With his wife and two sons he resides at 568 East Division Street, Chicago.

New Officers of the Institute.

At the annual meeting of the American Institute of Electrical Engineers, which was held in New York on May 17th and 18th, John W. Lieb, Jr., of that city was elected president of the association. The new vice-presidents are W. E. Goldsborough of St. Louis, John J. Carty of New York and Samuel Reber of Washington, D. C. G. A. Hamilton of New York was re-elected treasurer and Ralph W. Pope of New York secretary. Henry G. Stott of New York, Louis A. Ferguson of Chicago, J. G. White of New York and S. S. Wheeler of Ampere, N. J., are the newly elected managers.

JOHN W. LIEB, JR., PRESIDENT-ELECT OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

John William Lieb, Jr., the new president of the Institute, was born in Newark, N. J., on February 12, 1860. He attended the Newark Academy and the Stevens High School, Hoboken, N. J., and later graduated from the Stevens Institute of Technology in 1880 with the degree of mechanical engineer. In 1880 he engaged as draftsman with the Brush Electric Company in Cleveland, Ohio, and upon leaving there entered the employment of the Edison Electric Light Company, New York, in 1881, as draftsman. A year later he was transferred to the experimental department at the Edison Machine Works. Here he assisted in the tests of the first "Jumbo" direct-connected Edison dynamos, and Mr. Edison put him in charge of the installation of the electrical equipment of the old Pearl Street Edison station, under the direction of Mr. C. L. Clarke, chief engineer. While employed in this station Mr. Lieb assisted in the tests and experiments incident to the starting up of this pioneer station, the first commercial station in the United States supplying current for incandescent lighting and power from an underground system. Upon the beginning of regular service, September 4, 1882, under the auspices of the Edison Electric Illuminating Company of New York, he was appointed first electrician of the company.

A syndicate of Italian capitalists, with Professor Colombo as technical adviser, having purchased a complete equipment of boilers, engines, dynamos and Edison underground system for Milan, Italy, Mr. Lieb was selected by Mr. Edison to direct the installation. The Milan station, equipped with Babcock & Wilcox boilers, six 150-horsepower Armington & Sims engines and Edison "Jumbo" dynamos, began regular service in 1883, and Mr. Lieb remained in charge as manager on the organization of the Italian Edison Company. He was appointed in turn its chief electrician, director of stations and chief engineer in general charge of the technical department of the company, engaged in manufacturing electrical apparatus, installing isolated plants and constructing and operating lighting and power stations throughout Italy.

The company to which Mr. Lieb belonged was among the very first to exploit the alternating-current system, beginning with a plant in Milan, Italy, in 1886, and using also the Thomson-Houston arc system extensively. Mr. Lieb's last work in Italy was in the electric-railway field in connection with the installation of the trolley system in the city of Milan.

When offered an appointment with his old company—the Edison Electric Illuminating Company of New York—he returned home in 1894, acting at first in the capacity of assistant to the first vice-president, and advancing by steps to third vice-president and general manager. On the consolidation of various lighting interests in New York city, under the corporate name of the New York Edison Company, Mr. Lieb was appointed third vice-president and associate general manager, which position he now holds. He is also president of the lamp-testing bureau and director in several electrical corporations.

Mr. Lieb is a member of council of the American Society of Mechanical Engineers, member of the American Society of Civil Engineers, past-president of the Association of Edison Illuminating Companies and the New York Electrical Society, second vice-president of the National Electric Light Association and a member of a number of national and foreign technical societies.

Death of General Hickenlooper.

The death of General Andrew Hickenlooper last week took away one of the stalwart business men of Cincinnati and a conspicuous figure in the lighting industry. General Hickenlooper started in life as a poor boy, his birthplace being Hudson, Ohio. Going to Cincinnati when quite young, he entered the city engineer's office. Three years later he was city engineer. When the Civil War broke out he enlisted and it was not long until he was promoted. His record at Shiloh placed him in high regard, and on the march to the sea with Sherman he won still further laurels. At the end of the war he was honored with the title brevet brigadier-general. In 1872 General Hickenlooper was made vice-president of the Cincinnati Gas Light and Coke Company, and five years later succeeded to the presidency. In 1901 he combined the lighting interests of the city under the name of the Cincinnati Gas and Electric Company, remaining its president until May, 1903, when he resigned on account of ill health and was succeeded by Norman G. Kenan. General Hickenlooper was elected lieutenant-governor of Ohio in 1879 and served one term, but declined re-election. The remainder of his life had been devoted to business.

ANDREW HICKENLOOPER.

At the meeting of the National Electric Light Association which was held in Cincinnati in May, 1902, General Hickenlooper was very hospitable and welcomed the members of the association to the city in a happy speech. In speaking of the wonders accomplished by Aladdin of the oriental tale, he called attention to the fact that these wonders were accomplished by the genius of the lamp and of the ring—both of which might be considered to have an electrical significance—the lamp in a self-evident sense and the "ring" in humorous allusion to some of the operations of central-station companies.

While president of his company General Hickenlooper always made it a point to keep in close touch with the electric-lighting end of the business and was an indefatigable worker. He was an all-round fighter and never could be induced to compromise upon any measure. In this way he fought the battles of his company and almost always won. He was a member of the Loyal Legion.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

National Electric Light Association (annual meeting), Hotel Vendome, Boston, May 24th to 26th.

American Society of Mechanical Engineers and the (British) Institution of Mechanical Engineers (joint meeting), Auditorium Hotel, Chicago, May 31st to June 3d.

Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.

Canadian Electrical Association (annual meeting), Hamilton, Ont., June 15th to 17th.

High-pressure transmission convention of the American Institute of Electrical Engineers, Chicago, June 21st and 22d.

Indiana Mutual Telephone Association (annual meeting), Lafayette, Ind., June 28th and 29th.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

NEW ZEALAND, as a field for electrical enterprises, is commanding increased recognition, and although in electric light and traction it is only of recent years that the country has become a factor of importance, the movement along these lines is now becoming so general that it appears as if the people there are striving to make up for lost time. In order to understand the progress that is being made in New Zealand in electrical undertakings, it is instructive to note the amount of capital that has been authorized by the colonial parliament in the last few years for electric power. This authorization of capital for electric undertakings began in 1891, and from that time until 1900 the growth was slow but of a substantial nature. After 1900, however, a fresh impetus seemed to have been given, and from that date until the present time it is to be noted that no less than 14 different corporations and municipalities have been granted power to borrow sums of money ranging from $20,000 to $972,000. The total amount of capital which has been authorized since 1900 reaches the sum of $4,393,440. This is certainly a creditable showing, and one that may have a particular interest to exporters of American electrical apparatus.

GOVERNOR ODELL of New York has vetoed the Niagara, Lockport and Ontario power bill. No bill that has been before the Legislature of New York state in several years has commanded such general attention, not only in the state, but from people outside of the state. In 1894 the Niagara, Lockport and Ontario Power Company secured a charter from the state which allowed it to furnish pure and wholesome water to the city of Lockport, as well as to generate and sell electricity in the counties of Niagara, Erie and Orleans, the plan being at that time to build a surface canal from a point about 12 miles above the Falls to a gully west of Lockport. A decade of years went by and no move was made toward the development, and at the last Legislature the company sought to have its rights continued and also greatly enlarged, giving it privileges throughout the state. There was a fierce opposition to the bill, in which the New York State Reservation commissioners at Niagara, many private citizens defending the scenic attractions at the Falls, and the existing Niagara power companies, took part. Nevertheless the Legislature passed the bill, which now, however, fails to become a law owing to the governor's veto.

In vetoing the bill, the governor gives several reasons for so doing. The first is the lack of compensation to the state. But his second reason is that the great cataract has an esthetic value which cannot be disregarded. This is a vexed question at Niagara—the moral uplift of the grandeur of Nature versus industrial utility; and what Mr. Odell has to say on the subject is of general interest and worth quoting.

Niagara has been and is still the mecca of all those who delight in scenic beauty and wonders. Thousands of people, from all over the world, annually visit it, and among those who are actuated perhaps largely by sentimental reasons there has arisen the fear that the constant inroads that are being made upon it under charters heretofore granted may result eventually in its destruction. True it is that engineering skill has established to its satisfaction the conclusion that this proposed company would not materially injure the beauty of the Falls. On that question there is a serious difference of opinion. If the result, however, would be less harmful than those who seek for the preservation of the Falls believe, it certainly would lead, or rather be an excuse for other companies that would in time produce the results which are feared. I am of the opinion that, however much we may discount and depreciate the interference of the sentimental with the practical in life, that we cannot get away from the fact that this sentiment is not one of retrogression, but of constant progression in civilized life. There is due to it, therefore, the same consideration which should be given to all practical affairs of life. This seems to me to be a second and fully as important a reason for objection to approval of this measure.

Thus the Nature lovers in the continually recurring Niagara controversy have gained a powerful ally. It would, indeed, be a serious question whether the loss would not be greater than the gain if all the water of Niagara Falls were diverted to turn the wheels of industry. Fortunately, no such drastic alternative is now presented. With the quantity of water now taken from above the Falls by power canals multiplied several times, Niagara Falls would still be a stupendous spectacle.

BOSTON central-station practice has many features to interest the electrical visitor. Perhaps the chief of these are to be found in the L Street station, where a steam-turbine plant with 5,000-kilowatt units is under construction. The turbines are four-stage, rather than two-stage as at Fisk Street in Chicago, and they will be the first of that type and size to be installed. At this writing we believe the first turbine is still to be shipped from the factory, but even if visitors are not afforded an opportunity to see the machine, there are many other things about the station of quite exceptional interest, such as the coal-handling arrangements, the provision for condensing water and the elaborate and carefully worked out methods of switching. The older station at L Street is in itself a modern installation, if anything in power-house design can be modern that is a year old. At Atlantic Avenue, too, the Edison company has a fine, large generating station and a System of Distribution Building, from which many lessons can be gained. There are a number of sub-stations, and the methods by which many scattered and diverse electric-light plants are being absorbed into one compact, efficient system are of great interest. In the present issue Mr. John S. Browning describes this great central-station property, and we are sure that the readers of the Western Electrician—both those who go to Boston and those who stay at home—will find this article of value and of interest.

ELABORATE preparations have been made for the twenty-seventh convention of the National Electric Light Association, to be held in Boston next week. A programme has been prepared that is pressed down and running over with timely papers, practical reports and helpful departmental features. A great wealth of material has been provided, and it is difficult to see how all of it can be presented to the association and discussed in a three-day convention. However, there is sure to be much valuable discussion, and all of the literature will be available for future study. While it will be an impossibility for every delegate to assimilate all the information and data gathered for the convention, each one can specialize on the features in which he is more directly interested and gain much benefit from the meeting. Especial interest will attach to the report of the committee appointed to investigate the steam turbine and to the prize paper on underground construction, for which Mr. Henry L. Doherty will award a gold medal.

At Chicago last year the estimated attendance was 850, and in Boston, situated in a comparatively densely populated region, it will not be surprising if the number of delegates and visitors reaches a thousand or more. The association has enjoyed a prosperous and successful year and has materially increased its membership. It now embraces a greater proportion of all the central-station companies in the country than at any time in recent years, perhaps a larger percentage than at any time in its history. Under the energetic leadership of President Doherty a great uplift was given to the organization at the Cincinnati convention of two years ago, and this progressive forward movement has been continued with zeal and intelligence under the administrations of President Ferguson and President Edgar. The society is now wideawake, active and useful—exercising its influence not only at convention time but throughout the whole year. Mr. Edgar has given much of his valuable time to advance the usefulness of the association during the year, and unless all signs fail he will be greeted by such a large and enthusiastic assemblage of electrical men in his home town next week that he will feel repaid for his untiring exertions.

Electricity in a Cotton Mill.

Some interesting facts concerning the use of electricity in cotton mills are contained in a paper by E. W. Thomas, read before the New England Cotton Manufacturers' Association in Boston on April 28th. The paper contains descriptions of cotton mills which use electrical power throughout. One of these, located at Columbia, S. C., contains 57,000 spindles. The following paragraphs are taken from the description of this plant and from the general conclusions of the writer:

The mill is driven electrically from power obtained from a waterpower company not owned by the mill, the power being purchased at certain price per horsepower per year, the cost being based upon the meter readings at the mill. The power plant is located about one mile from the mill and the same power company also furnishes power to three other mill plants as well as several other local industries.

The division of the machinery in this mill, in sections for each motor drive, is as follows:

The opener and breaker pickers are driven from an extended cardroom shaft, and the motor, which is of 150-horsepower capacity, drives also 103 cards and all the drawing frames. Six intermediate and six finisher pickers are driven by a 75-horsepower motor.

All of the roving machinery and 12 spinning frames are driven by a 150-horsepower belted motor. The balance of the spinning frames are driven by six 150-horsepower motors. The spoolers, warpers and slashers are driven by a 50-horsepower motor.

The weaving room by three motors:

1 of 150 horsepower driving 664 looms,
1 of 150 horsepower driving 574 looms,
1 of 150 horsepower driving 304 looms.

The cloth room, containing three sets of cloth-room machinery, is driven by a 20-horsepower motor, and one motor of 20 horsepower is located in the machine shop.

Tests made at this mill show that of the total power required the

Picking and carding requires	19.45 per cent.
Spinning requires	57.80 per cent.
Spooling, warping and slashing requires	2.22 per cent.
Weaving in cloth room requires	20.53 per cent.
	100.00 per cent.

Having had ample opportunity to carefully observe this form of drive for some time my conclusions are decidedly in its favor. It occurs frequently in most mills that certain parts of the mill are "out of balance" with other parts, and it may be readily seen that any section or department may be run independently from the others. When certain departments of the mill, say the opener room, picker room, or cloth room, have "caught up" with the work, the throwing out of a switch at the motor by the overseer stops the machinery in that particular department without in the slightest affecting any other department.

In the construction of the building no belt towers are required. No large heavy belts, no large headshafts, and the counter belting is materially reduced. The widest belt is but six inches. Owing to short lengths of shafting driven by each motor, one diameter may be used throughout the mill, which, as all mill men know, is of great advantage if changes are required in shaft pulleys.

Each motor has its cut-out switch near at hand as well as a duplicate one on the switchboard in the engine room or wheel room. This is an advantage, inasmuch as in case of fire or accident the shafting connected with any motor may be immediately brought to a standstill without the necessity of notifying the engineer or the electrician in charge.

There is one other very important advantage one has in having the electric drive, and that is the fact that the actual power required by the machinery on any motor may be known at any time, as an automatic-recording instrument may be applied to the wiring at the motor itself or at the switchboard in which a continuous record in ink or pencil is transcribed either upon a circular dial or upon continuous strips of paper.

By these records the variation in the power may be seen at a glance and the study of these variations and their connection with the different degrees of temperature, and the amount of humidity, is most interesting. Oils may be tested on shafting and machinery and the results of the different makes compared. The tell-tale dial, or strip, shows to the manager another very important feature, and that is whether or not from start to finish of the working forenoon or afternoon the machinery on the motor was all in operation the whole of the time.

Records have been obtained where it was shown that when the starting time of the mill was 6:30 in the morning the full amount of machinery was not running until 7 o'clock, and the same record shows a dropping off in power from 11:30 to 12, showing that the employes were neglecting the work, preparing to leave for the noon hour. The engineer or electrician may have on his switchboard in the power house wattmeters for each motor, and can at any moment see at a glance whether any motor is running in excess of the normal power required.

It must be allowed that this is much more satisfactory than the present "guesswork" of trying to obtain the power required for any one room or department or class of machines from indicator cards from the engine, where, when it is desired to obtain the power required for any one room or class of machines, in most mills it is necessary to run all the shafting in the mill unless there are cut off couplings provided. It is also evident that in case of any accident but a minimum portion of the machinery is stopped. The slashers in the mill are operated through the noon hour so as to avoid stopping any slasher during the running of a set of warp beams.

An interesting point, I think, that is of important advantage is the uniformity of speed obtained by the machinery in the mill.

Many mills have been equipped with this form of driving, and not only have installments been made in newly built mills but a large number of mills, whose motive power was generated by steam or water, have changed their system and now use electric drive to their great advantage. To the person building a new mill and contemplating adding to its capacity later by extending the mill out at either end, the problem has no terrors; he simply extends his mill, places in his motors and extends his wires from the original generating plant, and his work is done. If he incorporates direct-belt driving in his new mill at the start he must necessarily be forced to install shafting of a larger size than is necessary for the first section of the mill in order to have it of sufficient strength to carry his contemplated extension.

To the manager and the manufacturer who is so unfortunate as to have a group of mills bunched together in an unmethodical system and so built that from no one unit of power can the requisite distribution be obtained, except by a large amount of shafting and belting, then the ability to wire from the central electrical power plant to his various buildings relieves him from a burden at once.

To the manufacturer having a waterpower, the advantage of locating his mill elsewhere than immediately adjacent to such power may be of material advantage. It is not a question today of locating the mill buildings at the water side, but contrariwise, distance from power plant to mill is becoming less a factor as the years go by.

Thus in many ways does electric driving open up advantages for a closer study of the power question, and indirectly to provide some means of determining some of the reasons why the percentage of possible productions of the machinery is so low in some of our mills.

Electric-railway Tests at St. Louis.

A full meeting of the executive committee appointed to determine the nature and scope of the electric-railway tests to be made at St. Louis and elsewhere during the coming summer was held in St. Louis recently. The committee consists of Professor W. E. Goldsborough, chief of the Department of Electricity, Universal Exposition, chairman; Professor H. H. Norris, Cornell University, superintendent of electric-railway tests; Professors B. V. Swenson, University of Wisconsin, and H. T. Plumb, Purdue University, assistant superintendents.

After careful study of the reports of the engineering committees, of the suggestions of the advisory committee, and of the excellent facilities afforded by the exposition officials, the executive committee decided to undertake the following series of tests:

1. Tests on the Service Capacities of Electric-railway Motors.—Equipments will be operated upon the special tracks, in order to determine the heating of the motors under conditions approaching as nearly as possible those of commercial practice.

2. Acceleration tests upon single cars and upon multiple-equipped trains will be made to determine the ability of the equipment to bring the cars to speed quickly and economically.

3. Braking tests upon single cars and multiple-equipped trains will be conducted in order to determine the quickness of action, the shapes of the braking curves, the relation between the braking forces and the applied pressures and the best methods of application of the braking forces.

4. Determinations of the resistances due to the rails, to the journals and gearing and to the air will be made by systematic and complete series of runs. The effect of the shape of the car body will be carefully investigated.

The actual work of observation and calculation will be carried on under the personal supervision of the superintendents by a corps of young men carefully selected from among the graduates of leading technical schools, the total number of observers being between 30 and 40.

Official Inspection of World's Fair Exhibits.

On Thursday, May 12th, President Francis, the executive committee, Director of Exhibits Skiff and other exposition officials made an inspection of the exhibit buildings of the exposition, ending at the Palace of Horticulture, where luncheon was served. It is said that in all of the buildings, with the exception of Machinery Hall, they found the installation over 90 per cent. complete. At the entrance to each building the party was met by the chief, who escorted the president through the building. An unfortunate accident to the high-tension mains supplying the Palace of Electricity prevented the operation of the many working exhibits which had been prepared for the inspection. Over 30 exhibitors were in readiness when the inspecting party entered the building, but as no current was available, their displays attracted little more attention than those less complete, or inoperative.

Testing Meters in Small Plants.

[From the Question Box of the Iowa Electrical Association.]

QUESTION.

What is the simplest and most practical method of testing meters in a small to medium-sized plant?

ANSWERS.

Enterprise Electric Light, Heat and Power Company, Garner, Iowa: By using a stop watch and formula, or have one standard meter connecting meters to be tested up with it.

Marengo Electric Light and Power Company, Marengo, Iowa: By bringing them to the plant and testing them on a rack with a meter known to be correct.

Humboldt Electric Light and Power Company, Humboldt, Iowa: Put up a second meter in series and leave it for a night—second meter known to be correct.

Jefferson Light, Heat, Power and Water Company: A satisfactory method of testing meters that we have used has been with a good portable voltmeter (which every plant should have) and a bank of incandescent lamps. The exact watts consumed at normal voltage by each of these lamps had been previously determined by the use of an indicating wattmeter. I had no wattmeter of my own but took advantage of the opportunity whenever a lamp salesman was in town to check up the readings of the lamps. By using a table showing watts consumed at various voltages the watts consumed by the lamps can be readily determined with the aid of the voltmeter. I have found it preferable in most cases to test meters in service without bringing them to the plant. This can be done without disturbing the customer's lights or apparatus in the least. Temporary connections can be made around the meter and the house wires removed from the meter after which the bank of lamps can be connected up, making the only load on the meter. The revolutions per minute can then be counted and by applying the proper formula in the usual way fairly accurate results can be quickly obtained.

J. G. Boyd, Sioux City: With indicating watt and voltmeters.

Union Electric Company, Dubuque, Iowa: By comparing speed of meter to be tested with that of a standard meter, both meters being connected on the same load and in such a manner as not to register each other's losses; this is preferably done in the company's test room so that the standard meter need not be moved around.

What Is Alpha Secondary Current?

A subscriber of the Western Electrician in Winnipeg, Manitoba, asks the following questions: What is meant by alpha secondary current? How can direct or alternating current of 110 volts be connected to run electric bells?

It is doubtful if there is any such term as "alpha" secondary current in good use, at least it is not used in engineering literature as far as can be ascertained. Perhaps some of the readers of the Western Electrician have heard the term and know what it means. If so, a definition will be gladly received.

In relation to the bell connections, the obvious method is to connect the bell to the 110-volt circuit through a resistance. The ordinary signal bell will, however, operate only on direct current. The writer does not mention what the bells are for, but if they are for door bells or the like, by far the simplest method is to use a few cells of primary battery for current in the usual manner. Some types of intercommunicating signal bells, however, are used for certain purposes, and these are often connected to the lighting circuit, which is done through a suitable resistance.

Large Turbine Engines for the New Cunarders.

Actual trial has proved the steam turbine to be a success on the smaller classes of vessels, but its adaptability to large vessels has yet to be demonstrated. The Cunard Steamship Company is about to build two mammoth steamships for passenger service, and, it is said, will install steam turbines for motive power. The new ships are to be 800 feet long and 85 feet beam, with a minimum draft of between 33 and 34 feet, on which dimensions they will have a displacement of about 40,000 tons. The contract will probably require that the new Cunarders develop a speed of 25 knots on trial and a sustained sea speed of 24½ knots an hour. No less than 75,000 horsepower will be developed on four shafts. On the outer pair will be the high-pressure turbines. On the inner pair the low-pressure, and also the go-astern turbines. The coal consumption will be over 1,000 tons

Method of Detecting Electrical Oscillations.

Electrical oscillations may be detected through the change which they produce in the hysteresis of iron as was discovered several years ago by Rutherford and later adapted by Marconi to his telephonic detector.

Alteration in hysteresis by a method differing from that of Rutherford has been produced by Dr. J. A. Ewing of the Royal Naval College, Greenwich, and L. H. Walter of London through the application of a principle embodied in an instrument invented by them some time ago for the mechanical measurement of hysteresis. The method is described by these two gentlemen in a paper read before the Royal Society last February.

In the original instrument the hysteresis is measured by the mechanical couple between a magnetic field and the iron, when either the iron or the magnet providing the field is caused to revolve. Thus, if the field revolves, the iron tends to be dragged after it, as a consequence of hysteresis in the reversals of its magnetism, and if the motion is prevented by a spring or other control, it assumes a deflected position. Suppose, now, the electric oscillations to act on it, any change of the hysteresis caused by them will be exhibited by a corresponding change in the deflection. It was anticipated, in accordance with the generally accepted view that hysteresis is reduced by the oscillations, that their presence would be detected by a fall in the deflection.

With this expectation, an experimental apparatus was arranged, consisting of an electromagnet, capable of being rotated on a vertical axis by an electric motor. The magnet poles were bored out circular, and between them was suspended, by a phosphor-bronze strip, a ring made up of three thin, flat annuli of soft iron, clamped together, and provided at the foot with an axial pivot. The ring was free to turn inside of two bobbins wound with fine copper wire, the windings being at right angles to the plane of the ring. Through these copper windings, electrical oscillations, produced in the usual manner by means of a distinct spark gap, were passed.

The first experiments resulted in a very small deflection from the position due to normal hysteresis, indicating, as was expected, a decrease of hysteresis when the oscillations arrived. The apparatus was also tested with an alternating current of about 100 periods a second in place of the oscillations, with the effect that the normal hysteresis deflection was almost entirely wiped out.

Various other forms were also tried, with indifferent results, when it occurred to the experimenters that there would be advantages in passing the oscillations through the magnetic material itself, making it of magnetic wire. A small bobbin was therefore wound with insulated soft-iron wire, and the ends soldered to the upper and lower halves of the spindle, which was itself divided at the center, the upper half bearing the controlling spring, and the lower dipping into mercury, from which a connection led to the other terminal. On passing oscillations through this winding, a remarkable and unexpected result was obtained. The change of deflection was much more marked than in the former experiments, and was in the opposite sense, indicating an increase of hysteresis, while oscillations were present. Afterward hard steel wire was substituted for the soft iron, and a very great increase in the effect was observed, still in the same direction—that of increase of hysteresis.

Owing to these encouraging results, it was decided to continue the experiments in this direction, abandoning the older form, in which a decrease of hysteresis was dealt with. The first bobbin constructed was about five-sixteenths inch in external diameter, and had a vertical wire space of one-fourth inch. The winding was a single No. 32-gauge iron wire, double cotton-covered, wound straight round from beginning to end. Later, No. 40 and No. 46 steel wires were employed, of which the latter gave the best results.

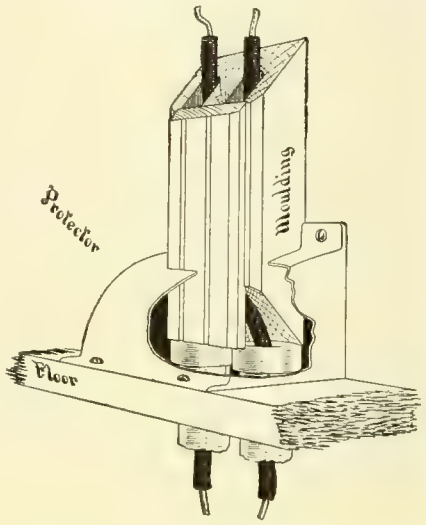
It was soon noticed that any method of increasing the oscillatory current in the wires, as by winding the bobbin with two wires having a slightly unequal number of turns, was of advantage in giving a larger deflection. Later a fine copper wire secondary, wound on the bobbin parallel to the magnetic wire, was tried, first with the ends insulated, and then with the ends soldered together. A marked increase in deflection was observed when the secondary was closed, showing that the magnetic nature of the wire itself was influential. Accordingly, a bobbin was then wound with insulated steel wire, doubled back on itself. This non-inductive winding gave by far the best results hitherto attained, and is now used, except when special results are required.

The instrument, though described as a detector of electrical oscillations, may be said to measure rather than detect, giving quantitative as well as qualitative results, and being capable of regulation from a sensibility of the same order as that of an average coherer down to practical insensibility to powerful sparks in the same room.

For the purpose of wireless telegraphy the instrument has the advantage of giving metrical effects. From the physical point of view the augmentation of hysteresis is interesting and unlooked for. It is probably to be ascribed to this, that the oscillatory circular magnetization facilitates the longitudinal magnetizing process, enabling the steel to take up a much larger magnetization at each reversal than it would otherwise take, and thus indirectly augmenting the hyteresis to such an extent that the direct influence of the oscillations in reducing it is overpowered. The net result appears to be dependent on two antagonistic influences, and, in fine steel wire, under the conditions of the experiments, the influence bringing about increased hysteresis, as a result of the increased range of magnetic induction, is much the more powerful.

Gleason Tube Protector.

The Gleason tube protector, manufactured by John L. Gleason of 290 South Street, Boston, as its name implies and as shown in the accompanying cut, is designed to protect insulating tubes from mechanical injury where passing through floors in connection with so-called "molding work," and also to furnish sufficient area and concealment for splicing at junction of ceilings and partitions where an ordinary miter joint would not cover the splices or conceal the breakage of woodwork or plaster caused by boring for tubes. These protectors are made of cast iron,



GLEASON TUBE PROTECTOR.

japanned for use at floors, and can be furnished of sheet metal to match the fixtures used on the ceilings. Provisions are made for recesses opposite each other to admit two strips meeting at right angles on the angle protector, if desired.

Protectors in stock are for three sizes of moldings taking wire from No. 14 to No. 6 B. & S. gauge. More than one strip of molding may enter one protector from the same direction if desired, by specifying the required opening. The letter "A" indicates that the protector is for a two-wire molding and "B" that it is for a three-wire molding.

A Breakdown Test of the Nernst Lamp.

For the purpose of demonstrating the stability of the Nernst lamp before officials of the Pennsylvania Railroad Company a test was made not long ago in the laboratory of the Philadelphia Electric Company, and the following is taken from the report of the test:

A six-glower, 210-volt Nernst lamp was supplied with new ballasts, heaters and glowers, and connected in circuit. The energy consumed by the heaters only, when the lamp was connected to a circuit of its normal rated voltage (210 volts) was 280 watts. The voltage was increased in steps of 10 volts, and the amount of energy consumed by the lamp at start and after burning five minutes was as follows:

Volts.	Start Watts at	Watts at the End of Five Minutes.	Per Cent Increase.
210	582.4	588.0	0.0
220	641.6	630.0	4.7
230	683.2	652.4	9.5
240	728.0	694.4	14.3
250	784.0	767.2	19.0
260	896.0	896.0	23.8
266	974.0	.	26.6

After the voltage was increased to 240 volts, the ballasts showed signs of deterioration and started to blacken slightly.

After the voltage was increased to 250 volts, the center ballasts were a deep black color, with a blue tinge.

After the voltage was increased to 260 volts, the ballasts were so hot that the glass bulged, and the ballast wires were badly distorted. All of the ballasts were very black, but the glowers were in good condition. The wire in one ballast broke after being in circuit four minutes; another broke at the end of the fifth minute, two more at the end of the sixth minute. The two outside ballasts broke at the end of 8½ minutes. When the fifth ballast broke the heaters all cut in on one glower.

Further tests were made by burning the lamp at its normal rated voltage, and then subjecting it to an instantaneous increase in voltage, with the following results:

Condition No. 1.—The lamp was supplied with new ballasts and started at 210 volts, and after the heaters were automatically cut out and the lamp burning under normal conditions, the voltage at the lamp terminals was increased instantaneously to 250 volts, or a 19 per cent. increase. The ballasts showed no signs of deterioration.

Condition No. 2.—The lamp was started at its normal rated voltage, and then the voltage at the terminals of the lamp was increased instantaneously to 360 volts, or a 71.4 per cent. increase. The ballasts were open-circuited. The same ballasts, heaters and glowers were used as in "Condition No. 1."

Condition No. 3.—The lamp was then supplied with new ballasts only. It was started at its normal rated voltage, and then the voltage at the terminals of the lamp was increased instantaneously to 300 volts, or a 42.8 per cent. increase. The ballasts showed no sign of deterioration.

Condition No. 4.—The lamp was then started at its normal rated voltage, and the voltage at the terminals of the lamp was increased instantaneously to 315 volts, or a 50 per cent. increase. The ballasts showed no signs of deterioration. The same ballasts, heaters and glowers were used as in "Condition No. 3."

Condition No. 5.—The lamp was started at its normal rated voltage. The voltage at the terminals of the lamp was then increased instantaneously to 325 volts, or a 54.7 per cent. increase. The same ballasts, heaters and glowers were used as in "Conditions No. 3 and No. 4." The ballasts were all open-circuited and had a slight dark tinge.

Condition No. 6.—The lamp was then supplied with new glowers, heaters and ballasts complete. The lamp was started at its normal rated voltage. The voltage at the terminals of the lamp was then increased instantaneously to 325 volts, or a 54.7 per cent. increase. The ballasts were all open-circuited and slightly blackened.

Mr. Baker of the Nernst Lamp Company and Mr. Proud of the Pennsylvania Railroad Company were present at the test.

Electrically Illuminated Signs.

The exposed location of an electric sign calls for a substantial waterproof and weatherproof construction in which, preferably, only metal is used. Metal roof signs in all sizes and styles have been designed in novel ways and are constructed by the Haller Machine Company of Chicago, and estimates are furnished by this company, including statements in regard to the operating expenses.

The metal letters (Fig. 1) are furnished to fit a well-designed angle-iron supporting structure, which can be readily mounted on the roof. Any local electrician can splice the wires from the letters to the service wire, and the local electric-light companies are, as a rule, willing to furnish specially low rates for this purpose.

There is always more or less demand for transparent (glass) signs needing comparatively few lamps. The Haller Machine Company has constructed a variety of tasteful transparent signs, set

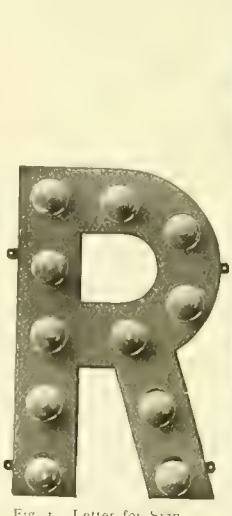


Fig. 1 Letter for Sign Work

Fig. 2 Type of Transparent Sign.

ELECTRICALLY ILLUMINATED SIGNS.

in all-metal frames and metal boxes of beautiful proportions and more or less elaborately decorated by embossed and raised-metal ornamentations of attractive designs and finished in gold, silver or colors. Like their other electric signs, the transparent signs are fire, water and weather proof, strong and durable, and yet light in weight.

The sign represented here (Fig. 2) is only one sample of the many artistic and novel designs from which the above company furnishes transparent signs.

Mayor Harrison has presented a new car-license ordinance to the City Council of Chicago which is to replace the one which expired last July and which has been renewed from time to time pending final settlement of the franchise question. The ordinance provides a license of $50 a year for every car and a fine of $75 to $200 a day for every violation. The council is to take action at its next meeting.

The Young Automatic Block-signal System for Electric Railways.

No one familiar with electric railroading can doubt that a thoroughly efficient signaling system is greatly to be desired. Interest attaches, therefore, to an examination of the "Young system," exploited by the Pneumatic Signal Company of Rochester, N. Y., and named after S. Marsh Young, the manager of the electric-railway department.

The theory of many signal engineers has been that on electric lines, inasmuch as the two traffic rails are used as the return for the 500-volt direct current, and are of the same potential, it is impossible to provide a track circuit of low voltage. The working out of a method by which a continuous track circuit could be furnished to govern the signals on an electric line forms the basis of the system to be described.

It will be readily understood that it is impossible to keep two direct currents of different potentials separate on the same conductors. If, however, one introduces a current of a different characteristic, such as an alternating current, to perform one of two given functions, and if proper apparatus is supplied to keep each current from interfering with the apparatus designed to be operated by the other current, the track circuit becomes, it is said, feasible and practicable.

The apparatus must be so designed that it only becomes operative under the influence of one current, and will remain inoperative in the presence of the other current, and while it may be called upon to afford a path of no resistance to the direct current, it must prevent the passage of the alternating current. One current may be used to operate the car, and the other to operate a track circuit to control the signals.

On a direct-current road an alternating current is impressed on the direct-current line for signaling.

Local signal circuits pass through the points of these relays. Where there is no car in the block the track circuit is completed from the secondary of the transformers through one rail, through the relay and over the other rail back to the transformer. This circuit when completed holds the relay points closed, and closes the local signal circuit, which holds the signal to clear. The entrance of a car into a block short-circuits the transformer, thereby de-energizing the relay, and opens the signal circuit and causes the signal to go to danger. Any interruption to the track circuit from any cause will rob the relay of its current and will result in a danger signal.

(I J) and (I J) are insulated joints dividing the rail (X) into blocks corresponding to the signal locations. The rail (Y) is continuous. The rail (X) is made electrically continuous for the direct-current return by means of devices shown as (B_1) and (B_2) placed across the ends of the blocks. Their carrying capacity is the same as the capacity of the rail. Their arrangement and construction are such that they perform the reverse functions in the presence of alternating current and maintain the requisite difference of alternating-current potential between the two traffic rails of the blocks to operate the signal relays.

With a battery-track circuit as used on steam roads, if the leakage between the rails is excessive, owing to the limited output of the battery, the relay will fail to work and the signal will go to danger. This may occur during bad weather, when the leakage across the rails increases rapidly. This necessitates limiting the length of the blocks by the condition of the roadbed. Where alternating current is furnished from transformers, and there is an unlimited supply of current available, roadbed conditions which would prevent the use of battery-track circuit may be operated with satisfactory results with the alternating-current system.

YOUNG AUTOMATIC BLOCK-SIGNAL SYSTEM FOR ELECTRIC RAILWAYS.

On an alternating-current road a current of a different characteristic is impressed for signaling on the alternating motor line which operates the cars. The immediate demand is for signals on direct-current lines. Except in the relay there are no moving parts. The track is divided into blocks as it is on steam roads, although but one of the traffic rails is broken for block-signaling purposes.

The insulated joints employed to divide this rail are, however, bridged by electrical devices, which, while they offer a path of no resistance to the direct current (to return to the station), they effectively prevent the passage of the alternating current and make the operation of the signals in one block independent of those of adjacent blocks. The signal system in no way interferes with the usual arrangement or operation of the motor circuits.

Many efforts have been made to devise a system which would give a proper measure of protection, but they have necessitated the abandonment of one of the traffic rails as direct-current return.

In the diagram is shown the arrangement of apparatus employed to provide a continuous track circuit to govern the signals on an electric road. In the drawing (X) is the block rail, (Y) the common rail, (L) alternating-current transmission line, (AC) alternating-current generator in station, (1, 2, 3) three blocks, (T) transformer furnishing track-circuit current to Block No. 1, (T') transformer furnishing track-circuit current to Block No. 2, (R) relay governing signals (S), (R') relay governing signals (S'), (I J) insulated joints, and (B_1) and (B_2) electrical devices to make rail (X) electrically continuous.

The operation of the system is as follows:

In the station, or sub-stations, there is placed a small alternating-current generator of a special characteristic. As each block requires about 50 watts, a double-track road 15 miles in length with one mile blocks would require a two-kilowatt machine. A No. 10 copper wire is carried along the entire length of the road (at say 300 volts) for the alternating current. The return for this alternating current is through the rails. The alternating-current line furnishes current to the primaries of 100 to one transformers in each block, shown as (T) and (T'). The secondaries of these transformers are connected directly across the rails at the ends of each block. This furnishes the track-circuit curent to operate the relays (R) and (R'). At the entrance to each block there is connected directly across the rails relays (R) and (R'). These relays can only be affected by alternating current of the proper frequency. The relay-contact points are closed by a partial revolution of the armature. Direct current does not in any way effect the relay.

Aside from one alternating-current generator for the entire road and the signal mechanism, which may be of any desired form, the complete apparatus for each block consists of one 50-watt transformer, the devices employed to make the block rail continuous, and a relay, which is the only piece of apparatus containing any moving parts or contacts.

The system is so arranged that there is no possible combination or failure of parts that can produce a clear signal when a danger signal should be shown. Even the breaking down of the insulated joints between the blocks will result in the giving of a danger signal.

No amount of direct current from any foreign source can affect the operation of the system, and the presence of stray alternating currents will also fail to operate the relay.

Where electric motor-semaphore signals are used six small cells of storage battery are connected through a resistance to operate the signal motor. The battery also provides a reserve which will operate the signals during such time as the motor current may be off. The battery is charged with about one-quarter ampere continuously.

Incandescent lamps are used as a resistance to cut down the 500-volt trolley circuit to charge the battery, and these lamps may also be used in the signal lantern and to outline the semaphore arm.

Electrical Operation of Steam or Air Whistles.

Whistles for signal or other purposes may be operated by electricity through the use of a device manufactured by the Electrical Appliance Company of Cincinnati. The valve of the whistle is operated by a plunger, which is in turn moved by a curved arm hinged to the top of a solenoid casing. This arm is moved downward by the solenoid plunger when the coil is energized, opening the whistle valve.

The device operates any whistle up to three inches diameter at 150 pounds steam pressure, and when provided with larger valve will operate a six-inch whistle at the same pressure. The parts are of substantial construction and reliable under exacting conditions. Electrically operated whistles are almost a necessity in many large plants, such as steel mills, ship yards, lumber yards, etc. They are also a most satisfactory adjunct to private-branch telephone exchanges, as they enable the operator to signal a call to anyone whose exact location may be unknown. Various local uses will readily suggest themselves to steam engineers.

New Cooper Hewitt Lamps.

The Cooper Hewitt Electric Company of New York has just placed on the market an improved form of its mercury-vapor lamp for the use of photographers. The essential improvement consists of mounting the lamps in a frame that is tilted in the vertical plane, instead of in a horizontal direction, as in previous types. This enables the lamp frame to be placed against the wall, and economizes space. The outfit as illustrated (Fig. 1) comprises four tubes. The two middle tubes are connected in series and can be used for printing from small negatives, the whole four tubes being switched on for larger plates. As seen in the company's show rooms, the lamp frame rested upon a narrow shelf, and the lamps were started by tilting the frame against a small block of wood on the left. The parabolic reflectors in this apparatus are also improved, and when a sheet of ground glass is placed before the illuminated tubes it is impossible to detect the direction of the tubes, so even is the illumination. A negative, therefore, can be exposed quite close to the ground-glass screen and the time of exposure is decreased. The tubes are operated on direct current at 100-120 volts.

Fig. 1. Frame for Photographers

Fig. 2. Two lamp Frame

NEW COOPER HEWITT LAMPS.

It is interesting to note that one of these frames is now being used for demonstration purposes by Mr. W. C. Duryea of the Eastman Kodak Company, who travels about New York state with it, and uses it before audiences of professional photographers. In these demonstrations negatives will print on velox paper in from five to seven seconds, and on bromide paper in a little less than a minute.

Another new form just brought out is a two-lamp frame mounted upon an iron standard (Fig. 2). These lamps are started in the old way by tilting the top of the frame backward, thus allowing the mercury to form a temporary metallic circuit between the electrodes.

The Cooper Hewitt mercury-vapor lamps have an average life of from 1,200 to 1,600 hours, according to the length of the tube. Prolonged experiments show, however, that the lamps often exceed these limits. The company has kept a record of 10 lamps which have been burning continuously in its offices for various periods, and which, with one exception, are still burning. This record, in tabular form, is:

No. of Lamp.	Hours Since Starting.	Approximate Loss in C. P.
1	[illegible]	[illegible] Per Cent
2	5,500	10 "
3	5,100	10 "
4	4,200	7½ "
5	4,000	7½ "
6	*3,500	5 "
7	3,500	5
8	3,200	5
9	2,700	5 "
10	2,600	5 "

*This lamp gave out at 3,500 hours.

These lamps are all one-inch diameter tubes, 48 inches long, and of 750 candlepower, working at 100-120 volts and 3½ amperes. No. 6 is the only lamp so far (May 10th) that has burnt out, and that was at more than twice the average life.

Proprietors of pleasure resorts are taking up the mercury-vapor lamps with enthusiasm, for moonlight effects, etc., and also for providing a means of obtaining new color effects. Owing to the absence of red rays in the lamps, some very curious changes in the appearance of the costumes of lady visitors are brought about. Brown tints have a tendency to become green; dull yellows become brilliant, and reds appear as purple.

Ohio Telephone Notes.

The United States Telephone Company has taken another important step in providing extra service for its subscribers. Hereafter, through an arrangement made with the United States Weather Bureau, the reports received at Cleveland will at once be transmitted over the lines to all exchanges with which the company has connections. Subscribers may then call up and get the predictions at noon each day. The Weather Bureau service will thus be extended at the same time and will be that much more benefit to the farmers, fruit growers, stock raisers and others.

A contract has been made between the United States Telephone Company and the National Telephone Company of Wheeling, W. Va., by which an interchange of business will be made. The National serves about 12 good towns in West Virginia. The contract will become effective on July 1st. In order to connect the systems, the United States will build 25 miles of line. The wires of the Flushing and Belmont Telephone companies have been leased by the United States company and the system will be connected by building lines to St. Clairsville and Cadiz.

The testimony in the application of the Queen City Telephone Company for a franchise in Cincinnati has been concluded before Probate Judge Nippert. Some of the city officials testified as to the difficulty of placing another conduit in the street. Bayard Kilgour, manager of the Bell interests in that city, was called for the city and his own company. He stated that the average cost of a Bell telephone is $43.20 a year. The American Telephone Company holds 30 per cent. of the stock of the Cincinnati company and furnishes and keeps in repair all the telephones, for which it receives 4½ per cent. of the rental. Mr. Kilgour said he had never heard anything of the need of a second telephone system in Cincinnati. Experts said that, while the streets had many pipes and conduit systems of one kind and another in them, they did not see any great difficulty in placing another system. Arguments of attorneys will be heard, although Judge Nippert said he did not think he needed them. He believes the case will be appealed. It is said that the Interstate, Fitzsimmons and Cincinnati Telephone Companies have about completed their plans for a consolidation. If this is done and the Queen City does not see fit to come in, a three-cornered fight will result. Independent telephone men are, of course, greatly interested in the fight that is taking place, but at the same time they do not see the necessity for more than one company of that kind in the field, and feel that the Independents there are making a mistake in not getting together on some plan.

An experiment was made at Genoa a few days ago with barbed-wire fence as a means of transmitting telephone messages. Instruments were attached a quarter of a mile apart, and conversation could be carried on very satisfactorily. Captain M. D. James, Lieutenant Fred Wachter and Sergeant Ford Wilkinson of the Toledo Signal Corps made the experiment.

The Summerfield Telephone Company of Summerfield has been incorporated with a capital stock of $5,000. J. H. Sparling and others are interested.

The Perry Telephone Company, Perry, has been incorporated with a capital stock of $10,000 by J. H. Brown, W. W. Cook, F. G. Sokeid, E. W. Orcutt and others.

June 2d has been chosen for a meeting of the Independent telephone men of the state at Columbus. The committee met at the Chittenden Hotel in that city a few days ago and decided upon the date. C.

Telephone Progress in Kansas.

The Western Independent Telephone Company, which comprises nearly all the Independent companies in Kansas, Oklahoma and Missouri, has given a mortgage to the amount of $1,500,000 to the Commonwealth Trust Company of St. Louis. The mortgage covers all the toll lines in this territory and the money will all be used to repair the lines and build new ones.

All operators of the Missouri and Kansas Telephone Company employed at Atchison, Kan., struck recently for an increase of $5 a month, which they received. The linemen have also gone out but have not received an increase.

Members of the Kansas City Commercial Club who were touring over western Kansas and Oklahoma last week had their train equipped with 11 long-distance telephones, furnished by the Missouri and Kansas Telephone Company and connected to a private switchboard on the train in charge of D. Cook, W. M. Johnson and F. C. Simpson of the company. A clear circuit was opened for their use by district managers at Hutchinson, Harper, Anthony, Chickasha, Enid, Blackwell, Arkansas City and Coffeyville.

It is announced that the Wichita Telephone Company, which has 2,300 subscribers in Wichita, will extend its lines to Hutchinson and Wellington, putting in, besides a copper toll circuit, rural lines from town to town.

The Supreme Court of Kansas has reversed the decision of Judge Pollock in which he held that a telephone company must secure the consent of farmers along whose farms it constructs pole lines. Chief Justice Johnson wrote the opinion in which he says: "The construction and maintenance of telephone lines on a rural highway is not an additional servitude for which compensation must be made to the owner of the land over which the highway is laid." K.

Telephone News from the Northwest.

The Iowa Telephone Company will put in a conduit system at Keokuk, Iowa.

The Union Telephone Company will build three rural lines out of Page, N. D.

The council of Winona, Minn., has granted a franchise to the Bell Telephone Company.

The Hutchinson (Minn.) Telephone Company is rebuilding its line to Bear Lake.

J. F. Mager and W. J. Camden will install a local exchange at Walhalla, N. D.

The Farmers' Telephone Company will install a switchboard with 500 capacity at Dallas Center, Iowa.

The Dakota Central Telephone Company has been granted a franchise at Ethan, S. D., for a local exchange.

G. G. Candee has sold his telephone exchange at Drayton, N. D., to John Scott, the change taking effect on June 1st.

A modern telephone system will be installed at Portage, Wis., with conduits for the business section of the city.

The Enterprise Telephone Company is stringing wires for a new automatic exchange for Motley, Minn.

George M. King has received the contract for laying about 60,000 feet of conduit in West Des Moines for the Mutual Telephone Company of Des Moines, Iowa.

A consolidation is about effected of the Hillsboro, Duance, Caledonia and Shelly and the Traill County telephone companies, with headquarters at Hillsboro, N. D.

Dr. W. B. Scott has secured a franchise to build a telephone line connecting Grinnell, N. D., with Hoffland, Nesson, Ray, Polege and Stordahl.

The county board of Mankato, Minn., has ordered all the Northwestern telephones withdrawn from county buildings except one at the jail. The Citizens' Telephone Company's instruments are to be installed.

The Stromberg-Carlson Telephone Manufacturing Company has furnished supplies for the construction of the Belgrade and New London (Minn.), the Lake Andrew and the Irving and Eastern telephone lines as well as the New London local exchange.

The Northwestern Telephone Exchange Company has secured quarters in Lake City, Minn., for an individual station. The Tri-state Company connects with the local exchange and the former declares that if it cannot get business from Lake City in any other way it will build a city system.

The following new telephone companies have recently been incorporated: Rogers Telephone Company, West Union, Iowa; College Springs Telephone Company, College Springs, Iowa, by O. Slough and others; Clark and Foster Telephone Company, Rice Lake and Wells, Minn.; August Miller is president. R.

Indiana Telephone Items.

The Bloomington Home Telephone Company of Bloomington has filed articles of incorporation. The capital stock is $150,000. The company will build a new exchange in Bloomington and construct telephone lines throughout Monroe and adjacent counties. J. D. Showers, W. D. Bradfute, E. L. Barber and Q. C. Montieth are the incorporators. Another new incorporation is the Farmers' Mutual Telephone Company of Owen County. The capital stock is $10,000 and the directors are E. F. White, Philip Hauser and S. H. Alverson of Spencer, Ind.

The telephone war at Flora has been brought to a close by the organization of a new company. A new plant will be established as soon as material can be secured. Dr. W. E. Callane is president and A. G. Crosswhite secretary.

Telephones have been installed by the Louisville and Southern Indiana Traction Company at all its stations and sidings between New Albany and Jeffersonville. The system has greatly facilitated the movement of the cars and enables the train men to keep in touch at all times with general offices in New Albany.

The franchise granted by the Board of Public Works at Evansville to the Citizens' Telephone Company has not yet been ratified by the council. The franchise provides that the company shall pay the city $105,000 and furnish service to the city offices and fire department. There is considerable opposition to ratification on the ground that there is danger of a dual system or service and that more money could be gotten for the franchise if offered to the highest bidder.

Considerable preparation is being made for the annual meeting of the Indiana Mutual Telephone Association, which is to be held in Lafayette on June 28th and 29th. The indications point to a large and profitable meeting. The Lohr Hotel will be headquarters, and leading manufacturers and supply men have already applied for display accommodations. An excellent programme, consisting of papers and discussions, has been prepared and a series of entertainments arranged. The electric and mechanical departments of Purdue University will be visited and also the Sterling Electric Company's plant. The officials of the Sterling Electric Company are especially active in the interest of the convention and are sending out a facetious invitation to all telephone men to attend the meeting and accept of the hospitality being provided.

The Telephone in Texas and Mexico.

The Phœnix Telegraph and Telephone Company has been organized, with principal office in Houston, Texas, for the purpose of building and operating telephone lines in a large number of counties of the northern and eastern parts of the state. The incorporators are J. M. Smith, Lorenzo Hills and A. L. Hills.

The Gertie-Webb Telephone Company has been organized at Webb, Texas, with a capital stock of $2,000 for the purpose of constructing a telephone line. J. H. Miller is one of the incorporators.

D. A. Walker of Columbus, Ohio, and associates have purchased the exchanges of the Tyler Telephone Company and the Globe Telephone Company of Tyler, Texas. The exchanges will be enlarged.

A report has been made by the state government of Sinaloa, Mexico, showing that there are 1,058 miles of telephone lines in operation in that state. A new telephone line has been constructed between the port of Topolobampo and the town of El Fuerte, along the Kansas City, Mexico and Orient railroad.

A telephone line is being built between Zamora and Chavinda, Mexico.

A new telephone line is being constructed between Opichen, state of Yucatan, Mexico, and the town of Celentur in that state.

A company is being organized at Culiacan, Mexico, for the purpose of installing a new telephone exchange and to build and operate long-distance lines throughout the state. H.

Double-winding Cut-off Relay.

It has been proposed to supply a telephone line with a low-wound cut-off relay and a high-wound line relay in the line circuit, so that when the subscriber calls the central station sufficient current will not flow to operate the low-wound cut-off relay, but is ample to operate the high-resistance line relay, and when the operator plugs in in response to the call additional current is sent through the low-wound relay to operate it to cut out the line relay. In such an arrangement, however, a low-wound relay is connected between one side of the talking circuit and ground or the office return, which might be said to be an objection, or the marginal difference of resistance between the line relay and the cut-off relay is so small as to tend to cause trouble.

In a new system recently patented by W. W. Dean of Elyria, Ohio, the low-resistance relay is dispensed with, and instead, a cut-off relay is inserted having two windings, one of the windings having, preferably, a low-resistance winding and the other, preferably, a high-resistance winding, the former being normally in the line circuit, while the other is normally cut out or short-circuited and only thrown into the circuit when a connection is established with the line, as by the operator in connecting for conversational purposes. In this way instead of the low resistance in the grounded branch, the full resistance of both coils of the relay or the high-wound coil is inserted.

Under these conditions the ground or common-return branch from one side of each subscriber's line exists; but each includes both windings or the high-resistance winding of the cut-off relay, and is therefore impervious to speech waves and does not hinder or affect the conversation over the metallic line. When the subscribers return their receivers to the telephone hooks, the relays in the cord circuit are de-energized and close the circuit of the lamps to indicate to the operator that the conversation is terminated and the connection may be pulled down and all parts restored to normal condition.

GENERAL TELEPHONE NEWS.

The Mark West and Santa Rosa Telephone Company has been organized at Santa Rosa, Cal. Service will be given between San Francisco, Mount Olivet and Mark West. A franchise has been petitioned for and will be granted at the May meeting of the supervisors. At Santa Rosa connection will be made with the long-distance lines of the Sunset Telephone Company. The officers are: President, Rapheal Peterson; secretary, John M. Laughlin; treasurer, Harry Hall.

The suit of the Western Electric Company against the North Electric Company of Cleveland, relating to alleged infringement of the Warner drop (telephone) patents has been decided in favor of the North Electric Company by Judges Lurton, Severance and Richards in the Sixth United States Circuit Court of Appeals at Cincinnati. The case was an appeal by the Western Electric Company from the decision of the lower court on April 5th in favor of the North Electric Company. The present decision is final.

Independent Telephone Men on an Inspection Trip.

In planning a trip to Chicago for the purpose of purchasing some new equipment for the Pittsburg and Allegheny Telephone Company, President J. G. Splane and Vice-president and General Manager S. H. Brown of the Pittsburg company arranged to engage a special car and invite a number of prominent telephone men of Pennsylvania and West Virginia to accompany them and make the trip the occasion for a general inspection of Independent telephone systems in the Middle West. The party was completed and last week a delegation of 14 gentlemen left Pittsburg. They visited Cleveland, Toledo and Grand Rapids and arrived in Chicago on May 11th. From Chicago they went to Kansas City and St. Louis, and returning went to Indianapolis, Louisville, Dayton and Columbus.

While the trip was primarily for the purpose of purchasing new material, still it is not denied that the possibilities and plans for the Independent telephone systems of the future were studied and freely discussed. With Chicago as a center it is possible that before long all the Independent systems between Kansas City and Philadelphia will be connected. This may be followed later by connections with the New England states and the Far West.

The party was composed of J. G. Splane, S. H. Brown, J. B. Hoge, H. B. Beatty, Senator William Flinn, Senator John A. Weller, Robert C. Hall, D. P. Reighard, Roger Williams, H. M. Hall, T. G. Davis, G. T. Braden, H. M. Nichols, John V. Ritts and T. P. Mifflin.

In Cleveland they were the guests of President F. S. Dickson of the United States Telephone Company and J. B. Hoge of the Federal. President Dickson said the object of the trip is to arrive at some plan for bettering the service and uniting the interests of the long-distance companies under a traffic arrangement that will be of advantage to the companies as well as give a better service all over the territory covered by the lines of the several companies.

At Toledo the exchange of the Home Telephone Company was inspected. The visitors were taken in charge by Clarence Brown, Ed L. Barber, J. E. Brailey, William Hardee, J. S. Brailey, M. I. Wilcox, R. E. Hamblin and General Manager C. E. Stinson, who took the party through the local plant and entertained them at the Toledo Club. Incidentally it should be stated that Mr. Stinson has recently been placed at the helm of the Toledo plant as general manager. His excellent record at Rochester, N. Y., as engineer and executive and his good work in the matter of the promotion of the reorganization of the Stromberg-Carlson interests are now matters of history to Independent telephone people.

During the inspection at Toledo Ed L. Barber was interviewed and said: "There is an idea prevalent in the East that the Independent telephone movement in the Middle West does not amount to much, and that the Bell people have everything their own way out here, the same as in the East. In the East, you know, the Bell people had ruled so long and had become so thoroughly entrenched in their position that capitalists were afraid to oppose them, and hence it was no easy matter to work up the Independent sentiment. The idea of this trip is to give them an object lesson in the progress of the Independents and to form a closer alliance with the Pittsburg and Allegheny lines. Of course we do not expect any immediate results from the trip other than a more fraternal feeling and a greater spirit of co-operation among the Independents. We can now compete with the Bell in every respect except in the long-distance service, and when our plans are completed we will have a service equal to theirs. The project is a big one, and it may some day eventuate into an absorption, but at the present time the idea is only to help one another in our long-distance service. We have an association now of six large cities, and when this new project is completed our lines will extend from Philadelphia to Kansas City."

The visitors were much pleased at the excellence of the Toledo plant with its 8,000 subscribers. The party then left for Grand Rapids, Mich., where the fine new automatic exchange of the Citizens Telephone Company was inspected.

Arriving in Chicago the visitors were taken in charge by H. D. Critchfield of the Automatic Electric Company and President Wheeler of the Illinois Tunnel Company. The tunnels and automatic telephone exchange of the Illinois Tunnel Company were inspected with great interest and were the subject of much favorable comment. The factory of the Automatic Electric Company was also inspected. Asked about the object of the visit, President Splane of the Pittsburg and Allegheny Company is quoted as follows: "We shall do for the Independent telephone companies what other corporations have done in consolidating and unifying different railroad companies. We have not decided what we shall call the corporation or the amount of its capital stock, but it is an assured fact." Another gentleman in the party is quoted as saying that the Standard Oil Company is back of the Pennsylvania and Allegheny, and it will back the new company.

From Chicago the trip was continued to Kansas City and St. Louis. Indianapolis was reached on the return trip and the visitors were entertained by H. B. Sale, who accompanied the party to Louisville, Dayton and Columbus. President J. A. Armstrong and Mr. J. D. Powers of the Home Telephone Company of Louisville entertained the party while in Louisville.

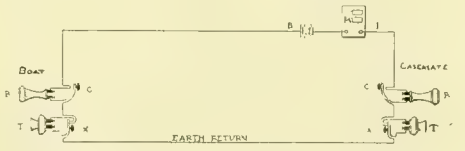
Boat Telephone Used in Laying Submarine Mines.

Communication between the mining casemate and the detail at work on the water, planting submarine mines or testing a system of mines already down, may be established by the use of an ingenious boat-telephone set which is described in the Journal of the United States Artillery.

The set was designed by Captain C. F. Parker, artillery corps, chief of the electrician sergeant's division at the School of Submarine Defense. Upon recommendation of the torpedo board the set has been adopted by the chief of artillery and will soon be ready for issue to posts supplied with a submarine-mine equipment, replacing the present type of boat telephone which has been in service some time and which is heavy, complicated and unsatisfactory.

This set has been designed with a view to simplicity, lightness and to withstand hard usage, and is practically waterproof. Two telephones (interchangeable), one interrupter (buzzer), and an earth plate constitute a set. When set up the system will consist of one telephone, interrupter and battery on the shore and one telephone in the boat connected in series through the core of a submarine cable, the circuit being completed through earth. Either storage battery or primary cells, wet or dry, can be used.

When not in use the current is through both receivers, the transmitters being shunted out. To call, the operator presses the call (black) button; this shunts out the caller's receiver and the lessened resistance causes the interrupter to vibrate, giving a loud buzzing in the other receiver. To cut in the transmitter, the transmitter (white) button is pressed and the current is through it, both receivers and the interrupter.



BOAT TELEPHONE USED IN LAYING SUBMARINE MINES.

The transmitter will be of the granular type, of solid-back construction.

The receiver is of the watch-case pattern, the receiver and transmitter being connected by a rigid handle of such shape that when the receiver is held to the ear the transmitter is convenient to the mouth. The call and transmitter buttons are located in this handle, the transmitter button being so located that it is pressed inward and the transmitter circuit cut in by the ordinary grasp of the hand in holding the instrument to the ear. A flexible silk cord about six feet long is permanently attached to the back of the transmitter for connecting the instrument to the line.

Each telephone is provided with a case of heavy oak-tanned leather, hand-sewed throughout, with leather hinged cover, the inside being stuffed to fit the shape of the telephone, with strap for slinging attached.

It will be noted that this telephone is on a closed circuit, but it should be emphasized that the instrument is not designed nor would it ever be required for long-continued use, being set up only when the boats are on the water, laying and connecting cables or testing cables already down, for a few hours at the very most, at any one time. With a charged storage battery or fresh dry cells the circuit would not be weakened during the short time a set would be in use. The advantage of the closed circuit is that it obviates the use in a small and unsteady boat of a magneto box and bell whose action may be seriously impaired by a dash of water, or by being dropped in the boat.

Ozone for Infant Incubator.

Infant incubators have become recognized as a valuable agent in the rearing of feeble infants. One of the prime factors requisite is, of course, air of absolute purity. Ozone, as is well known, is a powerful germicide and this fact has been made use of by George H. How of Chicago in an infant incubator which he has recently patented. He uses a static electric machine, the spark gap of which is located inside the incubator. The discharges between the terminals produce ozone in the interior which is said to be productive of many beneficial effects. "This allotropic form of oxygen, while stimulating physical growth and development in the infants, exercises a soothing effect and tends to induce healthful sleep. In addition, it is an active oxidizing and germicidal agent and serves to sterilize the atmosphere, rendering innocuous such particles of organic matter or other deleterious substances as may find their way into the incubation chamber with the atmospheric air." At least that's what the inventor says.

The Pioneer Edison Lamp.

In view of the recently celebrated twenty-fifth anniversary of the birth of the commercial electric incandescent lamp, it may be interesting to recall that it was in the early spring of 1877 that the defects of electric lighting first enlisted Edison's abilities. In the succeeding 10 months much was accomplished, and the incandescent light assumed a practical aspect which commended itself to the attention of business men. The outcome of this movement was the incorporation in October, 1878, of the Edison Electric Light Company, with a capital of $300,000.

On October 16, 1879, Edison decided that he had reached conditions where he thought a carbon filament might be made into a lamp. A cotton thread was the first substance utilized, and a groove in the shape of a hairpin was cut in a nickel plate, the groove being just wide enough to hold the thread. This was placed in a small nickel mold and filled with charcoal.

Five hours were spent in carbonizing and cooking the mold, after which, upon taking the filament out of the groove, it was found to be of such extreme fragility that it promptly fell to pieces, even in such practiced hands as those of Edison's able co-operator, Mr. Charles Bachelor. Repeated experiments were attended by the same disastrous results until a late hour in the night of the 18th, when a filament was rescued intact from its miniature crematory, only to be again fractured in the act of securing it to the conducting wire.

There had been no sleep for the workers since the commencement of the experiment, on October 16th, yet so potent was the spell of inspirational genius that Mr. Bachelor at once yielded to Mr. Edison's frantic suggestion that they should make a lamp before they slept or die in the attempt. On the 19th several filaments were obtained, all of which broke in clamping; but finally, on the morning of the 20th, after many alterations in the clamping devices, a perfect specimen was secured.

In carrying this fragile substance, the focus of so many hopes, from the laboratory to the glass-blower building, a malicious zephyr whirled it from its fastening and reduced it to impalpable powder. Utterly unmanned by this misfortune and unhinged by insomnia and fasting, Mr. Bachelor rushed into the presence of his partner and delivered himself of the following despairing sentiment:

"Edison, it's gone, broken by the wind. I'm sick; I'm disgusted."

But on the morning of the 21st events assumed a more fortunate guise. A lamp was finally completed, lighted and eagerly watched by the 30 or more experimenters attracted by the unusual interest of the proceedings. Partially relieved by the success of the trial, Edison, Bachelor and some others took a few hours sleep, at the end of which time they were greatly elated to find that the lamp was still burning without any apparent waste of carbon. This delicate thread of light was anxiously watched for several days, after which Mr. Edison decided to raise the candlepower very high in order to see how long the carbon would resist the strain. A greater power was attained than the inventor's most audacious dreams had ventured to picture, and sustained through an anxious period of two days; then the soft glow faded and the tiny filament melted "Like the baseless fabric of a vision." This was the pioneer flame of the Edison incandescent light.—Cassier's Magazine.

Canadians Investigating Electric Smelting.

The smelting of ore by electricity is a promising application of the cheap electric power which is so abundant in Canada; and it was the possibilities in this field which prompted the Dominion government to send a commission to Europe to investigate electrothermic processes in development there. Headed by Dr. Haanel of the Geological Survey and C. E. Brown, E. E., the commission visited Sweden, where the electric smelting of iron is carried out upon a commercial basis, and also Germany and France. At Livet in the Pyrenees a sample lot of 90 tons of Spanish ore was put through for the benefit of the Canadian commissioners, who brought away samples of the pig iron, which was smelted, it is said, at a cost of $8 a ton. It was demonstrated here that both pig iron and steel could be made by the electrical process alone. Dr. Stansfield of Montreal, in a recent lecture before the Canadian Society of Civil Engineers, expressed his doubts as to the commercial advantages of the processes he had examined, except in cases where waterpower was very cheap, and where both the raw material and the market for the finished product were close at hand. Dr. Haanel, however, appears to be much more hopeful of the processes he investigated, and a favorable report from Mr. Brown will likely result in a demonstration of electrothermic processes in Canada in a practical way.

The Rio de Janeiro Light and Power Company was recently organized under the laws of New Jersey, and has as its purpose the reorganization of the gas company and the consolidation and improvement of the various street-car companies of Rio de Janeiro, Brazil. James Mitchell, an American electrical engineer located at Sao Paulo, Brazil, is at the head of the company.

Increased Central-station Output.[1]

By A. W. Zahm.

The topic that has been assigned to me is one that is of the utmost importance to every central-station manager. This is especially true when the increased output also broadens the peak. In other words, it is of importance that you get a diversified class of business which is in use for a considerable period each day. Central-station load curves usually show a very pronounced peak during a very few hours each night. This, of course, necessitates capacity sufficient to take care of this peak for a very short period, and a large portion of the machinery is idle for nine-tenths of the time. If a class of business can be secured that will be used during this period of idleness, it is, of course, the most profitable class of business; hence a very low rate can be made for this current, regardless of the purpose for which it is to be used. It is customary for all central-station companies to make an especially low rate for power, but the fact is often overlooked that there are certain classes of lighting and certain other uses for electric current which are likewise entitled to an especially low rate; hence it is often quite a problem to ascertain the correct rate for certain classes of lighting without unfair discrimination against other consumers.

The field for increasing the output is practically divided into four different classes—general illumination, power, decorative or advertising lighting and heating. An equitable rate affecting all classes of consumers using current for lighting is the maximum-demand rate, and this, when properly applied, will take care of one of the greatest difficulties in handling large consumers. A merchant using a very large amount of light for but a short period each night is, of course, not as profitable to the central station as a consumer using a small amount of light for a considerable period each night. I would therefore suggest as a base rate for commercial lighting a rate of 20 cents a kilowatt for the first hour's maximum demand, based upon 30 days each month. For the second hour's use, or the first turning point, I would suggest a rate of 10 cents, and for the third hour and over, I would suggest a rate of five cents. The sum total of the above rates to be subject to a discount of 10 per cent. for payment on or before the 10th of the month. For churches, opera houses, etc., I would suggest a rate of 10 cents. This is in view of the fact that they use a large quantity of light for but a short period, and this at a time when you can best afford to supply it, as the demand is not made until after 8 p. m., when the peak has already dropped off. For residence lighting the above rate could not prevail, because the lights in a residence are seldom if ever all turned on at the same time; hence the householder would derive no benefit from the above rate. For this class of lighting I would suggest an arbitrary turning point, charging $2 for the first five lights installed and 10 cents for each additional outlet. Thus a residence having 15 lights installed would have a turning point of $3, and it has been found in practice that this is a fair and satisfactory rate for this purpose. By a little figuring you can readily see that the commercial rate would likewise be very just to all classes of consumers, for a merchant burning his lights an average of two hours a day would have an average rate of 13½ cents net. By burning them an average of three hours a day, his net rate would be approximately 10 cents; four hours, nine cents; five hours, eight cents; six hours, 7½ cents, etc.

Electric power consumers have been most eagerly sought after by central-station companies, and the field for this work has been constantly increasing. We find that a great many central-station companies are furnishing electric power for city pumping, and are doing so at a lower rate than the former cost to the city where the same power was used. Electric motors are also being extensively used for operating refrigerating plants. This is a splendid field, in view of the fact that a like amount of power is used for a period of from 18 to 24 hours each day throughout the summer months, whereas the load drops off during the winter months at times when the central-station company's output is working to its utmost capacity on the lighting load.

There are a great many new devices that are daily being placed upon the market requiring a small amount of power to operate them. None of these should be overlooked, as they are apt to run up into the consumption of large volumes of current in the aggregate if they are properly pushed. I would suggest that the merits of all power-consuming devices be carefully looked into and that circulars descriptive of these devices be mailed to each person interested. It is often possible in this way to create a considerable demand for them.

One central-station company recently instructed its solicitors to push the sale of blacksmith's blowers, requiring one-eighth horsepower each. These were installed on a flat rate of $2 a month. In 30 days time the company installed over 75 of these blowers in one town, making the increased gross revenue over $150 a month.

Some electric motor companies are making a specialty of applying their motors to certain classes of machinery, one motor house having specialized printing machinery, another laundry machinery, still another metal-working machinery, and so on. By getting correct data from these manufacturers as to the cost of operation, you can oftentimes interest persons that had never before given the matter of electric power a thought. Flour mills, planing mills, machine shops and foundries are now being extensively operated by electric power, and although it is oftentimes necessary to give these large consumers especially low rates you can do so at a profit in view of the fact that the power required by them is practically uniform throughout the day and is being used at a time when there is a minimum demand for other purposes.

There are a great many objectionable classes of power consumers, chief among which is the electric elevator, which, on account of its constant fluctuating load, is apt to cause flickering and dissatisfaction from your light customers. The revenue derived from this class of power is likewise very small as compared to the amount of power required to operate them.

I would suggest a rate for power purposes as follows: Ten cents a kilowatt-hour for the first hour's maximum demand; five cents for the second hour's maximum demand, or the first turning point, and three cents a kilowatt for all current used in excess of this amount, the sum total of the above rates to be subject to a discount of 10 per cent. for payment on or before the 10th of the month.

The field for decorative and sign lighting is comparatively new, but one that is especially profitable, and every effort should be made to increase your current consumption for this purpose. A special effort should be made to induce merchants that close their stores at six o'clock to keep their windows properly lighted until 11 or 12 p. m. This should properly be classed as advertising, and merchants that have tried it will agree with you that it is one of the best means of advertising. As an incentive for merchants to keep their window lights burning, I would suggest two methods: That no account be taken of window lights in figuring the maximum demand (thus insuring the minimum rate at all times) or that the lights be installed on a flat rate controlled by a time switch. As the cost of a time switch is considerable, I would suggest that they be rented to the merchant at from 25 to 50 cents a month. Where borders of four-candlepower lamps are installed in show windows, I would suggest a rate of 25 cents per light per month and for 16-candlepower, a rate of 75 cents per light per month, the lights to burn from dark until midnight.

Of course, I would not advocate these rates for any other purpose than for window lighting, decorative lighting or for electric signs. The great disadvantage of electric signs has been that they have used a very large amount of current, which made them prohibitive in the small cities. Recently, however, a number of new electric signs have been placed upon the market which are very effective for advertising purposes and can at the same time be operated at a very small cost per month. An electric sign recently placed upon the market by a St. Paul concern requires but 14 10-candlepower lamps for an eight-foot sign, 10 10-candlepower lamps for a six-foot sign and eight 10-candlepower lamps for a five-foot sign. All of the signs are double-faced and can be read for a considerable distance. It has now become quite a general practice for central-station companies to buy electric signs and install them for merchants on a yearly contract, the merchants to pay for the same in monthly installments, which brings electric advertising practicallly within the means of every merchant. The St. Paul Gas Light Company is installing five-foot electric signs equipped with eight 10-candlepower lamps at the rate of $10 a month for the first year, $4 of which is applied to the lighting account and $6 to the sign account. This company has installed over 100 of these signs within the last six months. The majority of these signs are controlled by time switches furnished by the central-station company at a rental of 25 cents a month. In the larger cities, foreign corporations oftentimes contract for electric advertising to permanently burn the brand of their goods in the public mind. Heinz's food products are a notable example of this, the proprietors having over 100 electric signs installed in various cities throughout the United States.

Electric heating has now become an important factor in the central-station output, and although this is largely confined to small individual heating devices, it will, if properly pushed and advertised, be a source of largely increased revenue to the central station. Manufacturers of clothing or hats find electric-heated pressing irons indispensable. A great many hotels have installed electric curling-iron heaters in every room in the house. Hospitals are using electric heating pads in place of hot-water bottles. A great number of hospitals in this state have also equipped their laundries with electric flatirons. The use of electricity as the sole cooking agent in a private house is as yet so infrequent as to be novel. This is largely due to the fact that the first cost of installation is prohibitive and the cost of operation is likewise considerably more than gas, now generally used for cooking purposes; however, disk heaters are almost indispensable in the nursery, as well as in all doctors' and dentists' offices. Griddle-cake bakers and toasters are used in a number of restaurants, and chafing dishes heated by electricity are far superior to the ones using an alcohol lamp. Ironing in the home by means of an electrically heated flatiron is becoming quite general. Only one iron is required, and the ironing can be done in less than one-half of the time than by any other method, as the iron remains hot at all times. Electric heating companies are constantly placing new devices upon the market. A number of gas companies have installed electric heaters around the suction pipe in their oil tanks to enable them to pump oil in extremely cold weather. Steam is impracticable for this purpose, as the condensation remaining in these pipes after the steam is shut off would oftentimes freeze. This requires a heater of about 15 kilowatts capacity, and, although used but for a very short period each day, is used at a time when there is little demand for lighting purposes.

During the last winter nearly every city in the country was troubled with frozen water mains and services These are readily thawed with an electric current, and, at the usual charge of from $7 to $10 an hour, make a largely increased revenue, even though it be for only a short period each year. Several central-station companies report that their gross revenue was in excess of $500 for thawing frozen water-service pipes during the last season.

In conclusion, I would say that it is necessary for every central-station manager to keep everlastingly at it. Judicious advertising will surely bring results. If your bills are mailed to your customers, enclose a folder descriptive of some new device each month. If you resort to newspaper advertising, it is policy to use cuts especially designed for this purpose and make frequent changes. Advertise the merits of every new device, and see what can be done with it. If found impracticable, do not get discouraged, for there are a great many thoroughly practical devices constantly being placed upon the market, which, if adopted by your customer, will be a source of increased output and increased revenue.

1. Paper read before the Iowa Electrical Association at Des Moines, Iowa, April 21, 1904. Mr. Zahm is general manager of the Brice Gas and Electric Company of Mason City, Iowa.

Electricity as a Substitute for Steam in Heavy Railroad Service.[1]

By Arthur M. Waitt.

The wonderful developments in electrical science and the rapid extension of the trolley lines throughout the country have caused many of the railroads to consider with more than a passing interest the possibilities and the practicabilities of electricity when applied to the heavy service now performed with steam in the transportation of passengers and freight to and from our great cities. It is with something akin to alarm that the managements of many steam roads have seen large inroads made upon their short-distance passenger traffic in the vicinity of their largest terminals by the successful competition of electric lines running lightweight cars at frequent intervals and at a reduced rate of fare. Like many innovations of importance on past prevailing practice, the use of electricity for transportation purposes has become a fad that has led to the construction of many lines which are entirely unwarranted by either the present demands of service or the probable future requirements for years to come. The annual reports of far too many of such lines show that in a very short time there is likely to be as large a percentage of such lines run by receivers as has been the case with the steam railroads of the United States within the last 10 years. Unfortunately for the stockholders, electric transportation lines, as well as steam lines, cannot be run successfully on sentiment, but need the hard-headed careful analysis and consideration that past experience has shown necessary to the successful establishment and extension of steam railroads.

With the advent of electrically operated lines has arisen an idea that it is not necessary to have expensive construction either in roadbed or in equipment; also that the many safeguards, such as substantial roadbed, strong bridges, careful alignment of track, modern safety signals and carefully prepared rules of operating are not so necessary with electric lines. Most absurd and unheard-of assumptions have been made regarding the speeds that can be obtained by the use of electricity as a motive power; as if the simple change in the propelling agent could entirely overthrow all the principles and experiences deduced from years of experience with steam as a motive power. Unfortunately many of those most prominent in advancing the claims of electricity for transportation purposes are men whose knowledge of electricity and the laws governing its use is large, but who are in most cases entirely devoid of practical railroad experience in handling heavy traffic in a congested territory. If there had been a larger percentage of thoroughly experienced railroad operators in the directorates and management of the proposed and constructed electric lines of the country during the last 10 years, many of them would never have been built and made candidates for a receivership, and those that were constructed would have been built and operated in a manner more likely to have produced permanency of ownership, creditable management, and good, reliable service, with possible future dividends to the investors.

In America, practically all the installations have been those using the direct current at a potential or pressure of from 500 to 600 volts. Most of the lines have made use of the third rail as having more advantages suited to their conditions than the overhead-wire and trolley systems.

In Europe, there is a greater diversity of practice than in America, and among the systems advocated

1. Condensed from The Railway Age. Mr. Waitt was until recently superintendent of motive power of the New York Central Railroad. He has recently returned from an extended trip abroad.

and used are the direct-current 500 to 600-volt trolley system; the direct-current 500-600-volt third-rail system; also a four-rail system, similar to the last named, but using a fourth rail midway between the running rails to take the return current. (This system is made almost compulsory in some districts of Great Britain by the Board of Trade restrictions, to prevent leakage of current, which causes electrolytic action on underground pipes, etc.) There is also the three-phase alternating-current system, requiring in the Valtellina (Italy) line two overhead wires and a roller contact, the potentials in the overhead wires feeding to the motors being 3,000 volts. There is also another three-phase alternating-current type installed on the high-speed test line between Berlin and Zossen, where there are three overhead wires at the side of track, one wire above the other, contact being made sideways by three separate poles. There is also being developed and experimented with, near Berlin, a short line, using a single-phase alternating current of 25 cycles and 6,000 volts, which is delivered to the car from a single overhead trolley wire.

Inquiry at home and abroad fails to bring out any figures showing any advantages in cost of producing power, by the substitution of electricity for steam, where the electric power has to be generated by means of steam engines, gas engines or steam turbines. There exist possibilities of some economy where feasible to obtain the generation of electric power by means of an ample hydraulic plant. It can, for the present, at least, be safely concluded that in cost of furnishing power there is no gain by substituting electricity. What advantages, then, are there? Primarily in the greater elasticity of the service; second, in the cleanliness of this mode of transportation, making it of especial adaptability for roads entering large cities, and also for underground and tunnel purposes. The elasticity of the service makes it especially adapted to the variations of suburban service from large cities, due to difference in amount of travel at different hours of the day. With steam it would be generally impracticable to run one and two-car trains at frequent intervals, say every 10 or 15 minutes. The number of locomotives required and the waste in the cost of operation would make it prohibitive. With electricity, with one-third or one-half the cars equipped with motors, the trains can be made long or short by the simple addition of an adequate number of motor cars to handle the idlers used. When a motor car is spare and stands idle, it is not eating up coal or water or requiring a hostler or watchman. The amount of power needed at any time is controlled with the greatest economy and with ease from a central station. With an elastic train service, with frequent short trains, the traveling suburban public may be much better served, long waits for trains avoided and travel made more a thing of pleasure instead of delay, dirt, smoke, cinders, crowding and discomfort that it too often is now.

Electric motive-power transportation is not all "a thing of beauty and a joy forever," for, in common with steam, it has its failures and disadvantages. Instead of "leaky boilers," "poor coal" and "low steam" will come "safety fuses burned out," "poor contacts," "short-circuits" and numerous other sources of failure, each productive of delay and possible derangement of the service. In winter, leakage of power from moisture and ice and from snow in contact with the live rail would seem from past experience to be frequently possible; for, so far, no entirely satisfactory cure for this winter disease has been found, although many means for mitigating the trouble have been tried with evident advantage. In a recent trip over the Milano-Varese-Porto-Ceresio third-rail line in Italy, it was the good fortune of the writer to be on the trains when a wet snow was falling, which stuck to the rails and partly froze on them. Though the live rail was cleaned by brushes, ahead of the contact shoes, and also by men sent along the line at frequent intervals to sweep the rails clean, yet the contacts were so poor that it was difficult to get sufficient current to keep the trains at half their schedule speed.

Inquiry among electrical engineers, both American and foreign, elicited the response that so far there had been no device brought out that would successfully overcome this loss of current and firework display, which is often so annoying and delaying under certain weather conditions in winter, especially on surface roads. Various expedients have been brought out to avoid this trouble, by means of wire brushes and steel scrapers ahead of the contact shoes, also by protective coverings over the live rails, but at times they all fail. They all require the running of cars so equipped at frequent intervals at night as well as day, whether business demands it or not, in order to keep the "live" rail clean. Inventors have proposed the use of an inverted third rail, the contact service being on the under side. This seems to have some advantages by being likely to be free from snow and sleet on the active surface, but, on the other hand, it calls for smaller clearance dimensions for equipment and makes a more expensive installation for the third rail. Advocates of the overhead wire and trolley systems claim for their method freedom from all such troubles, and they are largely justified in such claim. They also claim that the danger from contact with the "deadly live rail" is eliminated.

However, it seems like a choice between two evils, with the balance of advantage, for a heavy and frequent service, in favor of the substantial third rail, properly protected to prevent men or animals from inadvertently coming in electrical contact with the live rail. A trolley wire must be of copper, and for ordinary railroad suburban service, must be heavy, which means expensive. Copper wire wears more rapidly and would seem to require renewal and repairs with greater frequency than the steel rail. The wire would be in dangerous proximity to the trainmen when on top of the cars. The stretch of the wire would call for frequent adjustment, and unless a method of suspension was adopted, which would keep the feed wire absolutely level (which is quite expensive), there would be constant danger of broken wires and consequent harm to life and property. These reasons would seem to be sufficient to justify the adoption of the third-rail system in preference to the overhead-wire and trolley system, for general railroad purposes, except in places where the complications of terminal switching yards and the lack of an adequate third-rail application make it desirable from the standpoint of greater safety to switchmen to use a properly located and substantially supported overhead wire for such yards. The use of an inverted third rail, while possibly doing much to overcome the difficulties at times met with in winter, would have the disadvantage of greater expense of installation, lack of interchangeability of contact devices, together with restricting the clearance dimensions of equipment, in order to overcome a condition which, though causing great possible annoyance when it occurs, is confined to roads running in northern latitudes and is unlikely to be met with but a few times each year. In view of these objections, it would seem that a reasonably protected live rail, guarded against direct contact by stepping on it inadvertently, is the wisest design to adopt, emergency action being taken (even at a considerable temporary added expense), when necessary to remove the snow and ice which may interfere with the good service, a few times each winter, on some of the roads.

There exists in Europe, more especially, a great difference of opinion as to the most desirable voltage for use on heavy electric railroads. Happily, the strength of opinion is in favor of operating with a direct current at a tension of from 500 to 600 volts. In Great Britain the Board of Trade has limited the electric lines to within these figures. In Italy, on the Valtellina line, the three-phase current is generated at 20,000 volts, and is by means of stationary transformers stepped down to 3,000 volts, the working pressure. Near Berlin, a single-phase system is on trial which brings in to the car a current of 6,000 volts. Of course, with the use of such high tension, the use of the third-rail system for furnishing the current is, with our present knowledge, entirely impracticable on account of the danger to life from a live rail with such high voltage.

Special precautions have been taken, wherever extremely high voltages have been used, to reduce the danger to the life of operators and passengers to a minimum. Where the wires are brought into the cars they are thoroughly insulated and carried through metallic tubing, which is directly in continuous metallic contact with the ground, so that if there should be any leakage of current it would pass into the ground, and not be a source of danger. Precautions are also taken so that the roof and outside of the car is thoroughly grounded. Notwithstanding this and other precautions which have been taken, there still lingers in the popular mind, as well as the expert mind, a fear of possible catastrophe, for with these high-potential currents fed to the car from overhead wires there is danger of eventual breakage of the wire, meaning instant death to any person who might come in contact with it.

On some of the European lines using the extremely high-voltage currents, there have been several cases of broken feed wires. As a precaution against such breakage, on one of the leading lines using the high-voltage current, it is the practice to at once remove the trolley from the wire as soon as the current is shut off, so that there will be no strain or contact with the wire when the train is going into a station. After the train is brought to a standstill and before starting, the trolley is, by means of compressed air, put in contact with the wire again. This practice shows that even the most ardent advocates of the high-voltage system feel that there is a possible danger from broken feed wires. As referred to previously, there are many reasons in favor of a third rail for bringing the current to the cars, as against the overhead feed wires. If the conclusions are valid, this would, in the present state of the art, debar the use of the high-voltage currents.

The possibilities of unusually high speed have made the field of electric power for transportation purposes quite alluring. To demonstrate the practicability of high speeds the experimental line between Berlin and Zossen was equipped, regardless of expense, to deduce data in connection with high-speed running. It seems quite clear that in the beginning the advocates of electrical power had expected to show that speeds of 100 miles an hour, or over, were perfectly practicable. On this line the experimenters succeeded in reaching a maximum speed of 131 miles an hour. It was found that when the high speeds were reached the car ran very smoothly and was quite free from excessive vibration, the sensation being more like gliding on smooth ice, this condition existing after the maximum speed desired had been arrived at. In accelerating the speed of the car, of course, there was a very perceptible motion and vibration noticed. The result of these tests made between Berlin and Zossen has quite clearly demonstrated that for the present, at least, high speeds are not practicable. The necessity for an exceptionally heavy roadbed and an unusually high cost of maintenance, with the necessity for unusual care and expense in the maintenance of the equipment, together with the high first cost, show that, from a commercial standpoint, very high speeds are not likely to be successful for a long time to come.

On the basis of possible high speeds some very daring schemes have been proposed. Within a few years past a charter was asked for and granted by the British Parliament for the construction of an electric line between Liverpool and Manchester, which contemplated a speed approaching 100 miles an hour, it being the intention to make the run between the two cities in one hour's time. Schemes have been proposed for an air line between Chicago and St. Louis, to be run with electricity, in which the 100-mile-per-hour speed was considered feasible. The results of the German tests would seem to have clearly demonstrated that, for the present, at least, ideas of extremely high speeds must, from a commercial standpoint, be abandoned.

To one who has not had constant experience in running at high speeds on a locomotive it may be a matter of surprise to know that it is not infrequently the case that engineers hauling such high-speed trains as the famous Empire State express, in coming to a terminal station after a 140-mile run, are so completely exhausted and devoid of physical, as well as nervous strength, as to be hardly able to get down from their engines, this being especially the case where trains have been late and it was necessary to make extremely high speed. When it is realized that the average speed of the Empire State Express is considerably less than 60 miles an hour, it will be seen that the nervous strain upon an operator by increasing the average speed to, say, 75 miles per hour, would be almost beyond human endurance, at least for any great length of time, so that when high speeds are considered in the future the nerve endurance of the operators of trains will have to be given careful consideration.

At the present time it can safely be said that electricity for transportation purposes, as a substitute for steam, has a somewhat limited field. Its especial adaptability is for suburban traffic in the vicinity of large cities, where the travel is sufficient to warrant trains of from one to four cars being operated at intervals of one-half hour and less; for lines running underground or through tunnels, where the discomforts of steam, smoke and gas from locomotives make it desirable for a change of power; for tracks running through large cities, where smoke and noise are such a nuisance that they call for a remedy, and for short branch lines running from a main-line track that is operated electrically.

At present there seems to be nothing gained from the railroad operators' standpoint in attempting to handle long trains with electric power. Especial benefits come with short trains and frequent stops, owing to the possibility of much more rapid acceleration of trains where electric power is used than with steam. One important lesson should be drawn from the experience of some of the foreign electric lines during the last few years, which is this: That electricity should not be substituted for steam on any part of our railroad lines unless it is with the clear understanding of expending money for the best methods, the best materials and the best work possible. Economizing in first cost means danger to life, danger to property and reputation with greater certainty than where similar economies are practiced where steam is used. Where tunnel lines are operated it is necessary to use every known practicable precaution and safeguard that will prevent the possibility of such a terrible catastrophe as that which occurred on the Paris Metropolitan underground line less than a year ago. It is safe to say that if the principles of operation mentioned above had been carried out on this line, no such terrible disaster would have been possible. Good insulation of track and wires, automatic cut-out devices in the cars, automatic cut-outs for the track which would immediately cut out the current when there was a short-circuit on the line, together with a separate feed line for lighting the tunnel and a reasonable amount of good discipline and system will make a repetition of the Paris underground horror impossible. It is not unlikely that the development of the next 10 years in the establishing of hydraulically operated generating plants, making use of the power going to waste in many of the rivers of our country, will change the situation as regards the economy of generating of electric power, so that the field as a substitute for steam in railway service will be greatly broadened. In America as well as in Europe great work is being done in this direction, and there is reason to believe that in this direction there is opportunity for investment and development which will be productive of most satisfactory returns.

The proposed electric railway from Lewiston to Grangeville, Idaho, says Louis Dahl of Lewiston, one of the principal stockholders, is to be constructed at once, and $4,000,000 will be spent on the project. The road will serve the rich Camas Prairie country and also afford an outlet for the Buffalo Hump mining district. The present steam-railroad service in the district is said to be poor and many of the farmers have built tramways to the Clearwater River to send their products by boat. The road will be about 80 miles long and power will be developed from a natural waterpower on the Clearwater, near Mount Adams.

CORRESPONDENCE.

Great Britain.

London, May 7.—Considerable discussion is still taking place with regard to the Marylebone electric-lighting undertaking. It will be remembered that the Borough Council of St. Marylebone after being ordered to pay a large sum for the purchase of the electric-light undertaking of the Metropolitan Electric Supply Company in its district found itself legally unable to borrow the necessary money. After about three years of delay and negotiation parliamentary sanction has this year been obtained to borrow the money. The bill by which the local authority was empowered to do this also precluded it from entering into any working agreements for the lease of the undertaking except with the existing company. Negotiations have, therefore, been taking place with regard to a lease to the Metropolitan company, but nothing definite could be arrived at and the council has decided to proceed with its own scheme. It was estimated that if the company's terms were accepted a loss of nearly $200,000 a year would have been incurred compared with the estimates of the consulting engineer as to what can be done by carrying out a new scheme, taking into account the existing mains. It may be interesting to point out that the purchase price fixed by the arbitrator did not include a generating station, as this is situated some distance from the area. In any case, therefore, the council is obliged to erect a new generating station. An application is to be made to the courts for a further extension of time in which to carry out the purchase. It is also recommended that $2,000,000 be expended during the next two years upon the erection of a new power house, etc. It is expected that a supply will be then available by October, 1905.

Several decisions have been given by parliamentary committees during the last week which tend to have a considerable restrictive effect upon the electrical industry. The first is with regard to the gas company opposition to municipal electric-light undertakings—not a new opposition, it is true. The clause which is very often inserted in municipal bills is to the effect that the prices charged for electric light or the fares charged on tramways should be so arranged at the commencement of each year that the receipts should approximately be not less than the expenditure. Such a clause has been inserted in two bills this week. This is done of course to prevent the local authorities from running the undertakings at a slight loss during the first year or so in order to encourage patronage. Such clauses have been inserted in several bills in previous years, and usually a period of a year or two has been allowed before the clause became operative. In the two cases in question, however, this is not so. The clause comes into operation at once.

Another matter which brings the electric-lighting and gas industries into conflict is an application made by one of the gas companies near London to obtain a general power to claim compensation against anybody whom it may allege has caused damage to the gas company's mains by reason of the leakage of electrical energy. While it may sound quite fair that if one man causes damage to another man's property he should pay compensation, it must be borne in mind that the government itself has issued a set of regulations under which all electric tramways, for instance, have to work, and therefore the real attempt of such applications as I have mentioned is to alter the general law in their favor under the guise of a private bill. Luckily, as in this instance, they do not often succeed.

The District Railway Company, under the advice of Mr. Yerkes, is about to introduce a system of zone fares instead of the present system of so much a mile. The change, however, has met with some opposition, as many of the existing low short-distance fares will have to be increased in order to allow of the decrease in the long-distance fares. Under the new electrification scheme also only small handbags will be allowed as luggage, and in some quarters the advantages of a quick electric service are not deemed sufficient to compensate for the loss of facilities now given in the matter of luggage, etc. But the improved system will be adopted all the same.

One of the London omnibus companies has set aside $5,000 for experimenting with motor 'buses. Many attempts have been made to place a motor 'bus on the streets of London, but after a few trial trips nothing more has been heard of them.

The Croydon corporation (near London) is adopting the Nernst lamps for street lighting.

A bill has been introduced in the House of Lords by the government to amend the law relating to electric lighting. The present legislation in regard to electric lighting and traction has been severely commented upon for several years, and a bill was introduced last session dealing with the matter. It is to be hoped that the present measure will meet a better fate than the last one and not be crowded out at the end of the session. G.

New York.

New York, May 14.—With regard to the project of the Westchester Railway Company to lay trolley lines in the Borough of the Bronx it is suggested that the company should be bound to expend within two years the sum of $1,000,000 upon construction work. The company, however, has protested against this condition, and it is assumed that the project of the promoters is not so sincere as at first supposed and that the Port Chester scheme has a better chance for ultimate success.

Brooklyn critics are calling for something to be done speedily as to utilizing the new Williamsburg Bridge to full advantage for electric traction. The problem is to devise a plan so that the subway plans of the rapid transit commissioners can be harmonized with a scheme to make elevated loops to connect the new bridge with the old. The Brooklyn Rapid Transit Company, while anxious to come over the Williamsburg Bridge, does not see its way to order fireproof cars for use on a suggested Brooklyn subway, seeing that the subway portion of the new lines would only be one-fifth of the total route.

On Monday afternoon on the Third Avenue elevated road at Fifty-sixth Street there was a rear-end collision between two trains, resulting in the death of a motorman and severe injury to three passengers. A second rear-end collision occurred on Friday at Ninety-ninth Street on the Third Avenue line. Eight passengers were injured and two cars badly damaged. In this case the train overran its distance and was backed up to the platform without warning the following train.

H. H. Franklyn of Syracuse, N. Y., has just installed four Cooper Hewitt mercury-vapor lamps for his blue-printing department. A novel feature of this outfit is the provision of a means whereby a large printing frame formerly used for solar printing is utilized, and this is attached to the lamp frame in such a way that the frame need never be detached from its normal working position, and the lamps are started after the sensitive paper is in place.

William Marconi reached New York again today on the Campania from Liverpool and gave out a statement that during his trip he had tested five sets of space-telegraph apparatus with the result that he found that it was possible to maintain communication with England up to 1,700 miles, or more than half way across the Atlantic Ocean. He has made a new contract with the British government to connect his shore station with the entire telegraph system of the United Kingdom. Acompanying the inventor were Mr. W. W. Bradfield, manager of the Marconi Company in the United States; Chief Electrician Woodward of the Nova Scotia station; Mr. F. S. Stacey, assistant at Cape Breton, and his secretary, Mr. H. Kershaw. Twenty more ships are to be equipped with the Marconi system. Arrangements have been made with the Cunard line to furnish a certain amount of matter daily for a newspaper to be published on each ship of the line.

The Interborough Rapid Transit Company has announced that all motor cars on the subway division will be equipped with mechanical devices so that when there is current flowing to the motor the motorman must keep his hand on the controller. If he removes his hand from the controller handle the power automatically is shut off and the air brakes applied, the two actions being simultaneous. The object of the device is to prevent collision in case of the sudden death or disability of the motorman. D. W. W.

Dominion of Canada.

Winnipeg, Man., May 13.—The North American Telegraph Company, which has been doing business in Ontario for some years, has succeeded in getting a bill through the Dominion Parliament amending its charter so as to enable it to extend the business to Manitoba and the Northwest, with headquarters at Winnipeg. By the bill an increase of capital of from $1,000,000 to $10,000,000 is authorized.

The Winnipeg Street Railway Company and the Norwood Bridge Company have reached an agreement by which the street-railway company will run its cars over the bridge across the Red River. By this arrangement Winnipeg and Norwood will have connection within two or three weeks.

The Dominion government has issued an order in council granting free right-of-way to the White Pass railway for building a telephone line from White Horse to Dawson. The Dominion government reserves the right to use this line free of charge for official business.

Application for the incorporation of the British Pacific Telegraph Company has been made to the Dominion government. Its capital stock is $25,000 and the head office is in Victoria, B. C. The principal members of the company are C. H. Gibbons of Vancouver and D. V. Mott of Fernie, B. C., who have been granted a lease of the government telegraph lines on Vancouver Island in trust for the above company. The lease is for 21 years, terminable at any time upon compensating the company. The company is to keep the lines in good shape, to give the government free transmission of its messages and to make a small annual payment by way of rental. According to the last issue of the Blue Book the government lines showed a total length on Vancouver Island of 385 miles, with 20 offices. The report of the general superintendent of telegraphs shows that the total expenditure on all these lines for salaries, maintenance and improvements was $20,244, and the total income during the same period (one year) was only $2,969.

The Western Electric Light and Power Company of Brandon, Man., has been granted a charter. The idea of the company is to install an electric plant on the Assiniboine River, about nine miles below Brandon. The capital of the company is fixed at $300,000. The company proposes to supply power and light, and in the near future will establish a telephone system as well. Work is to be commenced at once. H

Toronto, Ont., May 13.—The long-drawn-out suit between the city of Toronto and the Toronto Street Railway Company has been brought to a close, an agreement having been signed by the solicitors for both parties and approved by the city's board of control. The company gives way on the point as to the city engineer's right to regulate the speed of the cars and to determine the service which shall be considered a proper carrying out of the contract. The company is by September 1st next to double-track and extend the lines on six streets and avenues in the city and from the present terminus of the double tracks on Winchester Street to and along five other streets. The company must also discontinue the use of open cars on or before October 15th in each year and not to use them again before May 1st. All cars must be equipped with heating appliances by November 15th, and are when necessary to be heated until April 15th.

The Canadian Bullock Electric Manufacturing Company has received permission from the secretary of state of Canada to increase its capital stock from $1,000,000 to $1,200,000 and to change the corporate name of the company to that of the Allis-Chalmers-Bullock Company, Ltd. The company is also given additional powers.

A contract has been awarded by the Halifax and Southwestern Railway Company for building 100 miles of telegraph lines between Halifax and Mahone and between Bridgewater and Liverpool, N. S.

The Anglo-American Telegraph Company's charter in Newfoundland has expired. It had a monopoly of the cable communication for commercial purposes between Newfoundland and Great Britain, Prince Edward Island and the mainland of New Brunswick.

The Dominion Wire Manufacturing Company of Montreal has just received an order from the Canadian Pacific Railway Company's telegraph department for 1,400 miles of copper wire, weighing 270 pounds to the mile. This wire is to be used to complete the fourth duplex circuit between Montreal and Winnipeg and from Winnipeg to Regina, and to complete and increase the telegraph facilities west of Winnipeg. The Dominion Wire Manufacturing Company furnished the first copper wire that the Canadian Pacific railway strung from Montreal to Vancouver. The Canadian Pacific will also string wire this year from Montreal to Quebec, from Toronto to Detroit, Hamilton to Winona, Montreal to North Bay, Fort William to Winnipeg, and from Toronto to Peterboro, all over existing pole lines. Many other entirely new extensions will be made. H.

New England.

Boston, May 14.—In accordance with the permissive bill passed by the state Legislature the stockholders of the Boston and Northern and the Old Colony street-railway companies have authorized the issuance of $15,000,000 50-year 4-per cent. bonds by the Boston and Northern and $10,000,000 by the Old Colony. These two properties are owned by the Massachusetts Electric Companies. Accordingly the directors of the Boston and Northern met on May 12th and voted to ask the railroad commissioners for authority to issue $8,432,000 in 4-per cent. bonds for the purpose of refunding the present bonded debt and $1,227,500 for the purpose of taking up floating indebtedness, the capital stock outstanding being $9,660,000, against which the bonds will be issued. On the same date the directors of the Old Colony voted to issue $4,667,000 bonds for refunding purposes and $2,145,600 to take up floating debt against a capital of $6,812,600.

This week the Boston Elevated Street Railway Company began the laying of tracks in the East Boston tunnel under the harbor preparatory to putting its line into service between the city proper and East Boston. It is the intention of the company to connect later with the city of Chelsea, via East Boston. The Boston Elevated Street Railway Company at present has no direct connection with the heart of Chelsea from Boston, the field being covered via Charlestown district by the Lynn and Boston section of the Boston and Northern road.

The charter of the East Lyme Street Railway Company, transferred a few days ago to a New York syndicate, headed by Morgan & Phelps, has been resold to Connecticut capitalists. The new owners are Thomas Hamilton, A. F. Phelps, Walter B. Denison, S. B. Mainwaring and J. R. Linsley, who are the directors of the corporation. Mr. Hamilton, who becomes president of the road, is the president of the Groton and Stonington Street Railway Company. Mr. Denison is the secretary and treasurer. The franchise is considered a valuable one and the authorized capital is $150,000. The charter authorizes the building of a line in Connecticut between London and East Lyme through Waterford, a distance of 11 miles.

The Worcester and Connecticut Eastern railway has applied to the Superior Court in Connecticut for authority to change its name to the Consolidated Railway Company. It operates a 63-mile road from Worcester, Mass., to East Killingly, Conn., and is capitalized at $500,000. It is virtually owned by the New York, New Haven and Hartford steam road.

Judge Lowell in the United States Circuit Court recently appointed John L. Hall and John T. Burnett as receivers for the Bristol County Street Railway Company upon application of the Pacific Surety Company of California. Bills have been filed in the United States Circuit Court also asking for receiverships for the Lowell and Boston Street Railway company and the Concord and Boston Street Railway Company. These two roads and the Bristol County road are connected indirectly with the Wareham road, all having been financed by the same company.

The Cambridge Electric Light Company has issued a circular to stockholders offering 1,000 shares of new stock at $140 a share at the ratio of six new shares for each share held. Subscriptions close on May 31st and payment must be made by June 10th.

The governor of Massachusetts has signed the bill permitting the Boston and Northern and the Old Colony electric-railway companies to issue blanket mortgages and long-time bonds upon their properties. The railroad commissioners will pass upon the amounts. It is understood that the Boston and Northern desires to issue to the amount of $15,000,000 and the Old Colony $10,000,000 for the purpose of retiring present outstanding issues and providing for certain expenditures. B.

Southeastern States.

Charlotte, N. C., May 14.—The Thomas Deaderick Electric Company of Nashville, Tenn., has been incorporated as the Standard Electric Company, with a capital of $15,000. Thomas Deaderick, W. H. Page and others are the incorporators.

It is semi-officially announced that W. J. Oliver has signed the contract to build an electric car line from Neals Shoals on the Seaboard railroad to Union, S. C. Work will be begun on June 1st.

The Cape Fear Power Company has installed its sub-station at Fayetteville, N. C., connected its wires with a number of manufacturing plants and will turn on the current July 1st.

The Tazewell (Va.) Electric Light and Power Company has been incorporated with a capital of $10,000. Joseph S. Moss is president.

The construction of an electric car line between High Point and Greensboro or High Point and Winston, N. C., is about to assume a tangible form. A. L. Garrell, who owns and operates several electric railways, is the chief promoter of the enterprise. The estimated cost is $200,000.

A 200-horsepower electric plant has been completed at Chattanooga, Tenn., to drive the $50,000 additional machinery recently installed in the Sheland Machine Works.

The new Clifton cotton mill, No. 31, at Clifton, S. C., is completed and will be run by electricity instead of waterpower. This mill was destroyed by a flood last June. L.

Texas and Mexico.

Austin, Texas, May 12.—The City Council of Brownsville, Texas, has revoked the franchise which it granted several months ago to J. W. Maxcy of Houston for the establishment of an electric-light plant and waterworks system there, and has granted a similar franchise to Judge James B. Wells of Brownsville. Judge Wells will also install a similar plant in Matamoros, Mexico, situated opposite Brownsville.

The Temple-Belton Traction Company, which is building an interurban electric railway between Temple and Belton, has been formally organized with a capital stock of $250,000. Its principal office is at Temple, Texas. A. F. Bentley of Temple and N. K. Smith of Belton, Texas, together with Pennsylvania capitalists, constitute the incorporators.

D. A. Cypher of Austin, Texas, has applied to the City Council of Caldwell, Texas, for a franchise for an electric-light plant. He will also install an ice factory.

The city of Atotonilco, Mexico, is asking bids for the construction of an electric-light plant.

The Mexican government will establish space-telegraph stations at Topolobampo and Rosarito, both situated on the west coast. Engineer Francisco Romero will have charge of the work of constructing these stations.

The City Council of Leon, Mexico, will receive bids until May 31st for lighting the city with electric lights. The city has a population of 65,000.

A new electric-light plant has just been installed at Tecoaltiche, Mexico.

The City Council of Vera Cruz, Mexico, has extended for three years the contract with the local electric-light and power company for furnishing the city with lights. The company will substitute arc lights for the present incandescent lights and will make other improvements. H.

Ohio.

Cleveland, May 14.—The Miami and Erie Transportation Company has been granted an extension of three years in which to complete the electric-haulage line from Cincinnati to Dayton by the State Board of Public Works. The action was taken at the request of the bondholders, who promise to reorganize the company, take it out of the hands of a receiver and clear the towpath of the canal of all obstructions within 90 days.

The Devere Electrical Company of Cincinnati has secured a temporary injunction against the International Brotherhood of Electric Workers to prevent that body from ordering its employes to strike.

The semi-annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers was held in Columbus this week, when a number of interesting papers on practical subjects were read. Quite a number of new members were added to the list also.

It is said that the plans for improving the Cincinnati, Dayton and Toledo traction property are now taking definite shape, and an attempt will be made to get at it at an early date. To make the improvements desired something over $1,000,000 will be required. The company has $1,500,000 bonds in the treasury yet, and $3,500,000 are outstanding. Manager F. J. J. Sloat is planning to make a better service and faster time.

City Solicitor Baker of Cleveland has rendered an opinion that the land in the Public Square cannot be used for electric depot purposes, as planned some time ago. The conditions of the deed conveying it to the city would cause a reversion to the original owners if it were used for other than park purposes.

The municipal-ownership feature will be injected into three of the proposed two-cent-fare ordinances in Cleveland before they will be approved by Mayor Johnson. The fourth was killed in council. The mayor and his followers expect, it is said, that the promoters will refuse to accept the ordinances in that way. The city of Cleveland could then claim that the applications were not made in good faith and attempt to retain the deposit of $20,000 that was made with it as a guaranty.

Superintendent Ralph Peters of the Pennsylvania road has confirmed the report that the Cincinnati and Muckingum Valley road from Lancaster to Trinway will be equipped for electric cars. Proposed electric lines through that section of the state, he says, makes it necessary to have cars run oftener than a steam railway can operate trains, and the electrical equipment will be put on to meet competition.

Representatives of companies manufacturing incandescent lamps met at the Hollenden Hotel, Cleveland, this week and, it is said, completed an association. Reports have been made that an agreement was entered into to increase the price of lamps, but this has not been confirmed.

The Panhandle Traction Company is arranging to connect Wheeling and Steubenville. The cost of making the connection and building the track needed will be about $160,000.

L. W. Parks has resigned as general ticket agent of the Columbus, London and Springfield electric railway, to accept a position with the Columbus, Delaware and Marion at Marion. Alfred Kock, his assistant, will succeed him.

George Stanley of Cleveland, president of the New York and Long Island Traction Company, took a party of Cleveland capitalists on a trip of inspection over the line this week. N. O. Stone, I. N. Topliff, Will Christy, L. W. Prior, George W. York, O. G. Kent, Samuel Strong, D. Leuty and several others were in the party. O. M. C.

Michigan.

Detroit, May 14.—Extensive improvements are being made in the Michigan Agricultural College, located near Lansing. A new $50,000 power house will be constructed of stone and brick, to be 122 by 84 feet. This will contain the engines for supplying electric power and water to the college grounds. Expensive tunnels are being constructed, which, together with the power house, will make a very elaborate system. The tunnels will cost about $45,000. They are six feet high and four feet wide; they will contain the steam and gas pipes and the electric and telephone wires. Steam will be taken from the main boiler house to 17 large buildings for heating purposes. Formerly the electricity for the college was taken from the city of Lansing, and during wet weather the college was sometimes without light, owing to the weakening of the current in the long transmission.

The University of Michigan has recently been granted two funds for the advancement of electrical study. The first was by the trustees of the Elizabeth Thompson science fund for the study of Clark and Weston standard cells. The second grant was by the Carnegie Institution of Washington, for the determination of the electromotive force of Clark and cadmium standard cells and of the electrochemical equivalent of silver. These funds have been placed in the hands of Professor H. S. Carhart.

Mayor Maybury of Detroit will not give up his fight against the street railways for a three-cent fare and a universal transfer. A meeting was held in his office this week which was attended by several members of the state Legislature and influential citizens and a resolve was made to make a determined effort to place the regulation of rates of charge by public-service corporations in the hands of the municipalities. A bill has been prepared by the city attorney and a committee appointed by the mayor to consider and act on changes suggested. The appeal recently made to other cities for a special session of the Legislature was without result.

The city of Wyandotte will spend $7,450 on its municipal light and water system. Of this amount the electric-light and fire-alarm system will receive $3,900.

The Detroit, Toledo and Monroe Short Line is going to put up a fight against the steam roads running between Detroit and Cleveland. Orders have been placed for four elegant sleeping cars, to be run between these cities, connections to be made at Toledo with the Norwalk line for Cleveland. These cars will leave Detroit and Cleveland each night at 11:30, as soon as the Detroit-Toledo company can arrange to run its cars to the Detroit City Hall over the Detroit United line. C. G. W.

Indiana.

Indianapolis, May 16.—F. T. Bowles, superintendent of the Lake Erie and Western railroad, with headquarters in Lafayette, announces that before the end of the summer motor cars will be in operation on all the divisions of his road where interurban lines parallel it. Mr. Bowles declares that motor cars are feasible and says gasoline will be used to furnish the motive power for the cars that are now being remodeled for this purpose.

The Citizens' Street Railway Company of Vincennes is completing a number of improvements. A number of new and modern cars have been put in service and the new power house is ready for the machinery, which will be installed this week. Extensions of several lines are also being made.

The commissioners of Delaware County have granted a franchise to J. P. McGrantz of Hartford City for an electric road through Delaware County.

S. R. Nelson, general manager of the Fort Wayne and Southwestern Traction Company, has returned from New York and announces that fast through cars will be put on and operated between Fort Wayne and Logansport in a short time. The roadbed will be put in shape and a few sharp curves taken out. It is proposed to run the 75 miles in a little over two and a half hours.

The Public Service Company of Mooresville is advertising for bids for the construction of the power house and machinery for an electric-light plant. The plans and specifications are ready and will be sent out to applicants.

The town board of New Haven has rejected all bids for the construction of an electric-light plant and will readvertise for bids at once.

The City Light and Power Company has been awarded the contract to light the city of Booneville. The company will construct a new plant and equip it with modern machinery. The city reserves the right to lease or purchase the plant at its option.

The Indianapolis Automobile Racing Association has been incorporated. The purpose of the company is to promote and encourage the manufacture of vehicles propelled by electricity, gasoline, steam, etc. James Allison, C. G. Fisher, C. B. Sommers and F. B. Willis are the incorporators. F.

Pacific Slope.

San Francisco, May 12.—The commissioners of Golden Gate Park are considering the advisability of installing an electric-light plant there at an estimated cost of about $7,200.

James F. Lawless, formerly manager of the San Francisco Gas and Electric Company, has left for New York.

At a recent meeting of the new directors of the San Francisco Gas and Electric Company the following officers were elected: President, W. E. Bourn; vice-president, A. H. Payson; second vice-president, C. O. Hooker; secretary and treasurer, Charles L. Barrett.

The directors of the California Gas and Electric Corporation have chosen E. J. De Sabla, Jr., president; John Martin, first vice-president; F. G. Drum, second vice-president; R. M. Hotaling, treasurer; John A. Britton, general manager, and C. W. Conlisk, secretary.

The Alturas Electric Light and Power Company has been incorporated at Bieber, Cal., by D. E. Mulkey, S. N. Mulkey, J. M. Gibbons and others. It is the intention of the company to install a power plant on Pine Creek.

Albert Dickison, George Sohns, Harry Kennedy and W. E. Gitzdanner of Seattle have been awarded a franchise for the construction of an electric-light plant in Seward, Alaska. The plant will have 1,700 lights to start with.

The city of Alameda, Cal., will install a day service for power from the municipal electric-light works. The plan to secure a part of the current from Oakland has been abandoned.

The Santa Maria Light and Power Company has been incorporated at Los Angeles with a capital stock of $25,000. The incorporators are H. T. Duff, Benjamin M. Page and W. F. Gibbs.

W. R. Hewitt, chief of the Department of Electricity of San Francisco, has submitted to the supervisors an estimate of the needs of the department for the fiscal year, which includes $16,488 for overhead construction, $4,049 for electric lighting in municipal offices, and $200,000 for a fire-alarm system.

A meeting of the stockholders of the Mutual Electric Light Company of San Francisco has been called for June 21st to vote an issue of $400,000 of gold bonds. The company is erecting a new 5,000-horsepower plant at the corner of Spear and Folsom Streets in San Francisco.

The San [illegible]

has been incorporated in San Francisco by A. D. Harrison, S. M. Van Wyck, Jr., and others. The company will construct a railroad to run from San Francisco to Napa, and also a telephone system and telegraph line. A.

PERSONAL.

W. M. Daly, general superintendent of the Detroit (Mich.) public lighting commission, who has been confined to his home for some time by sickness, is now reported better.

Thomas R. Mercein of Milwaukee, secretary of the Northwestern Electrical Association, was in Chicago last week, making arrangements to attend the Boston convention of the National Electric Light Association, to which he is a delegate.

The John Scott legacy premium and medal issued by the Franklin Institute of Philadelphia for meritorious inventions, has just been awarded to John A. Brill of Philadelphia for his invention of the Brill convertible and semi-convertible car.

Louis F. Philo, who for the last six years has been connected with the Wesco Supply Company, in the capacity of manager of the supply department, has resigned to accept the position of assistant manager of sales with the Ewing-Merkle Electric Company of St. Louis.

J. C. McQuiston, formerly secretary of the Westinghouse Companies' Publishing Department, has lately been made superintendent and responsible head of the department. Mr. McQuiston is a pleasing writer and a man of energy and ability. His promotion is well deserved.

Max Loewenthal of New York city was in Chicago last week, returning from an extended trip to the Pacific Coast in the interest of the Prometheus Electric Company. Mr. Loewenthal is an experienced electrical engineer and is now devoting much attention to electric heating and cooking.

John H. Young, formerly with the Wisconsin Telephone Company in Milwaukee, has recently assumed the office of general manager of the Modern Electric Company of Burlington, Iowa. Mr. Young is a graduate of the University of Illinois in the electrical engineering course, and has had extensive experience in telephone work.

Prof. Albert W. Smith has been made director of Sibley College of Mechanical Engineering, Cornell University, to succeed the late Robert H. Thurston. Professor Smith holds a similar position in Leland Stanford University, which he will give up at once. He is a graduate of Cornell in the class of '78, served on the Sibley College faculty from 1887 to 1891, and was professor of machine design in the University of Wisconsin when called to California.

In the list of alternate delegates-at-large from Illinois elected to the Republican national convention by the Republican state convention at Springfield last week appears the name of Mr. Samuel Insull, president of the Chicago Edison Company. Mr. Insull is now in Europe, and is expected to return about June 10th. It is believed that this honor has been bestowed upon Mr. Insull, in his absence, without his knowledge. Mr. Insull is, of course, prominent in industrial affairs, not in politics, and this fact makes the compliment more conspicuous.

Richard McCulloch, acting general manager of the Chicago City Railway Company since the resignation of his father, Captain Robert McCulloch, has accepted a position as assistant to the general manager of the St. Louis Transit Company, which position is held by his father. He will give his attention to the mechanical and engineering departments. Mr. McCulloch has been with the Chicago company four years, during which time the company has profited by his engineering skill. He is 32 years of age and was educated in St. Louis. Completing his studies, he went to Geneva, Switzerland, where he spent two years at practical work with a street-railway company. He will assume his new duties in about a month.

ELECTRIC LIGHTING.

A franchise has been granted for an electric-light plant in Lenox, Iowa. J. R. Thompson is interested in the enterprise and he is in the market for a dynamo, switchboard and other equipment for the plant.

The Quincy (Cal.) Water and Power Company has been incorporated by J. D. Goodwin and others. The capital is $50,000. The waterworks will be improved and an electric-light and power plant will be installed.

In some of the sleeping cars of the Chicago, Milwaukee and St. Paul railroad, passengers may now have electric lights in the upper berths. The sockets are fixed in the berths, but for the lamp the passengers must apply to the porter.

An unusually large electric sign adorns the new Butterick Building in New York city. The sign occupies the entire side of the building facing the North River and is easily readable a distance down the harbor, across in New Jersey and a long distance up the Hudson. The letter B is 68 feet high and the other letters measure 54 feet in height.

ELECTRIC RAILWAYS.

While the Illinois Central Traction Company is going ahead with the work of setting up its cars and finishing its track in order to begin its service, nothing has been done by the City Council of Springfield, Ill., in the way of passing a franchise ordinance to take the place of the one vetoed by Mayor Devereux. The special sub-committee to which the Hay ordinances were referred with instructions to draw up a new ordinance, has not even met. The delay is being commented upon in various ways and the idea was advanced that the council is going to give up the fight and let the old ordinance (perpetual franchise) stand.

POWER TRANSMISSION.

A proposition to transmit electricity generated at the large dam recently built by the Consolidated Water Power and Paper Company of Marshfield, Wis., to the city of Marshfield, to light the streets and business houses is being considered by the City Council.

The Oregon Power and Development Company of Baker City has been incorporated with a capital of $200,000. An electric plant will be constructed in the Greenhorn mining district on Granite Creek. Waterpower will be obtained from Granite, Boulder and Sunrise Creeks.

Governor Odell of New York has vetoed the Thompson bill, enlarging the scope and powers of the Niagara, Lockport and Ontario Power Company. In a memorandum explaining his veto he says the bill gives the company valuable rights without compensation, and he takes strongly the sentimental view that the state should preserve the natural beauty of Niagara Falls, which is menaced by the companies already installed there.

SOCIETIES AND SCHOOLS.

The annual convention of the Canadian Electrical Association will be held this year in Hamilton, Ont., on June 15th to 17th. Chairman R. G. Black of the committee on papers states that the promise of an excellent series of papers has been secured. There is much to interest electrical men in Hamilton, including the systems of the Hamilton Electric Light Company, Cataract Power Company and the new works of the Westinghouse Electric and Manufacturing Company. A day will probably be spent viewing the power-development work at Niagara Falls.

SPACE TELEGRAPHY.

The Cleveland Plain Dealer of recent date says: "A wireless-telegraph service has been opened to public use between this city and Buffalo. The distance of nearly 200 miles is the longest, assert the managers of the service, over which practical service has been installed."

Rev. Joseph Murges, pastor of the Roman Catholic church at Wilkesbarre, Pa., has invented and put in operation a system of space telegraphy which he asserts is more simple and at the same time has more speed in sending and receiving than the Marconi system. Several patents have just been issued on the invention.

Space telegraphy is said to be proving of value to the German authorities in Southwest Africa. In the beginning of the insurrection of the Herreros, the military telegraph lines, which were the only means of connection between the field and headquarters, were continually being cut down and destroyed by the natives. During the last few months, however, every detachment of troops in the field has been provided with wireless instruments, it is said, and has been in constant communication with the commander-in-chief. Because of this success the German War Department is reported to have decided to establish a new army branch of expert space-telegraph operators under the command of a high officer of the general staff.

PUBLICATIONS.

"Tipless Facts" are contained in a folder sent out by the Fostoria Incandescent Lamp Company of Fostoria, Ohio. In the folder it is asserted that the Fostoria tipless lamp has now so far been perfected as to be of the very highest grade, besides possessing the advantage of being without a tip.

Some "facts without fringe" concerning Columbia lamps, manufactured by the Columbia Incandescent Lamp Company of St. Louis, are contained in a little pocket-book sent out by that company which is entitled "A Wallet-full of Wisdom." The book will be found useful to prospective lamp buyers and will be appreciated by anyone who can recognize a clever piece of work.

The catalogue issued by the Sprague Electric Company of New York on 1904 electric fans will attract attention at once, even if for no other reason than the artistic design of its cover. But, in addition, the contents of the pamphlet are well arranged and present clearly just what the company wishes to express—the excellence of the Lundell fans. The fans described are of the desk and ceiling variety, and a line of small exhaust fans is also offered. The company also wishes to bring to the notice of the trade its type M. C. direct-current motors, which are described in bulletin No. 216.

The Adams-Bagnall Electric Company of Cleveland has issued a series of bulletins descriptive of its series alternating-current arc-light system. Several of the bulletins take up some one part or detail of the system and illustrate and explain that. For instance, one of the bulletins describes the regulator, another the switching devices, and others the various styles of lamps. There are also several bulletins giving directions for the operation of the system.

The Keystone Electric Company of Erie, Pa., is presenting to the public a booklet illustrating its generators, motors and switchboards. The booklet consists principally of illustrations of the different apparatus, it being the object to impress upon the possible purchaser the fact that the company is familiar with every application of the motor and generator to power and lighting purposes rather than to go into the details of construction. Switches, switchboards, panel boards and cabinets are treated more in detail in bulletin No. 4001, which gives descriptions of parts and dimensions.

MISCELLANEOUS.

The Washington Monument has again been struck by lightning, this time with no serious damage. The bolt entered at the top of the shaft, burned out the telephone there, passed down the iron framework in the elevator shaft to the lower floor, through the shaft to the motor room, and then along the electric cable to the engine room in the boiler house, where it entered the ground.

A Cincinnati concern is manufacturing a motor-driven ice-cream freezer. The motor and starting rheostat are mounted on a solid base, upon which is also secured the freezer geared to the motor. Great speed is thus attainable and the mixture is thoroughly beaten during the freezing process. The motor is placed on cans having a capacity as low as 25 quarts. On the 25-quart freezer the motor is two-thirds of a horsepower and makes 900 revolutions per minute, using current at 110 volts.

The Hudson and Manhattan Railroad Company will soon begin work on the third Hudson tunnel, which will extend from the foot of Exchange Place, Jersey City, to a point under Pier 13, New York, and up Cortlandt Street to a terminal on the west side of Church Street between Cortlandt and Fulton Streets, whence it will continue down Fulton Street to Pier 14, and back to the Jersey City terminal, near the Pennsylvania Railroad station. It is designed to carry passengers, baggage and express, and it is proposed to connect with the Jersey City surface cars, with the steam-railroad depots and in New York with the rapid-transit subway, now being built on lower Broadway.

TRADE NEWS.

J. H. Hallberg, who recently opened an office at 45 Broadway, New York, as consulting engineer, has decided to make a specialty of electrical distribution and illumination, particularly in the line of arc lighting.

The Northern Electrical Manufacturing Company has removed its Chicago office from the main floor of the Monadnock Building to Rooms 425-428. This change was made necessary owing to the company's constantly increasing business, obtained through the Chicago office, which is being so ably managed by F. L. Stagg.

The Chicago office of the Stanley Electric Manufacturing Company, heretofore located on the main floor of the Monadnock Building, has been removed to larger and more commodious quarters in Rooms 425 to 428, inclusive, of the same building. The Stanley company's western business, under the energetic management of E. L. Barr, has increased largely during the last year.

George H. Barker, vice-president of the American Conduit Company, passed through Chicago last week on his way to the California office of the company. Mr. Barker states that the demand for the American Conduit Company's product was never better. A. W. Buchanan, general manager of the same company, was transferred on May 1st from the Los Angeles office to Chicago. Mr. Buchanan will give close personal supervision to the manufacture and other details of the American Conduit Company's business and will make every effort to see that the increasing popularity of its bituminized fiber conduit will continue to be merited. The company's Chicago office is located on the tenth floor of the Manhattan Building.

BUSINESS.

Rossiter, MacGovern & Co. of New York city have on hand a large stock of second-hand electrical machinery, steam engines, boilers and cars, as shown by the long list issued May 1st. Generators, motors and transformers are listed of almost every size and made by well-known manufacturers. The firm guarantees all machinery sold to be in a first-class operating condition. Nearly all the machinery, before being placed on the market, is first overhauled and

inspected at the Jersey City or St. Louis factories of the company. Branch offices are located at Boston and St. Louis.

The Knutson gravity clutch, manufactured by John L. Peterson & Co. of Galesburg, Ill., continues to find favor with its many users. It is declared that each clutch is carefully inspected before being sent out, thus insuring the best possible operation. The company guarantees satisfaction. A neat booklet setting forth its numerous advantages may be had on request.

Judge Lacombe of the United States Circuit Court for the Southern District of New York, on May 9th, filed an opinion in the case of the Weston Electrical Instrument Company against the Whitney Electrical Instrument Company and Machado & Roller, declining to grant an injunction against the Whitney company and Machado & Roller upon the Weston patent No. 392,387, which was recently sustained against other instrument companies. It is stated that there is no appeal from Judge Lacombe's decision. Machado & Roller, the general selling agents of the Whitney Electrical Instrument Company, announce that, in addition to this recent decision, another suit brought by the Weston company against the Whitney Electrical Instrument Company and themselves on Weston patent No. 446,489, likewise covering Weston instruments, was dismissed upon final hearing by the court last October, and the costs assessed on the Weston company.

Mr. A. S. Hubbard of the Cooper Hewitt Electric Company of 220 West Twenty-ninth Street, New York, has sold 94 lamps for installation in "Dreamland" at Coney Island, New York, 30 of which will be used in the submarine boat. Ten of the Cooper Hewitt lamps have been furnished to Thomson & Dundy of Luna Park, Coney Island. Sixty-five of these lamps will be used in "Venice by Moonlight." The weird brilliancy of these lamps is a great attraction and the light is especially suited to moonlight, ice and water effects. The lamps are also being used on the Pike at the St. Louis World's Fair with excellent effect.

Judging from the increased demand for the Crystal chemical coloring used so extensively for coloring incandescent lamps and manufactured by the Webster Chemical Company of St. Paul, Minn., the company believes that the superiority of this mode of obtaining a brilliant and durable transparency has at last been appreciated by lamp users. The Webster product is used extensively and is said to give the best of satisfaction. The coloring can be furnished to give almost any effect. The process of obtaining the coloring effect is simple and practically instantaneous, consisting merely of immersing the lamp in a bath of the solution, withdrawing immediately and drying on exposure to the air.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) May 10, 1904.

759,229. Apparatus for Testing the Eyesight. Adolph Bechtold and August C. Bechtold, New York, N. Y., assignors to the Meyrowitz Manufacturing Company. Application filed August 20, 1902. Renewed August 12, 1903.

A motor-driven apparatus shifts successive rows of characters in front of an aperture for testing the eye sight.

759,237. Circuit Changer. Charles C. Cadden, Cleveland, Ohio, assignor to the Williams Abbott Electric Company, Cleveland, Ohio. Application filed June 15, 1903.

Contact strips are thrown into and out of connection by the movement of a lever.

759,241. Electric-railway System. George L. Cragg, Chicago, Ill., assignor to Bion J. Arnold, Chicago, Ill. Application filed May 22, 1902.

An alternating-current single-phase motor is carried by the car and is started by another electric motor carried upon the car. A variable-gear connection is supplied between the single-phase motor and the running gear of the vehicle, with means whereby the gear connection between the single-phase motor and the running gear of the vehicle may be broken.

759,242. Electric-railway System. George L. Cragg, Chicago, Ill., assignor to Bion J. Arnold, Chicago, Ill. Application filed May 22 1902.

The car motor is driven by a single-phase motor and is so arranged that it may be temporarily operated as a split-phase motor for starting.

759,243. Electric-railway System. George L. Cragg, Chicago, Ill., assignor to Bion J. Arnold, Chicago, Ill. Application filed May 22, 1902.

The single-phase motor is attached to the car axle by a variable gear with means located partly upon and partly of the vehicle for bringing the motor up to speed.

759,244. Electric-railway System. George L. Cragg, Chicago, Ill., assignor to Bion J. Arnold, Chicago, Ill. Application filed May 22, 1902.

The single-phase motor is brought to speed by a separate motor on the car.

759,276. Insulator for Telegraph Wires. Clayton Hobert, Philadelphia, Pa. Application filed April 10, 1903.

A lower portion of the insulator screws on to the insulator pin and has upon the top a groove for the reception of the wire. A cap screws on to the lower portion and holds the wire in place. (See cut.)

759,280. Telephone Attachment. Stephen C. Houghton, San Francisco, Cal., and Frank M. Potter, Jr., Syracuse, N. Y. Application filed December 30, 1903.

A support for the telephone receiver is described which holds it in the proper relation to the transmitter to bring it beside the speaker's ear.

759,281. Signaling. Gustav A. Huber, Mounthope, N. Y. Application filed January 9, 1904.

Spring-driven gearing is adapted when released to drive a small armature which develops current to ring signal bells.

759,286. Electricity Meter. Martin Kallmann, Berlin, Germany, assignor to the Internationale Electricitäts Zähler Gesellschaft, M. B. H., Berlin, Germany. Application filed September 28, 1901.

Extending axially through a shunt coil from the main circuit is a spindle carrying a brake disk. Armature arms extend from a sleeve on the spindle within the coil. A relay mechanism includes a resetting contact arm.

759,288. Electric Brake. Walter Lasar, St. Louis, Mo., assignor of one-half to the Lasar Elevator Company. Application filed February 10, 1902.

An electric brake comprises a breaking mechanism, a lever for operating the mechanism and a solenoid having a core operatively connected to the lever. A circuit-breaking arm is operatively connected to the lever to be moved thereby, and means for automatically retracting the lever to its normal position are supplied. The circuit-breaking arm is arranged to control the motor circuits and carries contacts in the solenoid circuit.

759,316. Telephone Receiver. Walter C. Runge, London, England. Application filed December 6, 1902.

A diaphragm between the casing and the cover of the receiver contains transmitting magnets. A threaded plug supports the magnets and engages with the inside of the casing while a removable locking ring is screwed into the casing and engages the plug.

759,327. Railway Switching and Signaling Apparatus. John D. Taylor, Buffalo, N. Y., assignor to the Taylor Signal Company, Buffalo, N. Y. Application filed October 25, 1901.

Supplied from a source of electric energy is electrical mechanism and an electromagnetically controlled switch. A wire is connected to one pole of the source of energy and a wire including the releasing coil of the electromagnet controls the switch, having one end connected to the other pole of the source of energy.

759,346. Railway Block-signal System. Winthrop M. Chapman, Newton, Mass., assignor to the Electric Railway Signal Company, Kittery, Me. Application filed May 12, 1902.

A signal movable from normal to either of two positions is operated by signal-setting and restoring means, a controller preventing the restoration of the signal until the last car leaves the block. The controller-actuating means comprises a magnet, an armature, and connections between the armature and controller with means for determining the position to which the signal is moved, comprising a magnet and an armature.

759,352. Meter for Measuring Electrical Energy. Louis P. Décombe, Paris, France. Application filed November 26, 1901.

Two fixed coils are carried by an oscillatory support. Two tilting coils are placed on the support and electric circuits pass through all of the coils so as to produce oscillatory tendencies on the support through the two tilting coils. Means connecting the tilting coils to make them tilt together and means for counting the number of oscillations of the support are further specified. (See cut.)

759,358. Magnetic Separating Apparatus. Thomas A. Edison, Llewellyn Park, N. J. Application filed June 21, 1900.

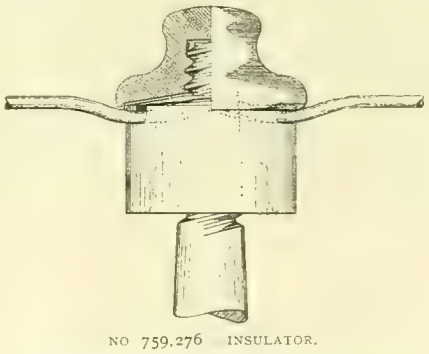
An improved magnetic separator comprises two tapering magnetic poles sustained adjacent to each other with a narrow gap between them and with the upper pole slightly overlapping the lower. Means are supplied for feeding pulverized magnetic and non-magnetic particles directly to the upper surface of the upper pole near its edge, whereby the magnetic particles will by the lines of force be deflected toward and fall below the under surface of the lower pole without passing through the gap. A dividing board below the lower pole separates the magnetic and non-magnetic particles.

759,383. Combined Switch Socket and Restoring Annunciator. Anton M. Knudsen, Chicago, Ill., assignor to L. Sands, Cleveland, Ohio. Application filed October 13, 1900.

In a telephone annunciator are combined a spring jack, a plug therefor, a shutter adapted to operate the night-bell circuit, and a pivoted arm operated by the plug and engaging the shutter to restore it to its normal position after it has fallen, the arm being insulated at the point where it engages the shutter to prevent short-circuiting the night-bell circuit.

759,409. Variable-speed Driving Mechanism for Sewing Machines. Johannes W. H. Uytenbogaart, Utrecht, Netherlands. Application filed October 12, 1903.

A small electric motor is arranged to drive a sewing machine.



NO 759,276 INSULATOR.

759,414. Ground-wire Attachment. Wilbert J. Bishop, Buffalo, N. Y. Application filed September 4, 1902.

An attachment for connecting electric wires to water pipes or the like, for grounding purposes, is described

759,426. Electric Soldering Iron. Sydney Evershed, London, England, assignor to himself and Evershed and Vignoles, London, England. Application filed December 8, 1903.

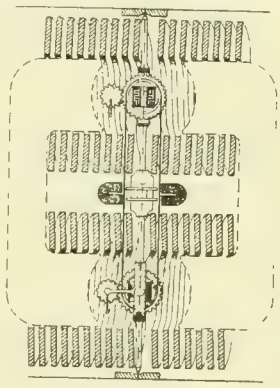
A metallic conductor of heat, of small mass, is placed in close thermal contact with the heater resistance and is adapted to carry heat to a bit. A tinned piece of metal connected with the carrier melts and applies the solder.

759,428. Telephone-transmitter Hood. Robert D. Fannon, Chicago, Ill., assignor to Delos Dunton, Carpentersville, Ill. Application filed October 29, 1901.

An adjustable hood to cover the face and transmitter to prevent the escape of sounds is described.

759,431. Electric Accumulator. Ricardo Fortun and Eduardo Semprun, Madrid, Spain. Application filed September 30, 1901.

Active material for battery plates is made by subjecting to the action of electrolysis a solution comprising a saturated solution of oxid of lead in a lixiviation of potassium hydroxid, rock candy and neutral potassium tartrate. The material deposited upon the anode is then separated from the electrolyte.



NO. 759,352. ELECTRIC METER.

759,436. Electrical Warp Stop Motion for Looms. Henry I. Harriman, New York, N. Y., assignor to the American Loom Company, Readville, Mass. Application filed December 3, 1901.

Electrically separated conductors of opposite polarity are associated with movable detectors and means to move a conductor toward and from the detectors, producing wiping contact of the conductor with a detector in its stopping position, to close the circuit.

759,441. Telephone Transmitter. Alfred W. Hill, West Hoboken, N. J., assignor to himself and D. P. Chesebro and Alfred E. Davidson, New York, N. Y., doing business as the Phonic Carbon Company. Application filed October 9, 1902.

An electrode and back for a telephone transmitter has an annular ledge or rest adapted to support the diaphragm of the instrument at its edge. A central depression or cavity inclosed at the rear face of the disk holds granular material.

759,453. Electric Railway. Timothy Mahoney, San Francisco, Cal. Application filed July 1, 1903.

Alined separated sections of a sectional conductor contain removable switch boxes interposed between and in the line of the sections. Contact members are placed in each of the boxes, one of the members connected electrically with one adjacent section and the other member with the other adjacent section. An armature plate normally rests by gravity on the contacts, and a number of connected alined magnets on the car are in the plane of the armatures, alternate magnets being of opposite solarity to the intermediate magnets.

759,464. Alarm System. Felix McGloin, New York, N. Y. Application filed December 31, 1902.

In a signal instrument are a main energized circuit and a number of signal instruments having independent instrument circuits normally unenergized. One terminal of each instrument is connected to the main circuit. There is an independent local circuit for each signal instrument and an electrically operated switch in each instrument and actuated by the local circuit for connecting the second terminal of the instrument to the main circuit and at the same time breaking the main circuit for all outside points.

759,492. Telephone Exchange. Clarence A. Anderson, Salina, Kan. Application filed December 5, 1901.

A ratchet wheel and a magnet for moving it from its normal position is returned to its normal position when a spring is released. A contact maker secured to and movable with the ratchet wheel, and three contact strips, the strips being arranged [illegible] moved in one direction [illegible] one of the strips and when moved in the opposite direction it is in [illegible] make up the apparatus.

759,506 Means for [illegible] in Wires in Electric [illegible] and William S. Everett, Malvern, Pa., assignors of seven-sixteenths to Charles F. Kindred, Philadelphia, Pa. [illegible] 1904.

Lead-in wires are [illegible] one of which has a [illegible]

practically the same as the material of the stem of the lamp and embedded therein.

759,511. Lighting System for Locomotives. Ethelbert T. Ford, St. Louis, Mo., assignor to Peter H. Murphy, St. Louis, Mo. Application filed December 21, 1903.

A lighting system for locomotives comprises a dynamo having two sets of field coils, a circuit containing an arc light in the locomotive headlight and a switch located in the locomotive cab within convenient reach of the locomotive engineer. A second circuit containing incandescent lights is located in the locomotive cab. One of the sets of field coils is shunted across the cab-light circuit and the other set arranged in series with the headlight circuit.

759,543. Electric-railway Signal. Elwood W. McGuire, Richmond, Ind. Application filed August 15, 1902.

Rails are subdivided into insulated blocks with a contact rail for each block. An insulated electrode is carried on the locomotive to operate the signal circuit.

759,550. Secondary-battery Electrode. Charles J. Reed, Philadelphia, Pa. Application filed January 16, 1901.

A rolled and laterally compressed secondary battery plate comprises a number of corrugated panels and intervening strengthening ribs and side ribs projecting beyond the panels and intervening ribs, the parts constituting an integral structure.

759,586. Electric Switch. Henry C. Baer, New York, N. Y. Application filed November 9, 1903.

The switch embraces two distinct or independent insulating blocks to which two pairs of stationary contacts are secured in a ring frame.

759,600. Electrical Switch. Fay L. Faurote, Ann Arbor, Mich. Application filed March 14, 1903.

Several disks have their centers in line, with means within the peripheries of the disks for forming a continuous electrical connection through the disks at a relative angular position. An index indicates the relative angular position of the disks.

759,612. Infant Incubator. George H. How, Chicago, Ill. Application filed April 30, 1903.

A static machine is used to purify the air for the infants within the incubator.

759,615. Burglar Alarm. Arthur J. Kercher, Minneapolis, Minn., assignor of one-half to A. S. Thomas and G. N. Kercher, Minneapolis, Minn. Application filed October 9, 1903.

Statically charged conductors of opposite polarity lead from the electrical source. A local alarm circuit, and a device having fixed and movable terminals oppositely charged through the conductors are arranged to close the alarm circuit when a variation occurs in the normal potential difference of the conductors, the movable terminal being arranged between the fixed terminals and normally tending to contact by gravity with one of them.

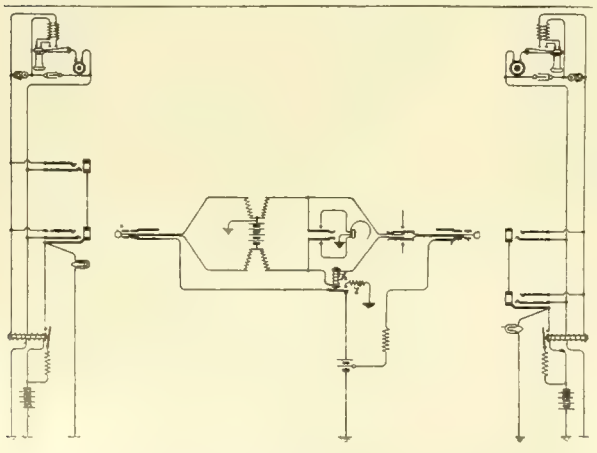
759,632. Switch for Incandescent Lamp Sockets. John D. Raymond, Chicago, Ill. Application filed February 1, 1904.

Details are described.

759,641. Signaling Apparatus for Telephone Switchboards. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 26, 1903.

A signal-controlling magnet connected with one limb of the line at the central office co-operates with a key at the sub-station controlling a connection from the limb to a return conductor. A switch at the sub-station controls a bridge of the two limbs, and a connection of the other limb to the return conductor at the central office is controlled by the magnet, whereby the continued excitation of the magnet after the actuation of the key is dependent upon the switch at the sub-station.

759,651. Process of Treating Flour. James N. Alsop, Owensboro, Ky. Application filed June 2, 1903.



NO. 759,771.—TELEPHONE SWITCHBOARD CIRCUIT.

The process of treating flour consists in subjecting it to the action of air which in turn has been so modified by the action of an electric arc that it is capable of increasing the nitrogen contents of the flour.

759,652. Railway Signal. John W. Anderson, Jr., Woodland, Ill. Application filed February 20, 1903.

The track is divided into insulated sections which are electrically connected to relays operating the signals.

759,697. Telephone Apparatus. Alfred Graham, London, England. Application filed February 4, 1903.

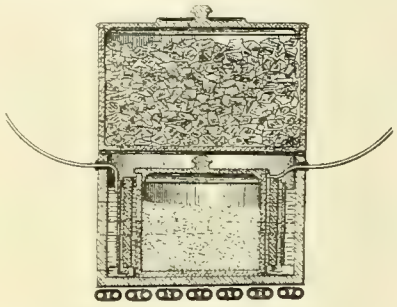
Telephone apparatus comprises a water-tight casing having at its rear end an upwardly extending sound-delivery passage, one end of which communicates with the interior of the casing through a hole in the rear wall. A receiver is arranged vertically within and at the rear portion of the casing and has its diaphragm secured over the hole. A transmitter is rotatably secured to the front of the casing, a hearing tube has one end in connection with the second end of the sound-delivery tube, and means located within the casing are capable of being operated from the exterior for controlling the circuits of the receiver and transmitter.

759,701. Facsimile Telegraph Apparatus. Ernst K. Gruhn, Dresden, Germany, assignor to the Telautograph Gesellschaft mit Beschraenkter Haftung, Dresden, Germany. Application filed November 21, 1902.

Motion of the stylus is decomposed into orthogonal coordinates to effect a variation in the resistance of the line conductors.

759,722. Electric Heater or Rheostat. Max C. Kruger, Chicago, Ill., assignor to the Magneto Electric Company, Amsterdam, N. Y. Application filed October 6, 1902.

Channeled or grooved resistance strips or plates are superposed upon each other and alternately insulated and electrically connected together at the respective ends with means for clamping the parts together.



NO. 759,740.—PRIMARY BATTERY.

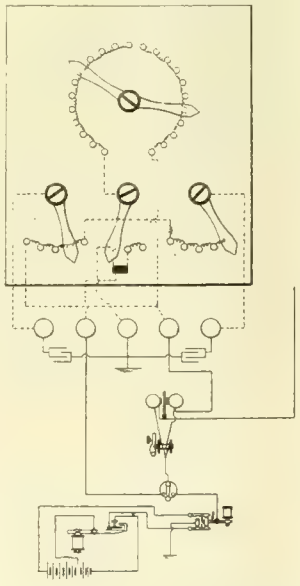
759,740. Battery. Jay Noble and Edward L. Anderson, St. Louis, Mo. Application filed June 1, 1903.

A carbon cathode, a non-decomposable anode, an electrolyte containing nitrogen-peroxid gas, means for condensing the nitrogen-oxid gases evolved in the battery, and means for heating the battery are essental parts of the device. (See cut.)

759,762. Signaling Apparatus for Telephone Switchboards. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed September 14, 1903.

Two line relays normally connected between the free pole of the battery and the two limbs of the line, respectively, each through a back contact of the other relay, are supplied with front contacts adapted alternately to ground the respective limbs of the line. Two signals, one at each switchboard division, are connected between the free pole of the battery and the respective limbs of the line.

759,771. Signal Apparatus for Telephone Switchboards. De Witt C. Tanner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed March 27, 1902.



NO. 759,797.—RHEOSTAT.

A signal permanently associated with one line and normally controlled by a magnet thereof is supplied with means made operative in uniting the two lines of the circuit for bringing the signal under the co-operative control of magnets in both lines. (See cut.)

759,796. Lightning Arrester. John C. Barclay, New York, N. Y. Application filed September 9, 1903.

In a combined fuse holder and lightning arrester fuse-holding spring clips are secured to a base and arranged to receive a fuse cartridge. A lightning arrester is located between the base and the position to be occupied by a fuse, and comprises conducting plates, an insulating member separating them, and two spring arms for holding the plates, the arms secured to the base and arranged substantially parallel thereto. One arm is offset slightly from the base, to permit spring action, the other is offset to a greater extent to afford space between it and the first arm for reception of the plates.

759,797. Rheostat. John C. Barclay, New York, N. Y. Original application filed September 9, 1903. Divided and this application filed November 18, 1903.

In a telegraph rheostat is variable resistance adapted for inclusion in an artificial line. A separate terminal is connected to an intermediate point in the resistance, and adapted for connection to a main line to compensate for battery resistance. (See cut.)

759,798. Electrolytic Apparatus. Henry S. Blackmore, Mount Vernon, N. Y. Application filed July 22, 1903.

Electrolytic apparatus comprises a receptacle divided by a partition into compartments communicating at the lower part, a liquid cathode in the lower part of the receptacle separating it into independent chambers by contact with the lower edge of the partition and an anode. An electrolyte in the anode chamber above the cathode is oxidizable in the separate or oxidizing chamber. Means supplemental to the weight of the electrolyte maintain the level of the cathode underneath the electrolyte below its level in the oxidizing chamber.

759,799. Electrolytic Apparatus. Henry S. Blackmore, Mount Vernon, N. Y. Original application filed July 22, 1903. Divided and this application filed February 23, 1904.

As a means for removing an easily oxidizable metal from a molten alloy which is solid at ordinary temperatures, particles of granular material electronegative with relation to the oxidizable metal are brought in contact with the alloy. An oxidizing electrolyte is brought in contact with the granular material and alloy and means are provided for effecting an automatic circulation of the cathode between the points where it receives and gives up the light metal.

759,814. Door-lock-actuated Circuit Breaker. Grayson G. Knapp, Auburn, N. Y., assignor of one-half to Charles S. Averill, Syracuse, N. Y. Application filed February 13, 1903.

Associated with the sliding bolt of a door lock is a casing having a U-shaped spring-pressed sliding contact mounted therein. Terminals are in the casing for engagement with the arms of the sliding contact, the terminals being in circuit. An insulating block is mounted on the contact, and adapted for engagement with the bolt.

759,825. Wireless-telegraph Apparatus. Joseph Murgas, Wilkesbarre, Pa. Application field October 2, 1903.

In a sending apparatus for a wireless-telegraph system is a circuit operatively related to a spark gap, operated by interrupters, each having a terminal connected to the other interrupters and the circuit. A common means connects the other terminals of the interrupters to the circuit at will.

759,826. Method of Communicating Intelligence by Wireless Telegraphy. Joseph Murgas, Wilkesbarre, Pa. Original application filed October 2, 1903. Divided and this application filed February 24, 1904.

The method of communicating intelligence by space telegraphy consists in transmitting and receiving disconnected signal elements, each differing in spark frequency from the others, the spark frequencies lying within the range to produce tones.

759,835. Coherer. Austin H. Stewart, Nashville, Tenn. Original application filed June 18, 1903. Divided and this application filed October 20, 1903.

A tube, terminals, metallic substance, an agitator within the tube and a shaft for operating the agitator comprise the coherer.

759,836. Generator for Telephone Calls. Ernest H. Strauss, Chicago, Ill. Application filed November 17, 1902.

A telephone generator embraces a magnet, an armature arranged within the field of the magnet, normally separated overhanging contact springs, a sliding and rotating armature-actuating means, and means connecting up the parts in electrical circuit. The armature-actuating means are adapted to engage one of the contact springs and to move the contact spring into contact or engagement with the companion contact spring.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on May 17, 1904:

362,957. Electromagnetic Thermoscope. Henry J. Haight, New York, N. Y.
363,079. Electrical Device for Operating Steam Whistles. William M. Pease, Pittsburg, Pa.
363,106. Method of and Apparatus for Forming Armature Cores. Frank Wynne, Westminster, County of Middlesex, England.
363,126. Self-exciting Alternate-current Electric Generators. James Easton, New York, N. Y.
363,127. Safety Contact Brush for Dynamo-electric Machines. James W. Easton, New York, N. Y.
363,128. Dynamo-electric Machines. James W. Easton, New York, N. Y.
363,129. Method of and Apparatus for Detecting Short-circuits in Dynamo-electric Machines. James W. Easton, New York, N. Y.
363,158. Transmitter for Electric Typewriters. James F. McLaughlin, Philadelphia, Pa.
363,183. Electric Switch. Elihu Thomson, Lynn, Mass.
363,184. Automatic Commutator Adjuster. Elihu Thomson, Lynn, Mass.
363,185. Alternating-current Electric Motor. Elihu Thomson, Lynn, Mass.
363,186. Alternating-current Motor Device. Elihu Thomson, Lynn, Mass.
363,188. Telegraphy. Francois Van Rysselberghe, Brussels, Belgium.
363,215. Electric Striking Device for Clocks. Silas C. Dickinson, Wilton, Iowa.
363,250. System of Electrical Distribution for Railways. William J. McElroy, Pittsburg, and John D. Nicholson, Allegheny, Pa.
363,290. Electrical Matting. Alexander H. Freeman, New York, N. Y.
363,304. Pocket Battery. Lucius T. Stanley, Brooklyn, N. Y.
363,332. Device for Attaching and Detaching Electric Lamps. William J. Hammer, Boston, Mass.
363,333. Indicator for Electric Lighting Systems. William J. Hammer, Boston, Mass.
363,334. Electrical Switch. William J. Hammer, Boston, Mass.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, MAY 28, 1904 No. 22

Combined Heating and Lighting Central-station System in Indianapolis.

The combination electric-lighting and steam-heating plant owned and operated by the Merchants' Heat and Light Company of Indianapolis, Ind., has many unique features about its organization, installation and ownership. During the winter of 1901-02 the natural-gas situation at Indianapolis was such that the prominent business men began to look around to see what was best to replace the gas, which was rapidly diminishing and which since that time has been entirely eliminated from the city on account of its failure. A committee was appointed by the Merchants' Association to investigate and report what was best to replace the gas, as the smoke caused by the use of coal was fast becoming a nuisance. This committee, after making a careful investigation, reported back to the association that its investigation had caused it to believe that a central-station heating plant, using steam, was entirely feasible and commercial, and also that, in the installation of the same, it was feasible and commercial to make the plant a combination lighting and heating plant. Estimates of cost and operation were submitted, and after giving them careful consideration the association decided to organize a company for the purpose of building a plant in accordance with the committee's investigation and report. The company was duly organized under the laws of the state of Indiana, and its entire capital was subscribed by members of the association.

Application was made to the Board of Public Works for a franchise, this franchise to permit the company to furnish heat and light to the members of the Merchants' Association. The Board of Public Works, however, refused to grant a franchise that would only provide service for the members of the association, but would grant a franchise provided that it be based upon furnishing service not only to members of the association but to the public in general. Accordingly a franchise was granted for a period of 25 years, covering the entire city, granting the use of the streets and alleys for the purpose of laying down mains for heating purposes, the installing of electrical conduits, the erection of poles and placing of wires thereon and the maintaining of the plant. This franchise was granted in July, 1902, and the company proceeded to the erection of its plant. On January 1, 1903, it commenced the furnishing of heating service, and in February it commenced the furnishing of current for lighting and power purposes.

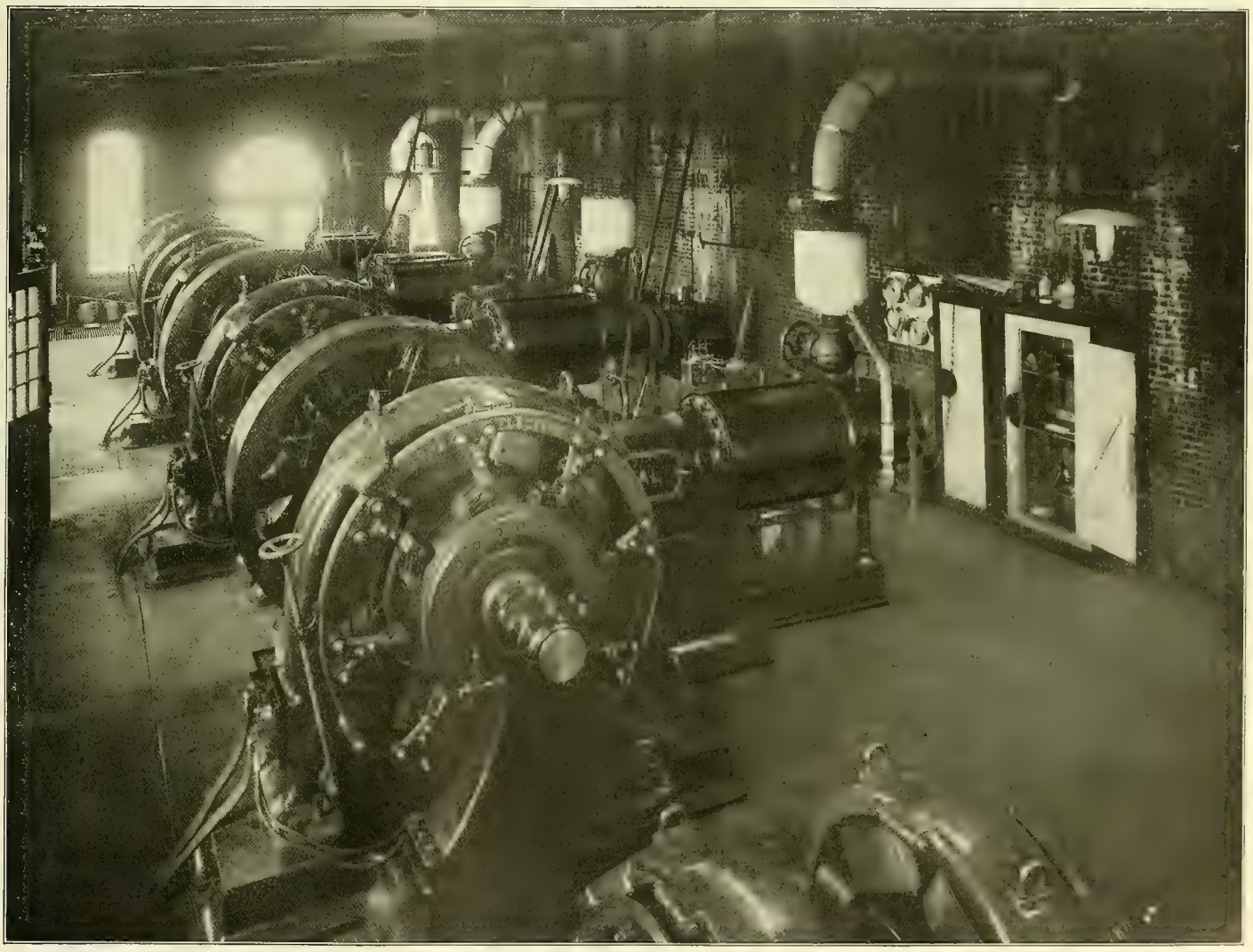


FIG. 1. COMBINED HEATING AND LIGHTING CENTRAL-STATION SYSTEM IN INDIANAPOLIS.—INTERIOR OF GENERATOR ROOM.

The district served by mains is, as indicated on the map (Fig. 2), the heavy lines indicating the steam mains and the broken lines the conduit system, all in the downtown district, or what is known as the "underground district."

In the installation of the plant it was the desire of the company to install a system liberal in its capacity so as to allow for the future and at the same time operate at a low-operating cost.

In the installation of the street work numerous obstructions were encountered. On account of the steam mains being of such large sizes, it was necessary to have the cutting and fitting of all sizes over 12 inches done at the factory. This required the work to be installed in strict accordance with the details, and in order to not encounter the obstructions of other companies it was necessary to install the work below the obstruction line of the other companies. The underground construction work is illustrated clearly in Fig. 3. The main trunk line of steam-main systems averages from 8½ to 12 feet below the grade of the street.

The steam-heating system in use is what is known as Schott's regulated steam system, consisting of a single-pipe system, graded. At all low points any condensation collected is trapped to sewers. The service is carried into the buildings and connected to a single-pipe system, the building equipment being installed as usual—a single-pipe gravity system—with the exception that all condensation, before being passed to the sewer, is passed through cooling coils so as to reduce its temperature and at the same time get some benefit out of the sensible heat retained by the condensation. This cooling coil is usually placed so as to assist in heating basements, or fresh air is taken from the outside and tempered by this surface to take care of the ventilation in the buildings. The amount of radiation required to be set is based upon 100° difference in temperature, with steam in the surface at atmosphere. The size of piping in buildings is based upon 40 feet velocity in mains and 20 feet velocity in risers.

Numerous tests have shown that the various installations will circulate perfectly on two-ounce pressure. Each installation is governed by a regulator, this regulator being placed on the service at its entrance to the building, the thermostat being placed at some central point which controls the air supply to the regulating valve. This air supply is furnished by an air line, which is laid throughout the system, a pressure of 15 [illegible] on it at all times.

To illustrate the value of a regulated system, reference may be had to the curve sheet (Fig. 4). This chart is one of [illegible] during the last heating [illegible]

conditions under which various buildings are operating. It covers a period from midnight of January 30, 1904, to 8 a. m., February 5, 1904. The upper line represents the temperature maintained inside of building, the maximum reaching 73° and the minimum 70°. The lower line represents the actual outside temperature, the maximum reaching 33° and the minimum zero. During this period the thermometer practically touched zero three times. The careful consideration of the building requirements and the heating surface, the latter to be installed in a proper manner and in the proper place in order evenly to distribute and at the same time get the equalized temperature as indicated by the chart.

During the last season the company had connected to its mains 127 buildings, having a total connected surface (not including cooling coils) of approximately 200,000 feet.

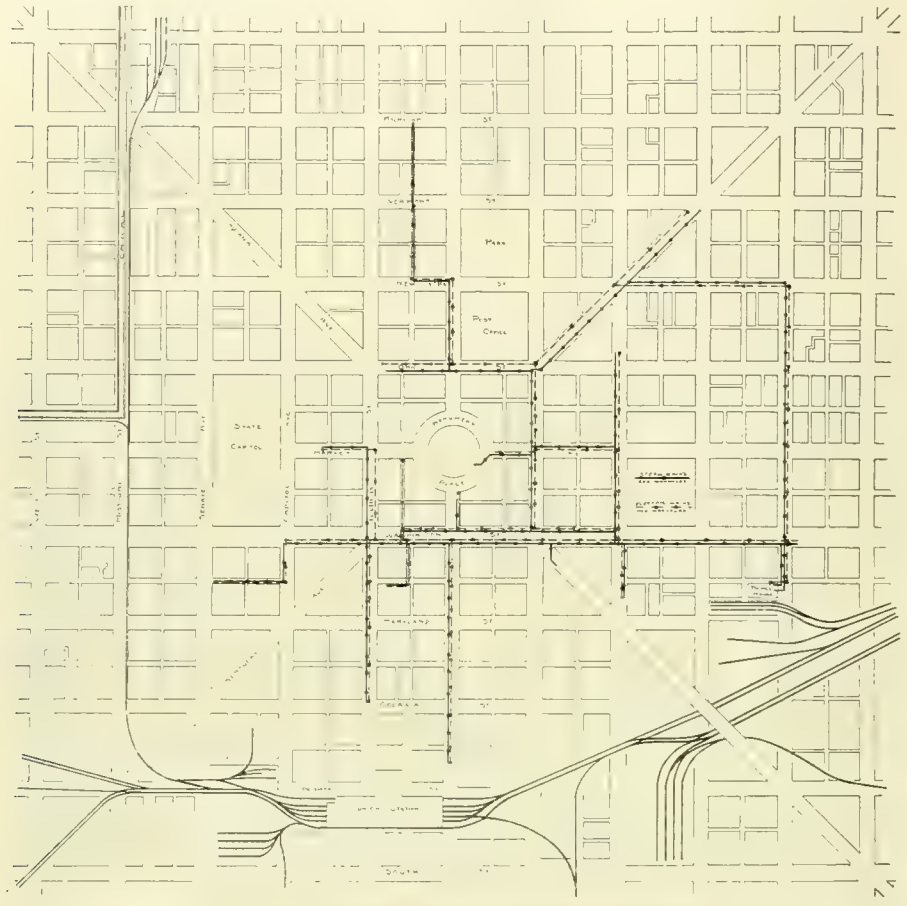


Fig. 2. Map of Territory Covered by Heating and Lighting System

Fig. 3. Underground Construction Showing Steam Main and Wiring Conduits.

COMBINED HEATING AND LIGHTING CENTRAL-STATION SYSTEM IN INDIANAPOLIS.

straight line indicated at 60° indicates the position of the regulating valve when wide open. The heavy line indicated at 50° represents the regulating valve when closed. The shaded line represents the actual position of the valve during the entire period.

The building in question, from which these data were taken, is a four-story store building, exposed north and south, with full glass exposures, and has a depth of 192 feet, and at all times the temperature in the building is controlled by the regulator, all hand control being eliminated.

It will be noted from the chart that the maximum condensation per square foot per hour during this period was 0.187 pound per square foot per hour. The minimum condensation per square foot per hour was 0.072 pound per square foot per hour.

The plant as designed and the method of figuring radiation are such that the average maximum condensation per square foot per hour (and this including all street losses) shall not exceed 0.14 pound per square foot per hour, or 700 pounds of condensation per square foot per season.

In order to confine the maximum condensation per square foot per season to these figures it requires

Fig. 5 illustrates the side view of the power house, with stack immediately in the rear. The power house at the present time contains three 300-kilowatt generators and one 200-kilowatt generator of the Western Electric Company's manufacture, these machines being 250-volt, direct current. Each generator is direct connected to an Ideal compound engine. At the present time the company is installing two 750-kilowatt Westinghouse-Parsons turbo-generators, which will give the plant a total kilowatt capacity of 2,600. This has become necessary on account of the large volume of business obtained by the company in order to give it ample capacity to furnish the necessary current.

The present electrical-distribution system consists of a three-wire compensator system, there being a complete system of mains throughout the district. Feeders run from the power house to various centers, thereby maintaining an equalized pressure on the distributing-main system. A perfect balance is maintained on the system by the use of compensators. The compensators (shown with the switchboard in Fig. 6) each have a capacity of 135 kilowatts, but the balance of the system is so good that with a 1,100-kilowatt load on the power house the maximum in balancing of system does not exceed 160 amperes.

A general view of the engine room is given in Fig. 1. The present boiler equipment consists of seven 250-horsepower Wickes boilers, each being equipped with Roney stokers. There is now under contract for installation four 612-horsepower Stirling boilers. These will be equipped with Greene chain grates, and coal-handling apparatus is being installed. All coal bins have a capacity of 500 tons.

The plant is run non-condensing during the heating season. The maximum back pressure on engines is five pounds. During the summer season the plant is run condensing. As water is not available for condensing purposes a cooling-tower system was installed and water taken from wells for the purpose of supplying water. The water consumption per indicated horsepower during the heating season when running against a back pressure of five pounds is 29 pounds per indicated horsepower per hour. The water consumption per indicated horsepower during the summer season, when running condensing, is 17 pounds per indicated horsepower per hour. On account of the conditions under which the engines are called upon to work, the ratio of cylinders became special instead of standard, and average economies were arrived at instead of sacrificing during the heating season in order to get a higher economy during the summer season.

With the installation of the new turbo-generator sets a sub-station is being placed in the center of the district, this sub-station supplying direct current into the direct-current system through rotaries. Throughout the entire district are being run four-wire, three-phase circuits, so that in the future no more copper will be necessary in the low-tension system. All non-inductive loads will be placed on the alternating-current system in this district, and all motor loads will be placed on the direct-current system, the outlying districts, however, being covered with three-phase alternating-current circuits only, being operated at 2,300 volts, with a frequency of 60 cycles.

All engineering and construction features, together with the organization and management of

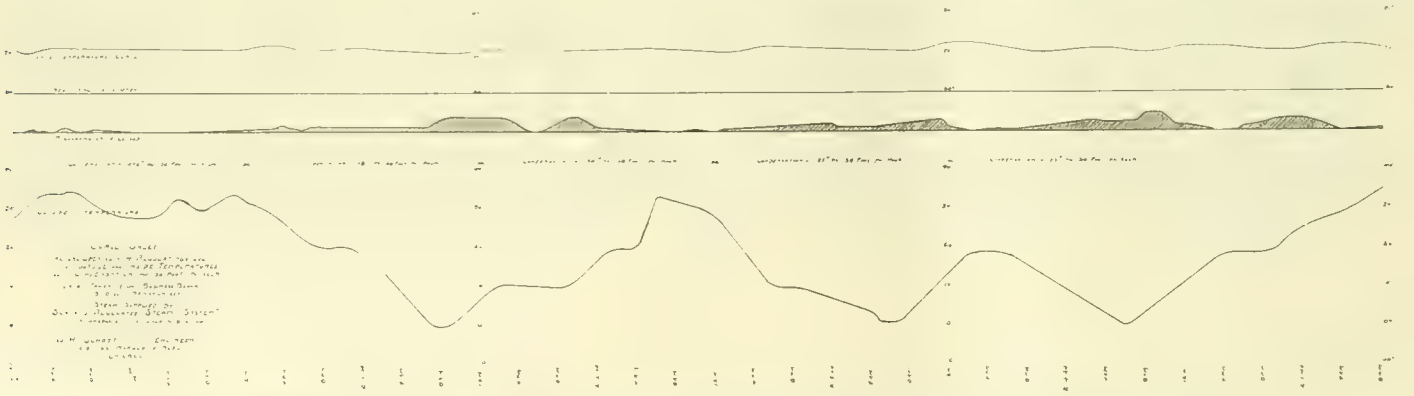


FIG. 4 COMBINED HEATING AND LIGHTING CENTRAL-STATION SYSTEM IN INDIANAPOLIS.—TEMPERATURE REGULATION CURVES.

the business, were in charge of Mr. W. H. Schott, consulting engineer, of Chicago. The complete success of the enterprise has been due to his earnest efforts in installing the plant and establishing its business on a commercial basis.

Annual Meeting of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers was held on May 17th and 18th at the Chemists' Club in New York city. Discussions followed the reading of seven well-prepared papers. President Bion J. Arnold was in attendance to perform the duties of his office.

On the first day four of the papers were read and discussed at the morning and evening sessions, the afternoon being given up to an inspection of the Rapid Transit subway. The papers read were "Predetermination of Sparking in Direct-current Machines," by W. L. Waters; "Effect of Self-induction on Railway-motor Commutation," by E. H. Anderson; "On the Calculation of Line Batteries," by W. E. Winship, and "Data and Tests on a 10,000-cycle-per-second Alternator," by B. G. Lamme. At the evening session the result of the election of officers was also announced as given in the Western Electrician last week.

Three papers were read on the second day and were "Notes on Flywheels," by H. H. Barnes, Jr.; "The Single-phase Induction Motor," by W. S. Franklin, and "Wave-form Variations of a Long-distance Line," by George H. Rowe. Before the meeting adjourned it was announced that subscriptions of $5,000 each, for the Union Engineering Building land and building fund, had been received from Thomas A. Edison and Dr. M. I. Pupin, and $1,000 from E. W. Rice, Jr. The subscriptions to this fund now amount to $60,000.

Report of the Board of Directors.

One of the important features of the meeting was the report of the board of directors for the fiscal year ended April 30, 1904. This report shows the Institute to be in a prosperous condition and indicates a healthy growth. An abstract of this report is here given:

Committee on Papers.—Seven meetings have been held for which arrangements have been made by this committee, although with two exceptions the number of papers has by request been limited to two in order to allow more time for discussion. Of the 17 papers four were voluntarily submitted by the authors, while 13 were prepared at the request of the committee. Papers are more readily obtained when a specific subject is suggested, and the diverse interests of the personnel of the committee have facilitated more intelligent work in this direction. This has also led to the organization of the discussions which have been more spirited and valuable. The holding of branch meetings has also led to the accumulation of additional material, which in many cases is of great importance, due to the practical experience of members working under varied conditions in different parts of the country.

The Editing Committee.—The duties of this committee have been largely increased by the great increase of matter from branch meetings. It has also brought about the printing of papers in the monthly editions sufficiently in advance of meetings to enable members to prepare themselves to discuss them intelligently, and also permit those who are at a distance to send in contributions to discussions so that they may be read, or incorporated in the printed record.

Finances.—An important change in the care of funds has been made by this committee. Separate bank accounts have been established representing certain funds which are drawn upon only for the specified purpose of said funds. In order to carry out this plan it was necessary to convert into cash seven $1,000 United States bonds held by the Institute, from which $7,409.37 was realized.

The ordinary receipts of the Institute during the year ended April 30, 1904, were $40,986.78. This amount was made up of $32,724.12 from members, including entrance fees from associates and transfer fees from members; $1,203 in students' dues, and $7,059.66 from advertising and miscellaneous sources. The ordinary operating expenses of the Institute were $36,394.20, leaving a balance of ordinary receipts over expenses of $4,592.58.

The bank balance available for current expenditures on April 30, 1904, was $7,861.44. Adding this sum to $8,875.63, the market value of the United States bonds owned by the Institute makes a total of $16,737.07 in cash or its equivalent. Subtracting from this amount $4,400 as due to the life-membership fund gives a net balance of $12,337.07 in cash or its equivalent, immediately available for any ordinary or extraordinary expenditure of the Institute.

The accounts payable on April 30, 1904, were $246.44, against which were accounts receivable amounting to $9,893.42, consisting almost entirely of arrears in dues, but not including any debts owed by members suspended or dropped for non-payment of annual dues. During the year the plant of the Institute was increased by the purchase of transactions, library books and fixtures and office furniture to the extent of $3,523.19, all of which was charged to current revenue.

The inventory valuation of the library has been increased over the amount reported last year by $12,300.38, for the reason that statistics were not available at that time to show its actual value. It has since been appraised by a special committee and the amount of $21,737.13 accepted as satisfactory.

The Board of Examiners.—All applications for transfer from the grade of associate to member, for election as associates, or for enrollment as students are considered by the board of examiners. Ten meetings have been held and a grand total of 1,042 applications have been reported to the board of directors.

Committee on Increase of Membership.—The record of an increase of membership by the election of 798 associates is a sufficient indication of the work of this committee in the past, but it is still engaged in its efforts to reach the very large number of eligible electrical engineers, who will no doubt appreciate the benefits of membership when the matter is properly presented to them. It believes a systematic canvass may yet be made through the branch organizations, which will be of great service to the Institute.

Local Organizations.—The Institute branches have been increasing in number and in interest. There are at present 29, of which 15 are in cities and 14 are student meetings in technical schools. The average aggregate attendance at these meetings is 1,250 (about 400 being students). The branch meetings are reaching our members and the young men who are to be the future electrical engineers of the country in a way which enormously increases our activity and our influence.

FIG. 5. EXTERIOR OF INDIANAPOLIS HEATING AND LIGHTING STATION.

International Electrical Congress.—While the actual organization of the congress has been carried on independently of the Institute, there has been continued and harmonious co-operation, which, it is believed, will lead to the best possible results. The Institution of Electrical Engineers will be the official guest of the Institute, while all foreign delegates and members of various foreign electrical organizations will participate in the circular tour arranged by the International Electrical Congress general reception committee and the committee on transportation and arrangements.

Cadmium Cell.—In accordance with a resolution adopted at the Niagara Falls convention, a committee appointed to report upon the adoption of a standard cell has prepared specifications and suggests that it be given the name "Weston Normal Cell." It is understood that this matter will be submitted to the International Electrical Congress and that the cell will become a universally recognized standard.

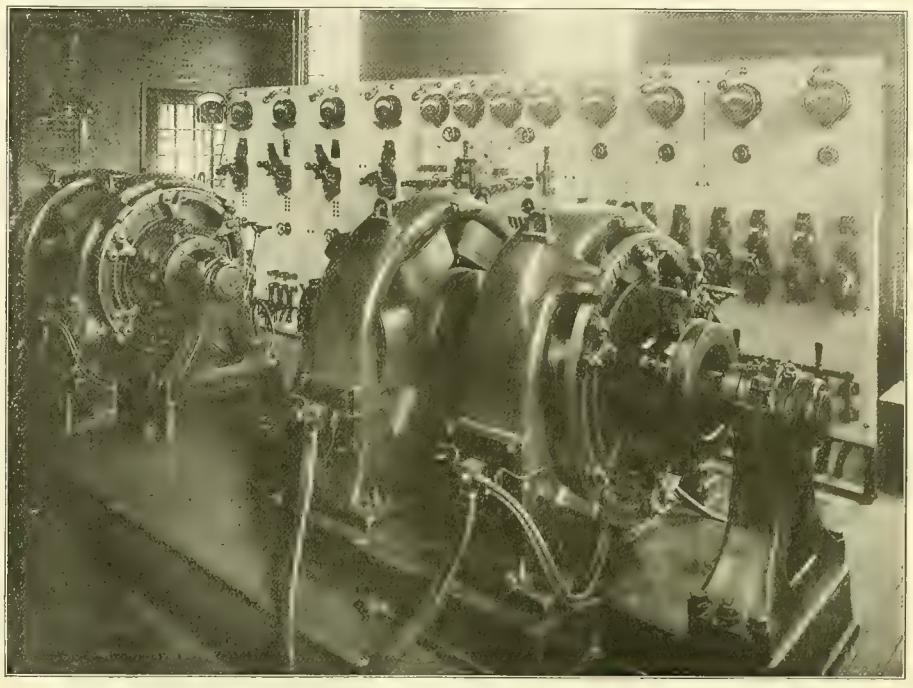


FIG. 6. COMBINED HEATING AND LIGHTING CENTRAL-STATION SYSTEM IN INDIANAPOLIS. -SWITCHBOARD AND COMPENSATORS

Union Engineering Building.—This project which was brought before the board of directors and the annual meeting a year ago has assumed a different form, owing to the declination on the part of one of the national engineering societies to enter into it. This made it necessary to obtain from Mr. Carnegie his assent to a renewal of his offer to the other societies, which he did, increasing his gift by 50 per cent.

The land has been purchased in behalf of the societies by Mr. Carnegie, who has advanced $502,000 for the purpose, for which he is to be eventually reimbursed. The United Engineering Society, which is to hold the property, has been provided for under the laws of New York state, each of the three engineering societies named in Mr. Carnegie's letter being represented upon its board of trustees.

An architectural competition has been arranged in which six architectural firms have entered, and designs are to be submitted to the joint committee on June 20, 1904. It is expected that the demolition of the buildings on the property will begin July 1, 1904, and that this and the construction of the new building will proceed continuously thereafter.

Building Fund Committee.—Four announcements have been issued by this committee, which reports that $41,000 has been pledged toward the amount of $200,000, the estimated requirement for the purchase of land, upon which Mr. Andrew Carnegie will erect the Union Engineering Building. The committee has received cordial and enthusiastic letters from branches indicating that a strong regard for the Institute has been developed, which should encourage a liberal policy toward them on the part of the Institute as a whole.

Transmission Committee.—During the last year this committee arranged for papers and discussions at one day's session of the convention at Niagara Falls and a meeting in New York, March 25th. It is now making preparations for a special meeting at Chicago, June 21st and 22d, 1904, to be devoted exclusively to transmission subjects. A report of the committee at this meeting will embody the returns received from the list of questions distributed last year. The success attained in gathering information in this field has led to a suggested plan by the chairman that similar committees composed of engineers of experience in the more important branches of electrical work could, by a systematic campaign, take up the discussion of important problems at certain meetings of the Institute.

Engineering Data.—The chairman of this committee has made an earnest effort to gather information which could be utilized for the benefit of the membership. Nothing could be accomplished without co-operation, and having received pratically no support, no progress has been made.

By-Laws.—During the last two years a committee has been engaged in framing by-laws in order that

the business and professional affairs of the Institute might be systematized. At the meeting of the board of directors, April 22d, the by-laws reported by this committee were adopted and are now in force. They have been printed in the April issue of the Transactions, and will subsequently be issued separately or in conjunction with the constitution. If the membership will consult these by-laws the secretary's office would be relieved of much correspondence, as many inquiries regarding the administration of Institute affairs will then be unnecessary.

Membership.—The total membership at the close of last year's report was 2,229. During the year there have been 13 deaths, 12 resignations and 84 dropped as delinquents. These, together with some elected before May 1, 1903, and since qualified, make the grand total April 30, 1904, 3,027. The gain in membership during the year was 798, an increase of 35 per cent. As there are now applications pending and associates elected but not yet qualified to the number of 165, there is an immediate prospective total of about 3,300 members.

Deaths.—There have been the following deaths during the year: Members, Frankland Jannus, T. E. Theberath; associates, E. T. Gilliland, Benjamin Brown, J. J. Crawshaw, C. D. Crandall, W. O. Garrison, Francis Forbes, G. S. Johnson, J. L. Kebler, J. B. O'Hara, W. H. Simpson, F. E. Perry.

In the report of the library committee it was stated that "during the last year no accessions by gift to the funds of the library have been received, and a much smaller number of books have been added to the library through donations than in the previous two years. This does not, however, signify any decrease of interest in the library on the part of members, but follows from the fact that in view of the great sum of money to be raised by the Institute to fulfill the obligations assumed in connection with the Union Engineering Building, your committee has refrained during the year from pressing upon the membership the claims of the library to their support." During the year $1,000 was expended for the purchase of books in the English, German and French languages.

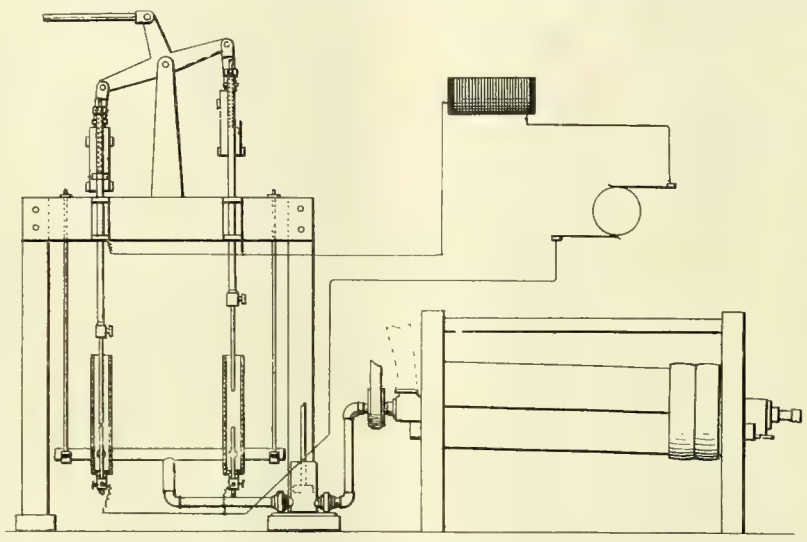
Electrical Process of Treating Flour.

Certain gaseous mediums are sometimes resorted to for purifying and bleaching flour. These gases act to reduce the carbohydrate constituents of the flour and increase the protein. The production of this gaseous medium is brought about by means of the electric arc, and the following is a description of an apparatus for this purpose, recently patented by James N. Alsop of Owensboro, Ky.:

The gaseous medium employed is atmospheric air which has been subjected to the action of an arc or flaming discharge of electricity. The resultant gas was discovered, first by laboratory experimentation and then by actual practice on a commercial scale, to possess the property of causing a material decrease in the percentage of the carbohydrate contents of the flour subjected to its action and a practically corresponding increase in the proteids, thus greatly increasing the nutritive in contradistinction to the heat-giving qualities of the flour. It has not been possible accurately to identify by chemical formula this gaseous medium. It has been determined by chemical analysis, however, that air treated in the manner to be described contains nitrogen peroxide (NO_2 or N_2O_4) and traces of ozone (O_3) and is in a state of ionization—that is to say, the air is separated into atoms or combinations of atoms, which are electrically charged, some negatively and some positively, and are thus in a condition to enter into new combinations.

In the art of milling it is desirable to manufacture flour which shall be white in color without destroying its nutritive qualities. Flour subjected to the action of air which has been subjected to the flaming discharge of electricity will be bleached or purified so as to render it white in color, and this bleaching or purification of flour is effected without destroying any of the nutritive qualities thereof, as shown by chemical analysis. Portions of the treated and untreated flours, equal by weight, if blended with equal quantities of distilled water form two doughs very different in consistency, that from the treated flour being apparently drier and much more elastic than that from the untreated flour, the dough from the latter being "short" and relatively non-elastic. When equal portions, by weight, of the two flours are blended with water sufficient to make a dough suitable for baking, it is found that the treated flour requires more water—from five to seven per cent. more. It has also been found that the treated and untreated flours from the same barrel when made into dough and baked will produce loaves of bread which upon being cut or broken show the same difference in color as was shown by the treated and untreated flours, the bread from the treated flour being much whiter.

Chemical analyses of the treated flour have demonstrated that the change is largely due to the fact that there is a chemical combination of a relatively large amount of nitrogen or nitrogenous compounds with the treated flour. It is also believed that such chemical combination of the nitrogen with the flour is facilitated by producing a state of ionization of the air, and it is possible that the ionized air itself in some other way acts upon the flour to assist in producing the changes herein indicated. Two chemical analyses of the flour were made, the first made to determine the extent and character of the change wrought in the constituents of the flour and the second made to determine the amounts of nitrogen which the untreated and treated flour, respectively, contains. Two samples of flour were submitted for analysis to a professor of chemistry in Columbian College, Washington, D. C. One of these samples was taken from a batch of flour before its treatment by the process and the other was taken from the same batch of flour after its treatment.



APPARATUS FOR ELECTRICALLY TREATING FLOUR.

The untreated flour showed the following constituents in the proportions named: Water, 9.84; starch, etc., 74.11; proteids, etc., 14.99; ash, 0.44; fat, 0.62. The flour which had been treated showed the constituents in the following proportions: Water, 10.13; starch, etc., 62.24; proteids, etc., 26.71; ash, 0.30; fat, 0.62. It will thus be seen that the flour which had been treated showed an increase of 11.72 parts proteids and a decrease of 0.14 parts ash and of 11.87 parts starch. The increase in the proportion of proteids relative to that of the other constituents of the flour, especially of starch and ash, is a highly advantageous result, as flour having such proportion of proteids is of course far more nutritive than the ordinary flour.

The second analysis of the flour was conducted by Prof. Henry, professor of physics at Princeton University, and his assistant professor, and it was found that while the untreated flour contained .054 of a grain of nitrogen per one gram of flour the treated flour contained .075 of a gram of nitrogen per one gram of flour.

The accompanying drawing indicates the apparatus by means of which the air is subjected to the action of the electric arc or flame. The apparatus comprises a frame having base-blocks, uprights and transverse-supporting beams, which latter support in any suitable manner, by means of rods, a conduit closed at its end and connected centrally to a pipe, which in turn is operatively connected to an air pump having an eduction pipe. Communicating with and extending upward from the conduit are shown two tubes opened at their upper end. Extending upward through the lower end of each tube is an electrode adjustably supported in holders by means of set screws. Extending downward through the upper end of each tube is a movable electrode. The upper electrodes are supported in an automatically adjustable manner.

The operation of this apparatus is as follows: Assuming the parts to be in the positions shown, the current is passing through the two electrodes at the left. As the walking beam is operated to raise the upper electrode an arc is formed and the air contained within the tube surrounding these electrodes will be converted into a gaseous medium having the properties indicated. This gaseous medium is withdrawn from the tube by means of the action of the air pump and is delivered by the pump through the eduction pipe to the reel at the right, where it is mixed with the flour. As the left-hand electrode continues to rise the one on the right will of course be correspondingly lowered and the same process gone through with on that side.

In treating air by this apparatus it is possible to employ a current of low potential. With the low-potential current some means must be provided for feeding the arc, or, in other words, to meet the increased resistance offered as the electrodes are moved farther apart. This requirement is met by the introduction into the circuit of a self-induction coil, the action of which is as follows: When either pair of the electrodes is brought together, thereby causing short-circuiting of the electrifying apparatus, the coil is excited to a high degree of magnetism, and as the electrodes are pulled apart and are followed by the arc or flash, which increases the resistance of the circuit, the strength of the magnetism of the coil will be diminished. This change in the strength of the magnetism generates an extra current in the circuit or coil in the same direction as the original current and proportional in strength to the magnetic change, all as is well known. As the electrodes are drawn apart to form arcs the resistance of the circuit is additionally increased, causing the strength of magnetism in the coil to be additionally diminished, thereby causing the potential at the electrodes to rise to the necessary strength to meet the resistance of the air or gas between them, as the distance between the electrodes is increased until the opposite pair of electrodes are brought together and short-circuit the arcs. The contact of the electrodes lasts for an appreciable length of time, and the time during which the electrodes are in actual contact is sufficient to enable the coil to become thoroughly saturated. As a result when the electrodes are separated to draw off the arc the potential of the current is increased in the manner explained, and not only so, but the arc is fed with current and prevented from appreciable attenuation and maintained at a practically uniform density, which is the maximum density obtainable at the time. This may be further explained by stating that in practice the arc drawn off rarely exceeds 4½ inches in length, whereas with a machine operating under the conditions described an arc 18 inches can be drawn off before the arcing distance is passed.

The reel for subjecting the flour to the gas, which is preferably hexagonal in cross section, is formed of wood or other suitable material and closed on all sides and at the ends except where the flour enters and leaves. Within the reel is a series of longitudinal ribs for the purpose of elevating the flour as the reel revolves so that flour may be thoroughly brought into contact with the gaseous medium supplied from the apparatus.

In the use of apparatus of this sort a fire hazard has been pointed out by S. H. Lockett, manager of the insurance survey bureau. He urges that the entire surroundings of the arc apparatus should be fireproof and in a separate building, the ionized air being passed to the purifying room through tubes.

The Thorold and Lake Erie Railway Company of Canada proposes the construction of an electric railway from Thorold to Port Colborne and Fort Erie, with a branch from Port Colborne through Dunville and Cayuga to Brantford. The road is projected in connection with the Wolvin Lake Transportation schemes, and will be used to carry passengers from Lake Erie to Lake Ontario, across the Welland Peninsula, in order to avoid delays in passing through the Welland Canal. Among those interested in the project are J. W. Norcross of Port Colborne and G. T. Smith of Quebec.

Installation Plan of the Palace of Electricity.

To show the location of the various exhibits in the Palace of Electricity at the Louisiana Purchase Exposition the accompanying diagram has been prepared. It indicates the plan of installation and designates the space occupied by each exhibitor. Following is a list of the exhibitors whose names do not appear on the diagram, together with the number and block indicating the location:

BLOCK 1.

1. Cassier's Magazine Company.
2. C. E. Yetman.
3. P. B. Delaney.
4. McGraw Publishing Company.
5. Gray National Telautograph Company.
6. Charles Kaestner & Co.
7. A. F. Collins.
8. Walter B. Phillips.
9. Western Union Telegraph Company
10. Postal Telegraph-cable Company.
11. Automatic Fire Alarm Company.
12. Windsor & Kenfield Publishing Company
13. Western Electrician.

BLOCK 2.

Lincoln Electric Company.

BLOCK 3.

1. Burdett-Rountree Manufacturing Company.
2. Burnham-Williams & Co.
{ Standard Underground Cable Company.
{ McRoy Clay Works.

BLOCK 4.

1. Sub-station.
2. Waite-Bartlett Manufacturing Company.
3. Kny-Scheerer Company.
4. W. Scheidel & Co.
5. National Cash Register Company.
6. Howard Electric Novelty Company.
7. Heinze Electric Company.
8. R. V. Wagner & Co.
9. American Electrotherapeutic Association.
10. Hinton & Tarkington.

BLOCK 5.

1. Dayton Electric Manufacturing Company.
2. Electric Controller and Supply Company.
3. Dicke Tool Company.
4. C. H. Thordarson.

BLOCK 6.

1. Thresher Electric Company.
2. National Electric Company.

BLOCK 8.

Wesco Supply Company.
Triumph Electric Company.
Warren Electric Company.
Peerless Electric Company.
Browning Company.
Adams-Bagnall Company.
Gardner Electric Drill Company.
Warren Electric and Specialty Company.
Wheel Trueing Brake Shoe Company.
Moloney Electric Company.
W. N. Mathews & Bro.
Locke Insulator Manufacturing Company.

BLOCK 10.

Hall Gold and Silver Plating Works.

BLOCK 11.

Carman Projector and Specialty Company.

BLOCK 14.

1. Northern Electric Manufacturing Company.
2. Pawling & Harnishfeger.
3. Ewing-Merkle Electric Company.
Commercial Electric Company.
Sumpter Telephone Company.
Sterling Electric Motor Company.
Lionel Manufacturing Company.
Jandus Electric Company.
Empire Instrument Company.
American Circular Loom Company.
Prometheus Electric Company.

BLOCK 16.

1. Portugal.
2. American Watchman's Time Detector Company.
3. Gould Storage Battery Company.
4. Gould Coupler Company.
5. Sterling Electric Company.
6. Dialt Motor Company.
7. Phelps Company.
8. Japan.

COURT.

1. Electra Water Purifier Company
2. S. R. Dresser.
3. H. B. Camp Company.
4. G. M. Gest.
5. Wyckoff Pipe and Creosoting Company.
6. National Clock Works.
7. Hutchison Wireless Telephone.

BLOCK 19.

1. American Electric and Novelty Manufacturing Company.
2. Robbins & Myers Company.
Eureka Tempered Copper Works.
3. Telephone Hygienic Company.
4. T. E. Clark.
5. Deforest Wireless Telegraph Company.
6. American School of Correspondence.
7. Roth Brother & Co.
8. Gray Telephone Pay Station Company.
9. Controller Company of America.

BLOCK 20.

1. American Electrical Heater Company.
2. James Clark, Jr., & Co.
3. Safety Insulated Wire and Cable Company.
4. Electric Storage Battery Company.

BLOCK 21.

1. Warren Ball-bearing Fixture Company.
2. National Clock Works.
3. Martin Armstrong.
4. St. Louis Brass Manufacturing Company.
5. C. J. Toerring Company.
6. T. E. Clark.

BLOCK 23.

1. Hutchison Acoustic Company.
2. A. F. Collins.
3. American Electric Fuse Company.
4. Central Telephone and Electric Company.
5. Baird Manufacturing Company.
6. D. A. Kusel Telephone and Electric Manufacturing Company.
7. Mexico.
8. Brazil.

BLOCK 24.

1. Faller Automatic Telephone Exchange Company.
2. Automatic Electric Company.
3. Kellogg Switchboard and Supply Company.

BLOCK 25.

1. B. F. Wasson.
2. Benjamin Electric Manufacturing Company.
3. Gervais Manufacturing Company.
4. W. F. Stilz & Co.
5. Purdue University.
6. Weston Electrical Instrument Company.

BLOCK 27.

1. Edison Storage Battery Company.

BLOCK 36.

1. A. S. Aloe.
2. American Carbon and Battery Company.
3. Ontario Power Company.
4. National Carbon Company.
5. American Watchman's Time Detector Company.
6. Electric Gun Company.
7. Shedd Electric and Manufacturing Company
8. Spain.
9. Norton Emery Wheel Company.
10. Denmark.
11. Federal Electric Company.
12. Carl Bajohr.
13. Bristol Company.

BLOCK 37.

1. De Forest Wireless Telegraph Company.

BLOCK 38.

1. Electric Candy Company.
2. Marconi Wireless Telegraph Company.

BLOCK 39.

1. A. Baumgart.
2. M. V. Barlow.
3. H. E. King.
4. United States Electric Signal Company.
5. M. Shearer.
6. Miller Anchor Company.
7. Le Vally Vitae Carbon Brush Company.
8. Dodd & Struthers.
9. Electric Contract Company.
10. Economical Electric Lamp Company.
11. Kester Electrical Manufacturing Company.

INSTALLATION PLAN OF THE PALACE OF ELECTRICITY.

Foreign Exhibitors.

Electrical exhibitors from 11 foreign countries now have their exhibits installed at the World's Fair. The countries represented, their location and the nature of their exhibits are as follows: France—Blocks 37, 38, 39, 40, 41, 81, 84; machines for generating and using electricity. Germany—Block 35; machines for generating and using electricity. Great Britain—Block 7; machines for generating and using electricity. Italy—Block 18; machines for using various applications. Japan—Block 16; generators, dynamos and telephones. Mexico—Block 18; various applications of electricity. Argentine—Exhibit installed in Palace of Manufactures and consists of machines for generating and using electricity. Brazil—Block 23; electric lighting. Denmark—Block 36; electrochemistry. Portugal—Block 36; various applications of electricity. Spain—Block 36; machines for generating and using electricity.

Following is a list of the foreign electrical exhibitors:

France—Eugene and Reis T. Beliot, Paris; J. A. Berne, Paris; L. F. J. Boudreaux, Paris; Compagnie Francaise de Charbons pour l'Electricite, Paris; Compagnie des Trefileries du Havre, Paris; L. and Grellou A. Francois & Co., Paris; Geoffroy & De Lore, Clichy; Alexandre Grammont, Pont-de-Cheruy; Albert Guenee & Co., Paris; Huguet Hillairet, Paris; Legros & Viel, Escamp, Seine-Inferieure; Abel Pifre, Paris; Societe Alsacienne de Constructions, Belfort; Societe d'Applications Industrielles, Paris; Societe Francaise des Cables Electriques, Lyon; Societe Gramme, Paris; Societe "Le Carbone," Levallois-Perret, Seine; Societe pour l'Exploitation des Brevete Dolter, Paris; Societe "l'Eclairage Electrique," Paris; Societe Industrielle des Telephones, Paris; Phillippe Delafon, Paris; M. Eisenmenger, Paris; Henri-Brignoud Fredet, Isere; Hand & Co., Paris; Lathoud Aine', Paris; Leclanche & Co., Paris; C. L. Bardon, Seine; Andre Blondel, Paris; Charles Boulanger, Paris; Louis Clere, Paris; Compagnie Generale d'Electricite, Paris; Denis Fontaine-Souverain, Dijon; Achille Gaillard, Beziers; Edouard Guinier, Paris; Ch. Fils Milde Company; Folembray Poilly de Brigode, Aisne; Hippolyte Portevin, Reins; Societe Anonyme des Anciens Etablissements, Parville; Societe des Etablissements Henry Lepaute, Paris; Societe Gramme, Paris; Vigreux & Brillie, Levallois-Perret, Seine; Gustave Weissmann, Paris; Administration of Postage, Telegraph and Telephone, Paris; Gregoire Bagrachow, Paris; Alphonse Darras, Paris; Eugene Ducretet, Paris; Maximillien Kotyta, Paris; Societe Anonyme d'Electricite and d'Automobiles Mors, Paris; Louis Ancel, Paris; Association des Ouvriers en Instruments de Precision, Paris; Prof. Bergonis, Bordeaux; Maison Breguet, Paris; Gustave Buttet, Marseilles; Chauvin & Armoux, Paris; Compagnie Continentale pour la Fabrication des Compteurs, Paris; Compagnie de Constructions Electroques, Issy-les-Moulineaux, Seine; Compagnie Francaise des Cables Electriques, Paris; Compagnie Francaise des Compteurs, Paris; Compagnie pour la Fabrication des Compteurs and Material d'Usines a. Gaz, Paris; Victor Destombes, Paris; Pierre Epinat, Lyon; Guenee, Albert & Co., Paris; Holzschuch & Bonnemaison, Paris; Lathoud Fils, Paris; L. K. Leon, Paris; Gabriel Lordereau, Lyon; Radiguet & Massiot; Paris; Madame Ravali, Paris; Jules Richard, Paris; Gaston Roux, Paris; Societe Francaise des Electrodes, Lyon; Paul Vaudrey, Paris; Michel Weyl, Paris; Charles Woittequand, Charleville.

French Colonies—Postes et Telegraphes, Tananarive.

Germany—Hugo Bremer, Neheim a. R.; Hartmann & Braun, Frankfort a. M.; Land & Seekabelwerke, Cologne; Siemens & Halske, Berlin; J. O. Zwarg, Freiburg; Prof. Abegg, Breslau; W. Apel, Goettingen; Georg Bartels, Goettingen, Prof. Bredig, Heidelberg; Prof. Classen, Axe la-Chapelle: Prof. Cohen, Goettingen; Carl Diedrichs, Goettingen; Prof. Drude, Giesen; Prof. Elbs, Giesen; Prof. Harries, Berlin; F. Hugerstoff, Leipsic, Erwin Kerker, Breslau, Fritz Koehler, Leipsic; Robert Mittelbach, Goettingen; Prof. Nernst, Goettingen; Prof. Ostwald, Leipsic; Prof. Ruff, Berlin; Gebruder Ruhstrat, Goettingen; W. Schmidt, Giessen; Vereinigte Fabriken fuer Laboratoriumsbedarf, Berlin; C. Conradty, Nuremberg; A. Kruess, Hamburg; Regina Bogenlampenfabrik, Cologne; Schmidt & Haensch, Berlin; G. A. Schultze, Berlin; Siemens-Schuckertwerke, Berlin; C. Lorenz, Berlin; Prof. Borcher, Aixe-la-Chapelle; Reinhold Burger, Berlin; F. O. R. Goetze, Leipsic; Guenther & Tegetmeyer, Brunswick; E. Gundelach, Gehlberg; Keiser & Schmidt, Berlin; Max Kohl, Chemnitz; W. C. Heraeus, Hanau; Leppin & Masche, Berlin; "Magneta" Factory of Electrical Clocks; Richard Mueller-Uri, Brunswick; Physikalisch-Technische Reichsenstalt, Charlottenburg; C. E. Schnee; Siemens & Halske, Berlin; Vesler & Schoch, Leipsic; Otto Wolf, Berlin; Continental Company, Nuremberg; I. Gast, Berlin; Max Judel & Co., Brunswick; Studiengesellschaft fuer Elektrische Schnellbahnen, Berlin; Zimmermann & Buchloh, Berlin; Aeronautisches Observatorium des Kgl. Meteorol. Institute, Berlin; J. & A. Bosch, Strasburg i. E.; Continental Caoutchouc and Gutta Percha Company, [illegible] Steglitz, Berlin; A. Riedinger, Augsburg.

Great Britain—B. F. Behr, London; Greenwood & Batley, Leeds; Cowper-Coles, Sherard & Co., London; Consolidated Electrical Company, London; General Postoffice, London; India Rubber and Gutta Percha [illegible] Company, London; Muirhead & Co., London; Cambridge Scientific Instrument Company, Cambridge; Consolidated Electrical Company, London; A. C. Cosser, London; Crompton & Co., Chelmsford; F. Darton & Co., London; Elliott Bros., London; Everett, Edgecumbe & Co., London; Kelvin & White, Glasgow; Nalder Bros. & Co., London; Nalder Bros. & Thompson, London; Robert W. Paul, London.

Italy—G. Fala c. C., Turin; Albertina Cerruti Eugenic, Rome; Societie Italiana Del' Elettrocarboniuh, Rome; Alessandro Artom; Cerruti Eugenic, Turin; Ministero delle Poste l dei Telegrafi, Rome; Ditto C. Olivetti, e. C., Milan; Simon Luigi [illegible] Rome.

Japan [illegible] Oki & Co., [illegible] City Council [illegible] Tokio.

Mexico [illegible] Hidalgo [illegible] City of Mexico.

Argentine [illegible] Bros., Buenos Ayres; La Teutonia, Buenos Ayres; Argentine [illegible]

[illegible]

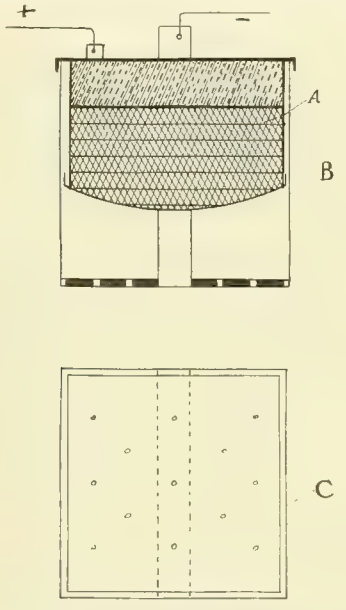
New Zinc-carbon Storage Battery.

Storage-battery troubles, aside from short-circuiting plates, are largely due to the composition of electrodes, whose compactness does not allow the electrolyte to penetrate freely as the electromotive force is set up. A new Russian patent, granted to C. Auer von Welsbach of Vienna, Austria, is said to provide means to avoid these inconveniences.

The anode is composed of tiny filaments of carbon, with some addition of powdered graphite, slightly compressed and forming a body which can be easily traversed by the electrolyte. Its weight is insignificant and the surface area very large, while the electric conductivity is high. Fig. 1 shows the vertical section of the new accumulator; Fig. 2 is a horizontal section; Fig. 3 shows the same accumulator, of a special design.

The anode (A), of a prismatic form, with a quadrilateral base, is turned toward the cathode. The anode is placed in a containing box (B) of celluloid, the bottom of which has been replaced by wooden strips to give solidity. Carbon-graphite is maintained against the strips by means of a cover provided with a terminal, insulated with paraffin oil. The terminal constitutes the positive pole of the pile.

The containing box (B) in which the anode is



FIGS. 1 AND 2. VERTICAL AND HORIZONTAL SECTIONS OF NEW ZINC-CARBON STORAGE BATTERY.

placed has in its upper part a diaphragm slightly bent toward the bottom; the diaphragm is made of parchment, covered with a layer of celluloid, in such a manner as to leave a free passage to the current. The object of the diaphragm is to protect the cathode against particles of carbon, which might fall down from the anode, to lead away the gas emanating from the surface of the cathode and to retain heavy substances which are formed while the battery is charged. The cathode is placed several centimeters below the anode, and it is composed of a plate of perforated zinc one millimeter thick, amalgamated with mercury. The zinc is placed in the bottom of another containing box (C), covered also with celluloid. The bottom of the containing box is provided with a groove one millimeter deep and one centimeter wide. A strip of iron, lined on one side only with an amalgam of mercury, is laid against the inner side of the containing box.

The box, containing the anode, is placed in a vessel filled with a solution of cerium sulphate, which is more efficient for setting up electromotive force than concentrated nitric acid. The cerium sulphate is easily decomposed by acidulated water, while the resulting fundamental salts are insoluble. The decomposition of cerium sulphate can be obviated by the addition of zinc sulphate in solution.

Electrolyte is to be obtained as follows: A sufficient quantity of cerium sulphate, kept in water for several weeks, will dissolve slowly but in a large amount. After the addition of a small quantity of sulphuric acid, the solution has to be treated with zinc. The substances present in the solution of cerium are then deposited and the resulting liquid, more or less colorless, has to be treated again with sulphate of zinc. A part of the liquid is then to be electrolyzed, and the other part can then be added, while slowly agitated.

During the charging of the cell, the zinc, combined with cerium, is deposited on the cathode, where it is partly decomposed by contact with the mercury, while the other part is deposited, forming crystals, and the amalgamated surface is constantly kept clean. If the charging current is strong, the oxygen emanating from the zinc will follow the path determined by the diaphragm and the walls of the jar and go out through an outlet in the covering. There is no production of gas whatever. The liquid surrounding the anode is of a brown color and smells of ozone.

These accumulators are said to be of special value for electric traction and in all cases where the charging and discharging of batteries are in rapid succession.

In central stations and other similar cases it is better to employ the arrangement shown in Fig. 3, which differs from the other in the fact that the electrolyte is in movement from the cathode toward the anode. The electromotive force is also set up in the cell, as in the former case, but the anode is more compact. The diaphragm is of no use and the quantity of mercury must be larger, due to the more rapid formation of metallic zinc. The jar containing the anode is placed in a larger containing box, in which it can be lifted up and lowered. Movement of the inner jar has to be regulated

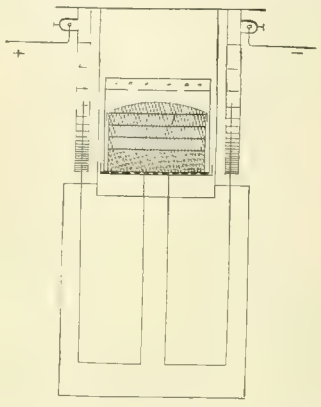


FIG. 3. SPECIAL FORM OF ZINC-CARBON STORAGE BATTERY

in proportion to the charging current, and it can be produced by some independent mechanical device. Space between the walls of the two jars can be packed with felt or some other material. If the movement is to be obtained automatically, as a result of weight variations of the cathode, the covering plate of the jar which contains the anode should be provided with a reservoir made of celluloid. The covering, as well as the carbon plate, beneath it, is provided with openings.

At the beginning of charging, the jar, which contains the cell, must be placed at the highest point and go down as the charging proceeds.

Joint Meeting of American and British Mechanical Engineers in Chicago.

In anticipation of the forthcoming joint convention of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers of Great Britain, to be held in Chicago, May 31st to June 3d, every preparation is being made by those in charge of the convention to make the occasion both an enjoyable and profitable one. A brief announcement of the meeting was given in the Western Electrician of May 7th.

Tuesday, the 31st, has been left free for the assembly of the guests and for visitors to points of interest throughout the city. The headquarters of the convention at the Auditorium Hotel will be open for registration and will continue so throughout the days of the meeting.

The opening session will be held Tuesday evening in the Fine Arts Building, after which a reception will be held in the parlors of the Auditorium.

Wednesday morning a business meeting will be held, after which three papers will be read: "The Wages Problem," by Harrington Emerson; "Some Recent Examples of Destructors for Town Refuse," by George Watson, and "Refuse Destruction by Burning," by Newton C. Russell. In the afternoon the party will visit the Illinois Steel Works at South Chicago. The evening session on Wednesday will be held in the music hall of the Fine Arts Building and will be devoted to the following papers: "Some Theoretical and Practical Considerations in Steam Turbine Work," by F. Hodgkinson; "The De Laval Steam Turbine," by E. S. Lea and E. Meden; "The Curtis Steam Turbine," by W. L. R. Emmet; "Different Applications of Steam Turbines," by A. Rateau; "The Potential Efficiency of Prime Movers," by C. V. Kerr.

Four papers will be read at the morning session on Thursday, which will be held in the Auditorium Hotel. They are: "Power Plant of the Tall Office Building," by J. H. Wells; "Power Plant of Tall Office Buildings," by R. P. Bolton; "Middlesbrough Dock Electric and Hydraulic Power Plant," by Vincent L. Raven; "Use of Superheated Steam and of Reheaters in Compound Engines of Large Size," by Lionel S. Marks; "Commercial Gas Engine Testing and Proposed Standard of Comparison," by William P. Flint. The visiting ladies will be taken to the retail stores of Chicago during this session. In the afternoon excursions will be made to the Fisk Street station and to the Union Stock Yards and the packing plants. In the evening a reception will be tendered to the officers and members of the two societies by the local members of the American Society of Mechanical Engineers at the Art Institute.

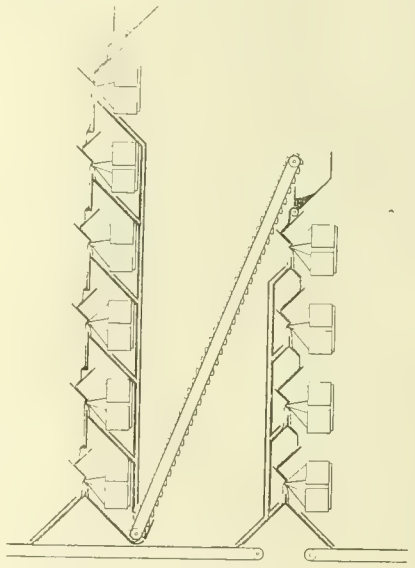
On Friday morning the closing session will be held at Lewis Institute, where the following papers will be presented: "Cast Iron Composition, Strength and Specifications," by William J. Keep; "The Effects of Strain and of Annealing," by William Campbell; "Experiments with a Lathe-tool Dynamometer," by J. T. Nicolson; "Road Tests of Consolidation Freight Locomotives," by E. A. Hitchcock; "Locomotive-testing plants," by W. F. M. Goss, and "Notes on Testing Locomotives." On that morning the ladies will be taken for a drive through the city parks and join the gentlemen for luncheon as guests of Lewis Institute. In the afternoon excursions will be made to points of interest about the city. In the evening the local members of the society have arranged for a special concert by the Thomas Orchestra in the Auditorium Theater.

George M. Brill of Chicago is chairman of the entertainment committee.

Magnetic Ore Separator.

Thomas A. Edison of Llewellyn Park, N. J., has recently taken out a patent on a magnetic ore separator which is intended particularly for the separation from gangue and concentration of material which is only slightly magnetic, such as specular hematite, iron garnet, and franklinite, the object being to provide an apparatus for the purpose wherein the feed of the material to the magnetic devices and the separation of the magnetic and non-magnetic particles are effected by gravity and without the necessity of moving parts.

One or more sets of magnetic separators are em-



MAGNETIC ORE SEPARATOR.

ployed, as shown in the illustration, each being in the form of an ordinary double-coil electromagnet with extended tapering poles, one of which slightly overlaps the other to form a relatively narrow gap between them. To the upper face of the overlapping pole a continuous but thin stream of the particles is delivered, moving at as slow a rate as practicable, whereby the non-magnetic particles are permitted to flow down the polar face and fall off at one side of a separating board, while the magnetic particles will, by the lines of magnetic force, be attracted toward the other pole and will fall on the other side of the separating board. Preferably a number of such separators are used, divided into two series, in the first of which the particles rejected by the first separating device will be subjected to the succeeding separators, whereby a very rough concentration will be secured, while in the second set the material concentrated by the first separator will be subjected to the succeeding separators to secure a concentrated product of high percentage.

In each section of the separator the material falls on a chute or apron, and before reaching the magnetic face of the pole is checked by a checking board, so that the material will fall upon the upper face of the pole, near the lower edge, immediately after it has been brought to rest. The material will thus not acquire any appreciable velocity by the time it reaches the extreme lower edge of the pole. The non-magnetic particles falling over the edge of the pole drop by gravity on one side of a separating board while the slightly magnetic particles passing over the edge will be attracted by the lines of force between the two poles, and the magnetic or slightly magnetic

particles will fall on the other side of the separating board, their trajectory being changed to an extent depending upon their magnetic affinity and upon the attraction of the poles. The process is gone over and over in each succeeding section till the last of the magnetic particles are separated.

An English Portable Sub-station.

An electrical equipment for supplying current to customers on very short notice for temporary lighting, as well as for supplying the necessary low-tension current for buildings under construction, and for exhibitions, has recently been provided by the Sheffield Corporation Electric Supply Department of the city of Sheffield, England. A small sub-station has been mounted on wheels, so that it may be easily moved from place to place, and has been found very useful in that city, enabling electric supply to be given while permanent sub-stations are being constructed and equipped with transformers, etc. As

FIG. 1. AN ENGLISH PORTABLE SUB-STATION.—GENERAL APPEARANCE OF VAN.

soon as the permanent sub-stations are completed the cables are disconnected from the portable plant and the van is moved on to some other point where its services are required. This equipment was provided by Mr. S. E. Fedden, manager of the Electric Supply Department, as difficulty had been experienced in complying with the demands of intending consumers, a considerable delay taking place before the current could be switched on if the premises to be supplied were not immediately on the existing circuit.

The accompanying illustration (Fig. 1) shows the general appearance of the van, which can be drawn by one or more horses, according to the grades encountered. It can be left standing over the hole in the ground where the mains temporarily terminate, powerful brakes being supplied to the wheels to prevent any possibility of the van shifting. The van is equipped with two 50-kilowatt Burnand transformers, together with the necessary cable connections and switches, to enable a supply to be given immediately from the high-tension mains.

A space is provided in the bottom of the van through which the cables are led up to the switchboard at the back of the construction, as shown in Fig. 2. When the back door of the van is lowered it forms a platform on which the operator can stand for operating the necessary switches on the board. At the top of the board two high-tension fuse boxes are provided, controlling the high-tension feeders by means of oil or dust fuses. Connection from these is made from the transformers inside the van, from the low-tension sides of which cables are laid to the low-tension switches in the middle of the board.

This English portable transformer plant provides for rapidly connecting up two high-tension feeders and four low-tension feeders, the high-tension feeders being lead-covered concentric cables, one being used for each phase. The low-tension cables are of the lead-covered four-core type, two phases being conveyed by the one cable. Portable sub-stations have been extensively used in this country in street-railway work on extensive electric-railway systems where rotary converters and step-down transformers have been found necessary temporarily at various points on the line. Portable transformer plants have also been utilized to a considerable extent in the various American cities for thawing out frozen water pipes. Equipment on the line of this English transportable sub-station would undoubtedly be of much service in many American plants, and very likely similar arrangements have been utilized. P.

After an experiment of six years, the officers of the street-railway company at Chillicothe, Ohio, have decided that the women conductors must go. Men conductors will be installed. The girls, they say, can collect fares and help people off and on cars, but they cannot do regular railroad work.

Death of William Wallace.

William Wallace, one of the pioneers of electric lighting, formerly of Ansonia, Conn., died at Washington, D. C., last week. The funeral took place at Ansonia on May 23d.

A born mechanic and of an ingenious bent, Mr. Wallace early in his career was heard from in the field of invention and he spent much time and capital in scientific research. He is said to have been the first in this country to build dynamos on a commercial scale, his first machine having been built in 1874. He was also the first to demonstrate the possibility of operating arc lights in series.

He numbered among his friends the foremost scientists, who were frequent visitors at his home. Among them was Thomas A. Edison, who paid tribute to his inventive genius in these words: "Wallace is one of the earliest pioneers in electrical matters in this country. He has done a great deal of good work for which others have received the credit, and the work which he did in the early days of electric lighting others have benefited largely by and he has been crowded to one side and forgotten."

Much of Mr. Wallace's time was spent in visiting Europe, where he was ever observant of the new developments in his field of work, and his home contains many mementos of these visits.

William Wallace was born in Manchester, England, on March 16, 1825, and came to the United States in 1832. In 1848 his father formed the firm of Wallace & Sons at Birmingham, Conn., for the manufacture of brass wire, the factory being later moved to Ansonia, Conn., where it was enlarged and was devoted largely to the manufacture of wire for electrical purposes. In September, 1849, he was married to Miss Sarah Mills of Birmingham, Conn., and two children were born to them—one son and one daughter. In his death the electrical industry loses one of its oldest and most tried friends and promoters.

A Combined Steam, Trolley and Cable Road in Tyrol.

A very unusual railway has recently been built in Southern Tyrol (Austria), which is an extension of the Bozen-Kaltern Steam Railway Company's line to Mendel Pass. From Bozen to Kaltern the steam locomotive is used, then for a distance of 1.2 miles to St. Anton the electric trolley furnishes power. From St. Anton to Mendel Pass the roadbed is too steep, being a 50-per cent. grade, for this method, and a cable hauls the train the rest of the way. The motor cars are each equipped with two 60-horsepower direct-current motors, which are supplied from two contact bows at a pressure of 600 volts. They weigh

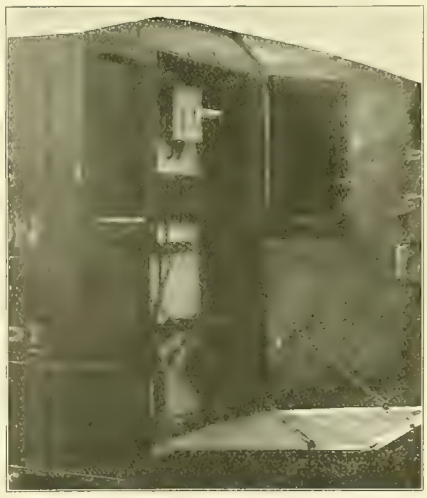


FIG. 2. AN ENGLISH PORTABLE SUB-STATION —SWITCHBOARD IN BACK OF VAN.

37,000 pounds empty and have standing room on the platform for 11 passengers and seating capacity for 15 second-class and five first-class passengers. They are equipped with hand as well as automatic brakes. The trailers weigh 25,000 pounds and carry 15 passengers standing and 45 seated.

The electrical equipment of the cable section from St. Anton to Mendel Pass was installed by the Austrian Union Electrical Company, the main cable wheel is driven by belt transmission from a 90-horsepower direct-current shunt motor running at a speed of 600 revolutions per minute. This motor is supplied with current from a 650-volt circuit and operates the cable through a system of intermediate gearing. The cable used has a factor of safety of 10 and a breaking strength of 75 tons. The usual load is 7.5 tons on grade of 50 per cent.

The current for this road comes from a power station at Novella, which is equipped with hydraulic turbine-driven polyphase alternating-current generators, which supply a 4,000-volt transmission line. At a sub-station are located step-down transformers and rotary converters to change the high-tension alternating into 650-volt direct current for use on the railway. The total distance from Bozen to Mendel Pass is 12 miles, with a total rise of 3,250 feet.

Chicago Tunnels for Carrying Mails.

Representatives of the Postoffice Department at Washington, D. C., have just been in Chicago inspecting the underground passageways of the Illinois Tunnel Company. They were escorted through the network of tunnels by President Wheeler and Engineer Jackson of the company and the men were impressed with the magnitude of the work and expressed the belief that a system could be worked out for transferring both through and local mails through the tunnels at a great advantage over the present wagon system. As a result of the inspection it is announced that within 60 days through mails received at the La Salle Street and Union stations will be transferred between these two points through the tunnels.

As quickly as possible the portion of the tunnel lying between the La Salle Street and Union stations will be equipped with electric cars capable of carrying tons of mail matter, and it is expected that by the middle of July the bulk of the through mail from the eastern roads arriving at the La Salle Street station will be carried underground to the western road terminals across the river. It is possible that by November 1st the entire tunnel system will be equipped to handle the mails between the railway stations, the temporary postoffice building at the foot of Washington Street, and all sub-stations.

The government has appropriated $100,000 for experimenting with the new method of transporting the mails, but the officials say it will be impossible to compute the entire expense of the new method for the purpose of arriving at a contract price for the service until the postoffice buildings, the sub-stations and all railway stations are connected and in running order. The cost of the present wagon service is about $107,000 annually.

Three-phase Arc Lamp.

Polyphase arc lamps have been the subject of much experimentation both by the Italian General Electric Edison Company at Milan and by Richard Fleming of the Lynn works of the General Electric Company in the United States. Two forms of the polyphase arc lamp patented by Mr. Fleming were described in the Western Electrician of July 4, 1903. Independently of these Dr. P. L. Mercanton of Lausanne, Switzerland, has been carrying on investigations in this line and has constructed an arc lamp which is described in the Scientific American.

The lamp contains three carbons connected each to a phase of the three-phase circuit, and constituting a regular triangular pyramid, on the top of which the arc is produced by virtue of electrodynamic forces. Regulation is effected by hand, and consists in inclining the carbons with respect to the axis of the pyramids. For this purpose they are supported by three carbon holders, which are pivoted at three points placed at angular distances of 120 degrees on the circumference of a circular metallic disk that serves as a base plate. To the middle of this disk, on the side opposite the arc, there is fixed a strong screw, the box of which is connected to a lever system controlling the mutual distance of the carbons. By a special arrangement the levers may be lengthened or shortened.

The aspect of the luminous focus of this lamp depends to some degree on the kind of carbon used: the latter should be rich in volatile substances. As regards the length of the arc, on which its behavior will depend to a high degree, this is always some millimeters, and in most cases over 10 millimeters. Under these conditions the ends of the carbon appear to the eye placed on the axis of the lamp, like three luminous points of a high brilliancy. The common angle between the carbons varies between 30 degrees and 50 degrees. The lowering in the frequency necessary to maintain the three-phase arc may be readily shown by adjusting the arc for the maximum of frequency and eventually withdrawing violently one of the carbons, when the arc ceases to pass between the two remaining points. The jumping of the single-phase arc from one pair of carbons to the other is visible by the flicker in the light given off from the edges of the crater in front of each other.

According to history a successful space-telegraph apparatus was in use in 1804. It consisted "of a beam which turned on a post having a movable arm at each of its extremities." When these movable arms were turned each movement "afforded a separate signal which might represent a letter of the alphabet or any other signification which should be agreed upon." By the aid of only 44 of these telegraphs, properly equipped with telescopes, news was received in Paris from Strasburg in six minutes and a half several years before the signing of the Louisiana Purchase treaty.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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DATES AHEAD.

American Society of Mechanical Engineers and the (British) Institution of Mechanical Engineers (joint meeting), Auditorium Hotel, Chicago, May 31st to June 3d.

Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.

Canadian Electrical Association (annual meeting), Hamilton, Ont., June 15th to 17th.

High-pressure transmission convention of the American Institute of Electrical Engineers, Chicago, June 21st and 22d.

Indiana Mutual Telephone Association (annual meeting), Lafayette, Ind., June 28th and 29th.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 3d to 7th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

RICHMOND, Va., is generally given the credit of being the first city in the United States to possess electric-railway service, the year of first operation being 1887, and the man who did the trick being Frank J. Sprague. There is, however, another claimant to the honor—not a vociferous claimant, but a pleasant city that says in effect, "We are not worked up over this matter, but lest anybody should ask you, please to take notice that we were there 'with the goods' a year before Richmond." This city is Binghamton, N. Y. In response to a recent inquiry from the Western Electrician, Mr. J. P. E. Clark, general manager of the Binghamton Railway Company, writes: "I think the Vandepoele system was installed and operated in Binghamton in the year 1886. We have upon the walls of our president's office a picture of the first car operated in the state of New York, which, as you may imagine, was a very crude and primitive affair. There is no question that Binghamton preceded Richmond, Va., in the matter of early operation of electric cars." If the service begun in Binghamton in 1886 was continuous, Mr. Clark's testimony seems to go a long way toward deciding the point of priority in favor of Binghamton.

MANY complaints of the manner of conducting the business of the Patent Office have been made, and in the famous Berliner telephone case the United States government itself brought suit to annul a patent, the application for which was pending in the Patent Office for no less a period than 14 years. In this suit it was held that there could be considered only one ground for attack upon the patent—fraud in the Patent Office in delaying the application. Judge Carpenter sustained the government's contention and found that there was constructive fraud on the part of the company owning the patent in permitting the application to drag along in the Patent Office for 14 years. Upon appeal, however, the Circuit Court of Appeals and afterward the Supreme Court reversed Judge Carpenter, and found that no fraud was proved against the owner of the patent.

This famous case is recalled by charges against the Patent Office made by Thomas A. Edison and laid before the president. Mr. Edison is the greatest inventor in the country, and he has taken out more United States patents than any other man. He is therefore qualified to talk with authority on the subject. According to the newspapers, Mr. Edison has been the victim of gross irregularities on the part of a patent examiner. One Washington correspondent writes:

The scandal involves the commissioner of patents himself, who is charged by Mr. Edison and his attorneys with refusing to take steps to correct the irregularities. Had the victim of the wrong been an ordinary inventor, Mr. Allen's refusal would probably have been the last of the matter, as such a man would not have cared to jeopard his interests at the Patent Office by making an open fight on the commissioner. But Mr. Edison felt strong enough to appeal to the president, and the latter issued a peremptory order to the commissioner of patents that the famous inventor should be given the hearing he had applied for. The scandal grew out of matters relating to Edison's new electric storage battery. While certain patents on this were pending an examiner in the office is alleged to have allowed another inventor to withdraw and amend specifications on a patent along the same lines as Edison's. The latter's attorney heard of the circumstances and investigation showed that the amendments to the specifications for the rival patent embodied certain features of the Edison patent.

This is a serious charge. Unfortunately, it is not the first time that allegations of irregularity have been made against the Patent Office, as we have shown. The inventors of the country more than support the Patent Office by the liberal fees exacted, and they are of course entitled to absolutely impartial treatment. There should be, and doubtless will be, a rigorous investigation of Mr. Edison's indictment.

IN abolishing its racing department the Western Union Telegraph Company has done a worthy act, although in popular estimation it will be considered to have been forced to this rather tardy decision by the pressure of public opinion rather than by the motive of abstract morality. President Clowry makes this announcement: "We have stopped our racing-news service absolutely all over the United States, and we are doing no business in that line. We cannot refuse messages that are filed with us in the regular course of business because they contain racing news. We have to accept them and transmit them as common carriers, but our racing department has ceased to exist." This is as it should be. As in the case of telephone companies, telegraph companies have no right to set themselves up as moral censors. Just as a railroad company has no right to refuse to carry a gambler or a gambler's goods, a public carrier of communications has no right to refuse to transmit a gambler's message. But to collect and disseminate, on its own account, racing news used notoriously and practically exclusively for gambling purposes is quite a different thing. Neither a telegraph company nor a telephone company should engage in such business, which is simply an encouragement and an incitement to public gambling—a vice which is always to be combated as a menace to the security and well-being of the community. But how about the daily newspapers and racing sheets that publish tips and "form cards" and gambling news of the races? Are they not equally as guilty as a telegraph company that considered it advisable to discontinue a racing-news service?

BY FAR the largest and most successful convention ever held by the National Electric Light Association was the one in Boston this week. Over 1,000 persons were registered, among whom were many of the most conspicuous men in the electrical industry today. Seventeen years have passed since Boston was the scene of a meeting of the association, and to the older members who were present at both conventions the marked contrast between the conditions existing then and now was made strongly manifest. At that time direct-current apparatus was in use almost exclusively, alternating-current machinery being only in its infancy. What strides have since been made in the development of electrical apparatus and central-station management will be made evident by a perusal of the valuable papers and reports which were presented at the meeting which has just been held. As President Edgar said, "We are astounded when we turn our gaze upon our own business, as represented by the members of this association, distributed throughout the United States and Canada."

Too much credit cannot be given to the officers of the association and members of committees whose co-operation and energy contributed so greatly to the success of the convention. Especial interest attaches to the report of the committee on steam turbines, which contains a thorough analysis of the three foremost types of turbines, making a valuable addition to the literature on this subject which will be eagerly sought by those interested in the new prime mover.

As suggestive of the great possibilities which are presented in the line of electrical power development, a statement from the report of progress gives food for reflection. "The field for the sale of electrical energy is comparatively unexploited. Its sale for general power purposes has only begun. In not a single city of the United States have the possibilities of the industrial-power business been fully developed, much less exhausted. In many of our best cities today the gross receipts from the sale of electrical energy for all purposes do not exceed $1 or $1.50 or $2 per capita per annum."

Altogether, the convention was all that could be desired; conditions were favorable, the attendance was more than could even be hoped for, enjoyable entertainment features, such as a city like Boston can provide, were carefully mapped out by the entertainment committee; everything, in fact, contributed to make the occasion one to be long remembered by those whose good fortune it was to attend.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

A great convention was that of the National Electric Light Association which was held in the Hotel Vendome, Boston, this week, the dates being May 24th to 27th, inclusive. The number registered up to noon on Tuesday, the opening day, was 550 and the total attendance later reached over 1,000. Thirty-three papers, addresses, committee reports and departmental features were presented to the convention in open session, in addition to the proceedings and reports in executive session. All were of a high order and, collectively, they make an important addition to the literature of the art.

When the convention was called to order on Tuesday morning a long line of delegates and visitors was still waiting to register in the secretary's office and obtain badges. The weather was pleasantly warm, and electric fans were in operation in the convention hall, which was a room on the ground floor of the hotel. This room was well filled when President Charles L. Edgar called the association to order. Many conspicuous figures in the electric-lighting industry were among those in attendance, including E. R. Weeks of Kansas City, James I. Ayer of Boston, Henry L. Doherty of New York and Louis A. Ferguson of Chicago, past-presidents of the association. Secretary Ernest H. Davis read letters of acceptance or of regret from John W. Lieb, Jr., New York city; S. B. Libermore, Winona, Minn.; Samuel Insull, Chicago; Thomas A. Edison, Orange, N. J.; C. L. Wakefield, Dallas, Texas; Louis Duncan, Boston; F. D. Fish, New York city; President Pritchett of the Massachusetts Institute of Technology; Professor A. E. Kennelly, Harvard University; C. H. Wilmerding, Chicago; E. A. Armstrong, Camden, N. J.; I. H. Francisco, Rutland, Vt.; A. M. Young, New York city; Frederic Nicholls, Toronto; Charles R. Huntley, Buffalo; Charles F. Brush, Cleveland; Professor E. L. Nicholls, Cornell University; George S. Bowen, Elgin, Ill.; Thomas D. Lockwood, Boston, and others.

A letter from A. C. Garrison, president of the Columbia Incandescent Lamp Company of St. Louis, asking visitors to the St. Louis Exposition to inspect its factory, was read.

Another invitation was from the Cooper Hewitt Electric Company, which kindly offered to take the photographs of groups of delegates, in its exhibit room, by the light of mercury-vapor lamps.

President Edgar then delivered the annual report of the president. In full this interesting address is as follows:

President Edgar's Address.

It is with peculiar pleasure that I welcome you to this city. It is now 17 years since this association met in Boston, and although I agree with my predecessors that the duty of the president of this association should be as an executive officer rather than as a historian, I cannot resist the opportunity to make a few comparisons between the year 1887, when this association met at the Parker House in this city, and the present year.

It was my pleasure to attend that convention as a guest of our old friend, Captain Brophy, and I have a somewhat distinct recollection of the meetings and of the entertainments. I know it was with considerable anticipation that I looked forward to the visit to the works of the Thomson-Houston company in Lynn, then rated as one of the largest works of its kind in this country; and yet the number of men employed in the entire works at that time was not as many as is now employed in almost each one of its dozen departments.

At that time, too, the Boston Edison Company, which, with its friends and associates in Boston, is one of those to welcome you here today, was the proud possessor of one small station, with a total load connected to its overhead system equal to the fortnightly growth of the present year. In those days, too, the horse cars made their weary way along the Tremont Street Mall of the Boston Common. Today not only the horses but the cars and the tracks have disappeared, and under this same mall, now made handsome by the disappearance of the tracks, is located and operated the first and one of the finest electrically operated subways in this country, or, in fact, in the world.

And so I might go on for an hour, showing that during these 17 years there are other things besides the electric-lighting business that have shown tremendous progress; and yet, after looking at all these other things and forming a conclusion as to what the rate of progress has been, we are astounded when we turn our gaze upon our own business, as represented by the members of this association, distributed throughout the United States and Canada. The number of electric-light stations has increased during these 17 years more than ninefold. Naturally, the membership of this association has not grown in proportion, but the fact that there are now upon our rolls 588 members, as compared with only 158 at that time, is a matter for sincere congratulation. The wonderful work done by my two immediate predecessors in getting new members into this association stands by itself. The growth this year, as the result of their work, has been rather slow. At the same time, the association has had a healthy and steady increase in membership, and I feel satisfied that it will continue in at least as great a ratio as during the last year.

Speaking now, for a moment, as one of the representatives of the electrical interests in this city, I beg to call your attention to the entertainment programme, submitted by that committee. This programme has been prepared with great care, and, although extensive and varied, does not, in any way, conflict with the business for which we came together. Six business sessions of the association have been arranged for, as shown by the official programme, and we are planning, with your assistance, on having three days of hard and conscientious work. Before proceeding to the consideration of this programme there are a number of matters to which, as chief executive officer of this association, I should like to call your attention.

Some months ago the question of an Union Engineering Building in New York was brought officially to the attention of this association. As is well known, Mr. Andrew Carnegie offered to give $1,000,000, to the four associations composing the electrical, the mechanical, the mining and the civil engineers of this country, together with the Engineers' Club of New York, for the purpose of putting up an Union Engineering Building, which would be the most comprehensive affair of its kind in the world. After due consideration, all of the organizations named, with the exception of the American Institute of Civil Engineers, decided to take part. It being generally understood that Mr. Carnegie had in mind an enterprise covering all branches of engineering life, great doubt existed in the minds of those interested as to whether or not he would be willing to go on, in view of the declination of the civil engineers to take their share. As the most of you may know, he has not only decided to erect this building for the remaining associations, but has increased the sum from $1,000,000 to $1,500,000. The space which it was intended to allot to the civil engineers is to be fitted up with modern office accommodations, and this association, as well as a number of others of the same general character, was asked if it would be willing to consider taking its permanent offices in this building. I conferred with a number of gentlemen connected with this association and familiar with its history and informed the committee that I thought that the National Electric Light Association would undoubtedly consider with great favor the question of locating its permanent offices in their building. To those of you who are familiar with the present unsatisfactory location of our secretary's office, the proposed arrangement will, I think, appeal with great force. Personally, I am strongly of the opinion that the location of our offices under these circumstances, in the quiet of the uptown district and in an engineering atmosphere will be a great benefit to all concerned.

The time has come when it seems desirable to make a somewhat radical change in the by-laws of your association. When it was organized some 19 years ago, the industry consisted of a large number of small companies, located throughout the country. Almost without exception, these companies were confined each to its own city; in fact, there were a number of cities, especially those of the larger size, that had a number of competing companies. As time went on, consolidations took place, either by the purchase of a local company by a syndicate or holding company or by the actual amalgamation either of competing or of adjoining companies. This has, at the present time, been carried on to such an extent that in some sections of the country all of the small companies have now been obliterated and one large corporation now covers the territory and does the entire work. A most striking example of this kind comes under my own personal observation. The Boston Edison Company has taken the place of 15 local lighting companies, all of whom were eligible for membership in our association. Under the regulations of this state, it is necessary to actually wind up these local companies, not only in a business but in a corporate sense, and a number of them have therefore had to resign from the association. Within the next year or two there will be only one company left, and the actual membership in the association will be cut down from seven to one. This is going on all over the country and is a matter of serious concern for the future of the association. The matter has been discussed at considerable length by the executive committee, and numerous suggestions have been made for overcoming the difficulty. These have been put in concrete form by your secretary and will be submitted to the association in executive session. Speaking generally, the remedy suggested is to have another class of membership, consisting of individuals called junior active members, to be elected under some sort of supervision from the active member with whom they are connected in business and paying as dues an amount in keeping with their privileges. I trust that this matter will be given serious consideration by the members of the association within the next two or three days, so that a conclusion can be arrived at at the executive session on Thursday.

The electric-lighting industry of this country has, in the past, in certain definite directions, been under somewhat serious disadvantages because of the lack of a comprehensive and correct directory of our industry. In most other lines of work it has been possible for manufacturers, investors or inquirers generally to find out something about the industry in which they were interested. This want was brought especially to my attention some time during the early part of the year. One of the various circular letters issued periodically by our assistant secretary was sent out over my name and mailed from Boston. The number of letters returned to me undelivered was astonishing, and I came to the conclusion that all the existing lists were worse than useless. About this time our attention was called to the prospect of this work being taken up by one of our own members and put on a par with the publications of other industries of like character. I think that we should give our earnest support to this enterprise, incidentally, because it is carried on by one of our own members, but primarily and selfishly, because we are interested in having it a success.

During the year a somewhat disturbing occurrence took place in connection with the proposed participation that this association was to take in the affairs of the International Electrical Congress. Both at the Cincinnati convention and a year later at Chicago invitations were extended to this association to meet at St. Louis to take part in the congress. Through an unfortunate combination of circumstances this invitation was overlooked in making out the final programme. The committee of your association which has in charge the relations which exist between this association and kindred organizations took the matter up, and, after long and somewhat complicated conferences, advised me that it was its wish that the association should accept a new invitation from the congress, inviting us to prepare three papers and to send the authors as delegates to the congress. The invitation in this form was accepted, and the executive committee is about to choose these delegates, and I have every reason to hope that an announcement of their names and their subjects can be made before the adjournment of this convention.

The work of the congress is truly international in its character, papers having been promised by some of the most noted scientists in the world, both in this country and abroad, and we are, for this reason, extremely anxious that our representation at the congress shall be in keeping with the standing of this association.

Until I became president of your association, I had no suspicion of the vast amount of work carried on at your permanent offices in New York. Under the efficient direction of your assistant secretary a large and varied correspondence is kept up with the member companies, an average of over 10 letters per day being written on all sorts of subjects. In addition to this, various compilations have been made during the year, and most of these have been forwarded to the members from time to time. The office is now engaged upon various other reports, notices of which will be given to you at the proper time. In short, we have a thorough and businesslike organization, capable of taking up and intelligently discussing almost any subject of interest to the members of the association.

Some time during the winter it was suggested to me by one of the members of the executive committee that there must be a vast fund of available information in the records of the association which were practically useless, because of the lack of an index. The matter was taken up at once, and there has been prepared a complete index of the papers and reports presented to this association since its organization, indexed and cross-indexed in various ways. It is intended to publish this as a separate volume for distribution with the proceedings of this convention. I think that none of you who have not specially looked into this subject realize the great amount of information which is locked up in the proceedings of our conventions, but which will be available at a moment's notice when this index is published.

A month or two ago Mr. C. O. Baker decided that he would be unable to attend this convention and therefore tendered his resignation as master of transportation. Mr. Baker has been identified with this office for so many years and has managed its affairs so satisfactorily, that many of you have not realized either the time or the ability which he has given to the affairs of this association. I would therefore suggest that an appropriate resolution be passed, recognizing the work of this efficient officer.

I was fortunate in finding Mr. George F. Porter, so long and so closely identified with all of you, able and willing to take up this work and it was therefore with great satisfaction that I appointed him to the vacant office.

The programme, to which I invite your attention, has, I think, a number of papers and reports of great interest to this association. This year we have made a special effort to have the papers printed in advance. Of the 28 papers upon the programme, all have been printed, and 23 were mailed to the home addresses of those intending to attend the convention about a week ago, and I think it is an appropriate time for me personally to express my sincere thanks to the authors of these various papers and reports for their promptness [illegible] sist me in carrying [illegible] that we hope to be enabled to give much more attention to the discussion of these papers, as they

have, I hope, been read and considered by the delegates before leaving home. I therefore have to suggest that various of these papers be read only by title and others abstracted in a somewhat brief manner. This is the practice among organizations of this character, and although it is an innovation in this association, I think the experiment is one worthy of consideration.

Another matter to which I wish to call your attention is the great delay which has taken place in the past years in the publication of our records. I have followed up this matter during the last year with great interest and considerable impatience. Remarks made at the Chicago convention in May have been uncorrected for three months. In an effort to prevent this, I asked that this year the arrangement for stenographic work be made on the basis of a corrected proof before the adjournment of the convention. I therefore most earnestly ask each gentleman taking part in the discussions to make a determined effort to correct his remarks before leaving Boston. This can be done in each case in a few moments and will enable us to send out our book while the matter is fresh in the minds of our members. I do not want to try to accomplish the impossible, but I am satisfied that months can be saved by a systematic effort on the part of each delegate to assist the secretary's office in this matter.

All of the committees recommended by your two preceding presidents have been appointed and have made reports which are in print and before you. The report of the committee on steam turbines is of the greatest importance, and it so appealed to one of the members of the committee that he has undertaken a further investigation of this subject abroad. Upon his return, only one month ago, he turned over to the committee such a wealth of material and data that it was impossible to get it in type many days in advance of the opening of the convention. It has been my pleasure to be present at one or two of the recent meetings of this committee, and I can assure you that the material contained is of the greatest value to you all.

The "Question Box" and the "Wrinkles" are both features worthy of your careful attention. The dividing line betwen these two departments is very hazy, and I am not at all sure that they should not be operated in connection with each other. This is a matter for the incoming administration to decide.

During the year the question of advertising has been taken up on a scale of considerable magnitude by a number of our larger member companies. The experience gained by these companies ought to be of great value, even to the small members, and the paper of your advertising reporter, together with its accompanying samples of advertising matter, will, I think, be a subject of much interest to you all.

The gold medal offered two years ago by past-President Doherty for the best paper on underground construction was not awarded last year. In February of this year notices were sent out to members of the association and to the public generally that this competition was now open. A number of papers have been presented and considered by the committee of three distinguished engineers, who were appointed for that purpose. They have come to their conclusion and will announce their decision at the morning session tomorrow.

When I took the presidency last year I discovered upon the records a number of committees which had not reported for some years. There seemed to be no clear distinction in the minds of anyone as to the difference between yearly and standing committees. I therefore called upon all of these old committees either to report or to suggest their discharge. I hope to leave to my successor the privilege of either appointing or reappointing committees only upon subjects which are active at the present time.

The work of the association is so well distributed among its various committees and reporters that it seems to me there are very few things which have not been covered. I do think, however, that we should have a strong, permanent committee upon the subject of municipal ownership. This subject is a perennial one, and although perhaps no more serious today than during the last half dozen years, it is certainly a subject of great importance and one which, handled by a strong committee and headed by some member who will take the initiative, would be of great assistance to the member companies of the association.

The extremely cold weather of the last year has also brought out prominently a novel use of the service of the electric companies. I refer to the thawing of water pipes. Unfortunately I have been disappointed in getting a paper on this subject for this convention. Although we may not have a winter such as the last for a number of years, I think the experience which has been gained by some of our companies during the last year should be made use of, and I therefore would suggest the appointment of a reporter to take up this subject, compile such information as he can obtain as to the recent experiences of our member companies and distribute it to the members some time during the coming summer or early fall.

The position of the president of this association is a hard one, and yet I do not know but that from the very nature of our organization it must be so. The association and its business are continuous. The president, sometimes taken from the executive committee and sometimes from the ranks, finds himself upon the adjournment of the annual convention at the head of an extensive organization of which he knows very little. It takes months to absorb and understand the really great and comprehensive work which this association is carrying on. As soon as he gets this into his head he is called upon to prepare for the next convention, and then, when it is all over, he lays down the duties of his office with a sigh of relief and a feeling of commiseration for his successor. I do not know that this can be helped. I think that our theory of having three members of the executive committee elected each year, thus making that body continuous and having it the governing one of the association is good; but, as a matter of fact, the executive committee has never had any reason to believe that it had much to do with the executive work of the association. I think that we should have a general understanding that the executive committee is intended for work; that it should get together at least once in three months and be a connecting link between the president and the sentiment of the association as represented by its members. For this purpose I think that the executive committee should be chosen with some reference to geographical location and with considerable reference to the size of the companies represented. Then, in order to make it easy and possible for the members of the committee to attend the periodic meetings of the committee an arrangement should be authorized for meeting the necessary expenses of these meetings. This matter has been discussed by the executive committee during the last year and I hope that it will have some definite suggestions to offer in its report which it will make on Thursday at the executive session.

Even if this can be accomplished, I realize that the difficulty is fundamental. We must look to our permanent officers to keep the work of the association going in the right direction. It devolves upon them to instruct the incoming administration as to the precedents and policies of the past and in general to keep the permanent policy of the organization before the mind of each new executive, leaving to the latter the privilege of bringing to the office and to the work the strength of his own personality, and thus, by a mixture of the old and the new, build up an organization that will stand distinct and unique among its confreres.

Committee on President's Report.

A burst of applause followed the reading of Mr. Edgar's address. On motion of H. L. Doherty, the president's address was referred to a committee of three, to consider it and report. This committee, appointed by Secretary Davis, consisted of H. L. Doherty of New York, G. W. Brine of Atlanta, Ga., and H. T. Hartman of Philadelphia.

T. Commerford Martin then presented his report on progress.

Report of Progress.

Mr. T. Commerford Martin, in his report as the committee on progress, at the outset gave some census statistics of the central-station industry for the year 1902. At the time of the enumeration there were 3,620 central electric stations in operation. The cost of their construction and equipment amounted to $504,740,352. The gross income for the year was reported at $85,700,605, and the total expenses at $68,081,375. These stations furnished employment to 23,330 wage-earners, who received $14,983,112 as wages during the year. The power-plant equipment consisted of 5,930 steam engines with 1,379,941 indicated horsepower, and 1,390 waterwheels with a stated horsepower of 438,472. The generating plants consisted of 12,484 dynamos of every description, with a stated horsepower of 1,624,980. A noteworthy feature in the development of this industry has been the installation of plants operated under the control of municipalities. There were 815 of these plants in operation. The cost of their construction and equipment was reported at $22,020,473. They gave employment to 2,467 wage-earners and paid $1,422,341 in wages.

The above figures, however, do not tell the full central-station story, as during the same year there were 252 electric railways doing a central-station business; nor, of course, are any data presented from the 50,000 isolated plants—more or less—that exist all over the country. The current output for the year was estimated and returned at 2,507,051,115 kilowatt-hours, or about 25 per cent. of the possible work that the stations could do in 24 hours of daily operation. There were 385,698 arc lamps operated and 18,194,044 incandescents. There were reported 99,102 stationary power motors on the circuits, with a capacity of 619,283 horsepower, and 2,379 trolley cars were supplied with current. Of the street-railway companies in the lighting field, as shown by the census report on the street railways, 118 made reports that were kept separate, although 252 such companies generated current for light and power, with a total income from it of $7,703,574. They had 33,863 arcs, 1,442,685 incandescents and 10,049 motors of 35,688 horsepower.

Conditions abroad received considerable attention in the report. Brief reports from England, Germany and Spain were given. On the question of central-station business the following comment from Mr. W. F. White was quoted: "The field for the sale of electrical energy is comparatively unexploited. Its sale for general power purposes has only begun. In not a single large city of the United States have the possibilities of the industrial-power business been fully developed, much less exhausted. In many of our best cities today the gross receipts from the sale of electrical energy for all purposes do not exceed $1 or $1.50 or $2 per capita per annum. Such volumes of business can be multiplied three, four or fivefold."

Turning to technical development, Mr. Martin considered successively the Nernst lamp, osmium lamp, magnetite arc lamp and other lamps. In the case of the magnetite arc lamp only the negative or lower electrode consists of magnetite, and is consumed. The positive terminal is not replaced, but is a copper segment, which constitutes a permanent part of the lamp. The metals of the iron group yield a brilliant arc flame of very high efficiency and white color. To give a long life the metals which are combustible are not well suited, but a stable oxide of these metals must be used. Among the conducting oxides, magnetite fulfills best the requirements of a carrier of the arc flame.

Mercury-vapor lamps were considered and also, among other topics, such subjects as lamp reflectors, electric heating and three-phase central stations.

E. R. Weeks, an honored past-president of the association, discussed Mr. Martin's report as "one of the old guard." The seniors of the great electrical industries are still young men, he said. Contributing to the proceedings of the association have been men like the late Professor Rowland, a man of pure science, and Marsden S. Perry, a man of affairs. The electrical industries still lead the van of human progress. The great attendance at the convention was a fine compliment to Mr. Edgar, Mr. Weeks said in conclusion. Others who took part in the discussion were E. F. McCabe of Lewistown, Pa., Samuel Scovil of Cleveland, and Arthur Williams of New York. The last-named said that there was a gap in the lighting field between the smallest arc and the largest incandescent. The Nernst lamp of from three to six glowers seems to fill this gap. The English experience is that the larger Nernst lamp has the larger field. In closing the discussion, Mr. Martin said the Nernst lamp was particularly adapted for art galleries. The Cooper Hewitt lamp, too, has many spheres of usefulness, in cases where the color of the light is not objectionable.

500-volt Lighting and a New Arc Lamp.

"A Three-wire 500-volt Lighting System" (in Providence, R. I.) was described by Walter I. Barnes. An abstract of this paper is presented elsewhere in this issue.

In the discussion, P. Junkersfeld of Chicago uttered a word of caution in relation to the adoption of this system. He doubted whether it was adapted to average conditions in American cities. L. A. Ferguson of Chicago and Alex Dow of Detroit took part in the brief discussion. Mr. Woodward of Providence admitted that the 250-volt incandescent lamp was not as efficient as the 110-volt lamp. Nevertheless it is satisfactory. The insurance companies were rather hard to convince in relation to the safety of the system, but once convinced, there had been no adverse comments. The system was criticized considerably by some of the delegates, particularly in relation to the arc lighting. Captain Brophy of Boston, Arthur Williams of New York and P. G. Gossler of New York and others took part in the discussion.

"The Luminous or Flaming Arc" was described by Welles E. Holmes of Newton, Mass. This is a new open-arc lamp made by the General Electric Company. One of the lamps was on exhibition in the convention hall. The lower carbon is made of magnetite—a kind of iron. The lamp is said to burn 150 hours. The lamp gives off smoke, which is cared for by a chimney. It is therefore not adapted for inside work. The advantage of the lamp is some increase of illumination for a stated current consumption. The light is a near approach to sunlight. There is no consumption of the upper electrode. The public is pleased with the lamp for street lighting in Watertown, Mass., where 30 are installed.

At the conclusion of Mr. Holmes' paper the luncheon adjournment was taken.

Tuesday Afternoon's Papers.

Robert Howes of Spokane, Wash., read his paper on "A 100-mile Transmission Line" at the beginning of Tuesday afternoon's session. This paper is presented in abstract on another page of this issue. The plant is that of the Washington Water Power Company of Spokane, Wash. In the discussion, R. S. Kelsch of Montreal, P. G. Gossler of New York, Dr. Louis Bell of Boston, W. L. Abbott of Chicago and the writer of the paper participated.

The committee on standard candlepower of incandescent lamps made a brief verbal report, through Dr. Louis Bell. The committee recommended close co-operation on the part of the members of the association in making technical investigations. The committee was discharged with thanks.

George N. Eastman of Chicago read an abstract of his paper on "Grounding the Neutral of High-voltage Generators." Mr. Eastman is one of the technical experts of the Chicago Edison Company, and his paper is based on the results of practical experience. The paper was one of the more technical ones of those presented at the convention. Mr. Eastman believes that the proper manner of grounding the neutral of the generators is through

as low a ground resistance as can possibly be obtained. In the discussion J. H. Hallberg of New York was the principal speaker.

"Remote Control of Electrical Apparatus" was the title of the paper of William H. Cole of Newton, Mass. The speaker described a system of controlling constant-current transformers connected to circuits of arc or incandescent lamps arranged in single or multiple circuits.

Samuel G. Rhodes of the New York Edison Company gave an account of "The Organization and Equipment of an Arc-lamp Department," referring particularly to the practice of his company. For the year ended March 31st last the arc-lamp business of this company was increased 32 per cent. The contract department has an arc-lighting engineer to help in getting arc-light business. The arc-lamp department has a system of forms which Mr. Rhodes described. Several labor-saving devices were mentioned. The company furnishes the lamps free, which perhaps accounts, in part at least, for the increase in New York. Detroit (so Mr. Dow says) also furnishes arc lamps free. Of recent years, however, the demand for arc lighting has fallen off materially. This has also been the case to a large extent in Chicago, Mr. Gilchrist reported. Douglass Burnett of Baltimore said that by furnishing the lamps free and studying the customer's individual needs arc-lighting business can be obtained. But the Humphrey gas-lamp competition is formidable. In New York one trimmer at $12 a week, in six days, will trim 650 lamps.

James I. Ayer of Boston gave an abstract of his paper on "Electric Heating." Future attention to this interesting paper will be given in the Western Electrician. In the discussion Alex Dow told of his experience—a personal one—with the electric kitchen. The cooking load is about two hours a day. One can waste about half the current by having the wrong vessel to put on the disks. The cords are a nuisance. Devices for varying the heat are bad to put in the hands of kitchen mechanics. Two heats—a simmering heat and a quick heat—are all that are really necessary. The worst fault of the apparatus is the repair bill. The load is a desirable one; rates might be made practicable, but the repair-bill question is serious. Arthur Williams said the kilowatt price was not all important. The advantages of such useful and inexpensive appliances as heating pads should be considered.

The report on "Lost and Unaccounted-for Current" was made by C. W. Humphrey of Denver, who explained the methods of the Denver Gas and Electric Company. The manner of determining transformer iron, primary resistance, secondary resistance and meter-shunt losses was indicated. Mr. Humphrey showed the great importance of analyzing the output of the central station. Mr. Burnett, E. V. Matlack of St. Louis and F. G. Prout of Memphis participated in the discussion. Adjournment for the day was then taken.

LECTURE ON HISTORIC AND TECHNICAL BOSTON.

In the hotel dining room on Tuesday evening an illustrated lecture on "Historic and Technical Boston" was given. This lecture was delivered by Mr. Samuel C. Clough, who has acquired by study and research a fund of information regarding old Boston. He embodied in his lecture much interesting and valuable information. The technical part of the lecture was contributed by Mr. L. L. Elden and Mr. I. E. Moultrop. The part written by Mr. Elden referred especially to the electrical development of Boston, and that by Mr. Moultrop referred to the new turbine station of the Edison company in South Boston. The lecture proved very interesting and instructive and was illustrated by lantern slides. It was in charge of Larue Vredenburgh of the Boston Edison Company.

Wednesday's Proceedings.

[Special dispatch to the Western Electrician.]

Boston, May 25.—Promptly at 10 o'clock President Edgar called Wednesday's session to order. The first feature was the reading of a paper on "Economy in Minor Station Supplies," by Edgar B. Greene of Altoona, Pa. The discussion was opened by W. L. Abbott of Chicago, and Arthur Williams of New York, and others took part.

E. E. Arnold of Pittsburg read an abstract of his paper entitled "Notes on the Internal-combustion Engine, as Applied to Central-station Service." The paper was illustrated by lantern slides of diagrams and of photographs of apparatus. This paper was the first of several referring to engine and boiler-room practice. The second one described a test of a 5,500-horsepower, three-cylinder, compound engine and generator in the Waterside Station of the New York Edison Company. It was read by J. D. Andrew of New York.

Following this came the report of the committee on the investigation of steam turbines, presented by W. C. L. Eglin of Philadelphia, chairman. The other members of the committee are F. Sargent of Chicago and A. C. Dunham of Hartford, Conn. This exceptionally important report was presented as a pamphlet of 65 pages, having a number of illustrations and drawings. An abstract of this report will be given in the Western Electrician next week; in general, it may be said that the report is highly favorable to the turbine. On motion of L. A. Ferguson a vote of thanks was extended to Mr. Eglin and his associates for their very excellent work.

Francis Hodgkinson of Pittsburg gave an abstract of his paper on steam turbines, which was devoted principally to the Parsons-Westinghouse type. His remarks were illustrated by pictures thrown on the screen.

REPORT ON DOHERTY MEDAL AWARD.

Much interest attached to the report on the award of the H. L. Doherty gold medal for the best paper on underground construction. Dr. S. S. Wheeler of Ampere, N. J., made the award verbally. The other members of the committee were L. A. Ferguson of Chicago and H. G. Stott of New York. All arrived independently at the conclusion that the medal be awarded to Mr. William P. Hancock, general operating superintendent of the Boston Edison Company. Mr. Hancock was present, and, amid great applause, stepped forward and was handed a large handsome gold medal, suitably inscribed, by Dr. Wheeler. It was stated that Mr. Blood presented the paper second in merit. Mr. Hancock made a suitable response and Mr. Doherty, the donor, also made a few remarks.

Those taking part in the gas-engine and steam-turbine discussion were R. D. Mershon of New York, George B. Tripp of Colorado Springs, H. L. Doherty of New York, Captain Tarr of Philadelphia, William R. Gardener of Pittsfield, J. D. Andrew of New York, E. W. Rice, Jr., of Schenectady, W. L. Abbott of Chicago, E. E. Arnold and Louis R. Alberger of New York. Mr. Rice's discussion was written and referred especially to the Curtis turbine. He was listened to with attention. Mr. Doherty also spoke at some length.

Edwin Yawger of Pittsburg read his paper on "The Mechanical Stoker and Human Operator," and after some discussion the association adjourned for the day to enjoy the courtesy of the entertainment committee in a trip down the harbor and on an inspection of the L Street station of the Boston Edison Company.

Thursday's Proceedings.

[Special dispatch to the Western Electrician.]

Boston, May 26.—On Thursday morning C. R. Maunsell of Topeka, Kan., read the paper of C. L. Wakefield of Dallas, Texas, on "Electric-light and Power Plants in Connection with Ice Plants." There was a brief discussion, and then President Edgar announced that the Boston entertainment was due to a committee of local electrical men, and not to the association or to the Boston Edison company alone. It may be said here that this entertainment was most profuse and hospitable and was greatly enjoyed by all the visitors.

Arthur Williams of New York then presented his finely illustrated paper on "Sign and Decorative Lighting." This paper and that on "Advertising Methods," by LaRue Vredenburgh of Boston, also effectively illustrated, were printed in advance by the New York and Boston Edison Companies, respectively, and copies donated to the association. Mr. Williams said that the fact that the electric-sign business is increasing so rapidly is the most eloquent advocacy of the business that could be had. Mr. Vredenburgh followed with his excellent paper. The two papers were discussed together and Converse D. Marsh of New York, Douglas Burnett of Baltimore, E. F. McCabe of Lewistown, Pa., and others participated. Mr. Edgar said that the Boston company spent 2½ per cent. of its gross income in canvassing and 2½ per cent. in advertising. Mr. Williams said that in one month's record in New York the company received 66 cents in revenue for every two-cent stamp used in a follow-up system. As a committee on nominations Messrs. Gossler of New York, Robinson of Seattle, Butterworth of Denver, Eglin of Philadelphia and Smith of Somerville, Mass., were appointed.

Mr. Douherty read the report of the committee on the president's address. Nearly all of the president's recommendations were indorsed. This committee was also made a committee on revision of by-laws. G. W. Brite of Atlanta presented the report of the committee on purchased electric power in factories. The other members of the committee were W. H. Atkins of Boston and S. Morgan Bushnell of Chicago. L. A. Ferguson, who, as president, appointed the committee last year, was disappointed that more of the companies had not responded to the committee's circular. Power business is very important to central stations, which should go after the big factories as well as the small ones. Mr. Ferguson made a very interesting addendum to the committee's report. He said every club building in Chicago and nine-tenths of the office buildings were on the central-station mains. In factories a similar condition is rapidly approaching. Mr. Williams of New York, Mr. Gossler of New York, Mr. Burleigh of Boston and Mr. Dusman of Baltimore also made good contributions to the discussion.

The report of the committee on "District Heating" was presented by E. F. McCabe of Lewistown, Pa., on Thursday afternoon. The subject was discussed at some length, and then the report on "Office Methods and Accounting," prepared by Frank W. Frueauff of Denver, was read by title in the absence of the writer. Mr. Butterworth, president of the Denver Gas and Electric Company, was present and made a few remarks on the Denver system.

An abstract of the paper on "A Proposed System of Standard Instruments for Operating Companies" was given by H. P. Davis of Pittsburg.

W. A. Layman of St. Louis presented his paper on "Single-phase Power Motors for Electric Lighting Stations," and J. H. Hall of New York discussed it.

Mr. Doherty as chairman of the committee on "Photometric Values of Arc Lamps," reported verbally that owing to the illness of Prof. C. P. Mathews the committee had done little work during the year. He suggested that if the committee be continued it might take up the newer lamps, such as the mercury vapor lamp.

H. L. Doherty as chairman of the committee on analysis of flue gases said that a report had been prepared but was not quite finished and he suggested that the report be distributed after the convention. The committee was continued and its scope broadened to embrace fuel economy. Mr. Doherty also presented the "Wrinkles" pamphlet, prepared by Charles H. Williams of Madison, Wis. A vote of thanks was tendered Mr. Williams for his thorough work.

H. T. Hartman of Philadelphia presented the "Question Box," a volume of 473 pages, carefully prepared. It contains a great deal of valuable information and a vote of thanks was tendered Mr. Hartman.

Mr. Hancock's prize paper on underground construction was read by title. This paper will be published in a future issue of the Western Electrician.

C. E. Skinner of Pittsburg read an abstract of his paper on "Oil for Insulating Purposes."

The executive session will be held this evening, and at that time it is likely that Ernest H. Davis of Williamsport, Pa., now secretary of the association, will be elected president. It is also probable that the convention will go to Detroit next year.

On the Chicago Train.

A pleasant journey was that made over the Lake Shore, New York Central and Boston and Albany railroads by the convention party originating in Chicago. The train left the La Salle Street station in Chicago at 2 p. m. on Sunday, May 22d, and arrived in Boston at 6:30 p. m. on Monday. The weather was pleasant, and the scenery from the car windows, with the prospect of fresh verdure, flowers and blooming trees was greatly enjoyed. Included in the party for a whole or part of the trip were W. L. Abbott, Chicago Edison Company; J. A. Bendure, Lima Electric Railway and Light Company, Lima, Ohio; Bernard A. Conolly, Lima Electric Railway and Light Company, Lima, Ohio; George Cutter, Chicago; E. L. Draffen, Gould Storage Battery Company, Chicago; George N. Eastman, Chicago Edison Company; Robert L. Elliott, Chicago Edison Company; L. A. Ferguson, Chicago Edison Company; John F. Gilchrist, Chicago Edison Company; W. J. Hanley, General Electric Company, Cincinnati; Charles F. Hewitt, St. Joseph Railway, Light, Heat and Power Company, St. Joseph, Mo.; William E. Keily, Western Electrician, Chicago; J. R. Lovejoy, General Electric Company, Chicago; R. H. McMullan, Des Moines Edison Light Company, Des Moines, Iowa; Charles R. Maunsell, Edison Electric Illuminating Company, Topeka, Kan.; Thomas R. Mercein, Northwestern Electrical Association, Milwaukee; Hary L. Monroe, General Electric Company, Dallas, Texas; Frank I. Perry, Western Electrician, Chicago; Otto M. Rau, Milwaukee Electric Railway and Light Company, Milwaukee; Francis Raymond, General Incandescent Arc Light Company, Chicago; C. W. Regester, Westinghouse Electric and Manufacturing Company, Chicago; Jesse Scribner, General Electric Company, Chicago; R. S. Wallace, Peoria Gas and Electric Company, Peoria, Ill.; W. E. Weinsheimer, Mineral-lac Company, Chicago; James Wolff, New York Insulated Wire Company, Chicago.

The ladies of the party were Mrs. George Cutter, Mrs. E. L. Draffen, Mrs. L. A. Ferguson, Mrs. J. R. Lovejoy, Mrs. C. R. Maunsell, Mrs. O. M. Rau and Mrs. J. Scribner.

A Three-wire 500-volt Lighting System.[1]

By Walter I. Barnes.

In 1897 the commercial 220-volt incandescent lamp was yet in the future; in 1899 the 250-volt lamp was in increasing demand, and the first American installation of any magnitude using the so-called high-voltage lamp was made under the engineering advice of Mr. Bion J. Arnold in St. Louis, Mo., and is fully described in a preliminary paper read at the Omaha meeting of the American Institute of Electrical Engineers in June, 1898, although the system was not in commercial operation until some months later. Owing to certain legal obstructions it was inadvisable for the St. Louis system to be installed as a pure three-wire arrangement, and it was left for the Narragansett Electric Lighting Company to be first in the field using a direct-current, three-wire feeder-and-main system with grounded neutral.

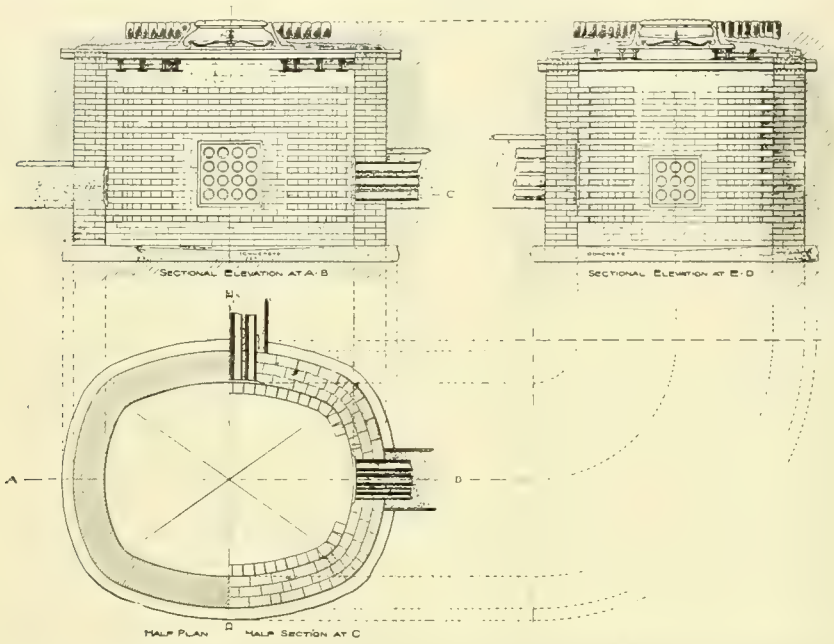


FIG. 1. A THREE-WIRE 500-VOLT LIGHTING SYSTEM. DIAGRAM SHOWING MANHOLE CONSTRUCTION.

The original request of the general manager called for a report on a five-wire system using 125-volt lamps and a three-wire system using 250-volt lamps, and a joint report was presented by Mr. William C. Woodward, the electrical engineer of the Narragansett Electric Lighting Company, and Mr. B. J. Arnold, in May, 1899.

The immediate decision of the manager was in favor of the three-wire system. With the 250-volt lamp as a factor in the situation, the alternating-current transformer was no longer a necessary part of the system, for, wherever a 500-volt, two-wire system could be operated to advantage, it was at once possible to modify the arrangement so as to allow of the use of a three-wire, 250-500-volt system.

In 1899 the Narragansett Electric Lighting Company had a connected load of 9,000 kilowatts, of which 4,900 kilowatts was in alternating-current multiple distribution, 2,700 kilowatts in direct-current, 500-volt motors, 400 kilowatts in series commercial arc lamps and 1,000 kilowatts in series arc lamps on city contracts. The electrical generating equipment consisted of three 500-kilowatt, alternating-current, 60-cycle generators, three 500-kilowatt, direct-current, 500-volt generators, 16 Thomson-Houston series generators, 50-light capacity each and 18 Fort Wayne series generators, 125-light capacity each.

A city ordinance relating to overhead wires required that all overhead construction of the Narragansett Electric Lighting Company within the close fire district of the city should be removed within three years from the passage of the act. This necessitated the removal of 600 poles and about 160 miles of wire in any event, and as the company, for the benefit of the service, proposed to extend the district prescribed by the ordinance, the amount of territory was voluntarily increased about 100 per cent.

In general, the proposed reconstruction provided for, first, the construction of a complete underground system; second, an installation of a storage battery; third, the discontinuance of the alternating-current system in the close fire district and some adjacent territory; fourth, the discontinuance of the commercial series generators; fifth, the removal of the poles and wires as required by the ordinance.

The construction of the conduit system was begun in October, 1898, and continued until December, 1901, during which time about 40 miles of streets were opened and 1,700,000 feet of ducts were laid. Of this amount about 1,000,000 feet are single-duct and 700,000 feet, multiple-duct. There were built about 850 manholes of an average size of six feet square and seven feet deep. The general construction of the manhole is shown in Fig. 1. The ducts that were used in the underground system were laid on a three-inch bed of concrete, which was spread on a spruce-board bottom; the side walls beyond the ducts were of concrete three inches thick and well rammed between the side boarding and the ducts. Over the ducts was a three-inch layer of concrete, above which was placed a protective layer of creosoted plank an inch and a half thick. After laying, the ducts were all rodded and cleaned, ready for drawing in of cable.

Owing to the peculiar location of the streets along the river front, the conduit system was often constructed below tide level, and it became necessary to waterproof the system of conduits and manholes where the same were close to the water front. This was accomplished by building 12-inch side walls on the concrete bottom of the trench, and covering the side walls and concrete with several layers of tar paper laid in hot asphalt. The waterproofing of the manholes was accomplished in a similar manner, and the results indicate that such a method is perfectly satisfactory. The illustration in Fig. 2 shows a method of conduit construction.

Into this system of ducts there was drawn about 2,000,000 feet of cable, varying in size from No. 14 B. & S. gauge, used as potential wires, to cables having an area of 1,000,000 circular mils, used as tie lines between generating and battery stations. Rubber-covered cable only was used, the insulation being okonite, varying in thickness from five thirty-seconds to nine thirty-seconds of an inch, according to the purpose for which it was intended. The five-thirty-seconds-inch insulation was used in the three-wire system. For the alternating-current, 2,200-volt system, and in the constant-current, 6,050-volt system, the insulation was seven thirty-seconds, and in the 11,000-volt transmission circuits the thickness of insulation was nine thirty-seconds of an inch. It is worthy of note that in five years of continuous operation not a single fault has developed in the cable or conduit system.

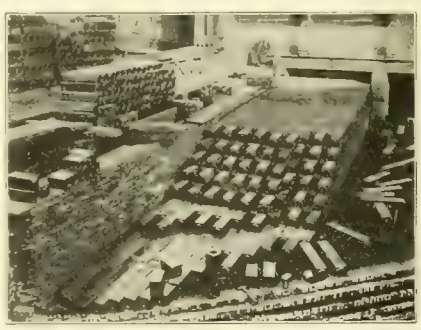


FIG. 2. A THREE-WIRE 500-VOLT LIGHTING SYSTEM.—VIEW SHOWING CONDUIT CONSTRUCTION.

In the direct-current system there was used about 1,100,000 feet of cable. The main conductors have an area of 200,000 and 300,000 circular mils, according to the district in which they are situated. The feeders vary in area from 200,000 circular mils to 500,000 circular mils, according to length and load.

There are 33 feeder points in the direct-current system, and the connected load at present is about 9,000 kilowatts, of which 4,000 kilowatts consist of stationary motors varying in capacity from 0.25 kilowatt to 75 kilowatts. The remainder of the load consists of 80,300 incandescent lamps and 1,280 arc lamps. The incandescent lamps average 3.3 watts per candlepower, and have a useful candle-hour area of not less than 4,000 hours, assuming the smashing point to be 80 per cent. of the initial candlepower.

It is quite interesting to recall that in 1899 the average watts per candle varied from 3.8 to four watts, and at that time the candle-hour area did not exceed 2,900 hours.

The arc lamps in use at present are of the twin-carbon, enclosed type, and operate in multiple on 250-volt circuits—that is, two arcs in a single inner globe—the current averaging 2.3 amperes, the energy per lamp averaging about 575 watts. This lamp has proved quite satisfactory, and is much to be preferred to the single-carbon lamp, in which the volts at the arc are about 160.

For the purpose of producing the best possible regulation of the system and also to tide over the peak load, a storage battery was installed at a substation about 2,400 feet from the generating station, in a location which in time will be fairly in the center of the distributing system.

The battery consists of 296 cells of 43 plates each, the eight-hour discharge rate being 840 amperes. The cells are mounted on an insulating system, which has served to annihilate the various troubles often found in battery insulation.

While the conduit system and the storage battery were being installed, active preparations were being made whereby existing installations on the alternating-current, two-wire system might be readily transferred to the direct-current, three-wire system.

As the 250-500-volt, three-wire system that it was proposed to install was a radical departure from all standards then existing, every precaution was taken to obtain the best and safest results. It was decided to re-wire most of the older installations, and although in many instances the wiring in customers' premises called for but slight modification, yet there were other cases where the entire wiring equipment was replaced.

There was naturally found a great saving in the amount of copper used in the new system, which was of great benefit to the consumer. In re-wiring some old installations it was not unusual to find two or perhaps three No. 0000 wires in each side of the mains, run in a heavy molding from transformer to center of distribution, the installation having been made in the old days of 4.5-watt, 50-volt lamps. These conditions were in marked contrast to the small iron pipe run from manhole to center of distribution, and the three No. 10 wires that were drawn into them and supplied an equal amount of energy as in the case just mentioned.

The several sections of the city that were included in the changes were served with about 50,000 incandescent lamps, 1,000 arc lamps and 2,000 kilowatts in stationary motors, and these installations were reconstructed to comply with the requirements of the new system; the change from aerial to underground supply, and from alternating-current to direct-current service, was made without any interference with the customer.

In a central station already operating a two-wire, 500-volt motor system, the addition of a third wire is all that is necessary to obtain an efficient and a flexible wiring system for lighting purposes. The fact, too, that the same generating apparatus may be used for both motor and lighting service is no small factor in the situation, the natural motor load being a day load, while the lighting load, generally extending well into the night, serves to produce a very satisfactory load curve, particularly if a properly proportioned storage battery forms part of the equipment.

The author personally favors the general use of neutral connection, which is continuous from source of supply to point of use, and is thoroughly grounded at every possible point inside the customers' premises, and certainly in the network of mains and feeders in the streets. The use of single-pole switches on the positive and negative sides of the system is a sufficient means of opening any branch circuit.

A 100-mile Transmission Line.[1]

By Robert Howes.

The plant considered is that of the Washington Water Power Company of Spokane, Wash. The power house is located at the foot of the lower falls of the Spokane River, in the very center of the city of Spokane. The theoretical head on the water-wheels is about 71 feet.

That portion of the plant which furnishes the power for the transmission line is composed of two Y-connected, 4,000-volt, 2,250-kilowatt, 60-cycle, 300-revolution-per-minute, revolving-field alternators, each direct-driven from a pair of 40½-inch special turbines, made by the Stilwell-Bierce and Smith-Vaile Company, and designed to develop 4,000 horsepower under 68 feet of effective head. The water is supplied to each unit through a steel flume 10 feet in diameter and over 500 feet long.

The wheels are governed by Lombard governors, with compensating action modified to meet the demands occasioned by kinetic energy of the water moving in the long flumes. These governors can be relied upon to keep the speed from rising or falling over three per cent. from the normal with instantaneous changes of 600 kilowatts at any position

[1] Abstract of paper read before the National Electric Light Association at Boston, Mass., May 25, 1904.

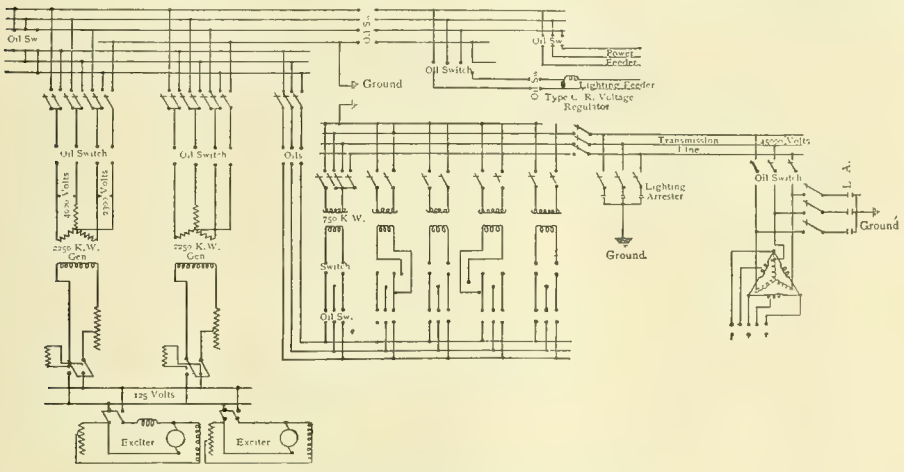
of the gates, and will care for small changes of load to within one-third of one per cent. of normal speed.

The accompanying diagram gives the important electrical connections. All instruments have been omitted, to avoid confusion of lines, but a fairly complete set is installed. The principal exciter is driven from a separate wheel, which is supplied with water from either of the two flumes.

The plant is designed to furnish three-phase current at 4,000 volts for local power and 2,300-volt, single-phase current for local lighting service in Spokane. Any lighting feeder can be thrown on either of the three legs of the Y-connected generator, by means of the type G oil switches, and the load on the generators kept balanced. Type C R hand voltage regulators are installed on the neutral or grounded side of each lighting feeder, the voltage being regulated with the aid of a voltmeter compensated for the line loss.

The generator, transmission line and main city switches are motor-controlled and of the type-H variety. Those on the transmission line and city have automatic overload tripping devices. The city feeders have automatic oil circuit-breaker switches, hand-operated.

The step-up transformers are 750 kilowatts each



STATION CONNECTIONS IN 100-MILE TRANSMISSION LINE.

and of the water-cooled type. They are connected in delta on the 4,000-volt side, and in Y on the high-tension side, the neutral connection being grounded at the power house. The high-tension winding is for 34,700 volts, taps being brought out for 26,000 volts also, thus giving a choice of 60,000 or 45,000 volts line pressure. Two spare transformers are installed, and the switching arrangement is such that one of the spare ones can be cut in to replace either of the three in use without shutting down. The second spare one can be connected on any phase by shutting down about one minute.

Three banks of lightning arresters are installed on the line—one at Spokane, one at the end of the line and one about 20 miles from the end of the line. The main line is 98 miles long at the farthest substation and has three short branches at present. Low-tension current is transmitted about two miles farther up the canyon, making the total transmission just 100 miles. On leaving the power house the line goes through the city streets for 3½ miles, the poles used being from 40 to 85 feet long, in order to get above everything that might be interfered with. Wherever it crosses other lines, grounded wires are strung over them several feet below the transmission line.

Leaving the city, the line follows a county road for about 24.5 miles, till it reaches the Cœur d'Alene Indian reservation. Across this, a distance of 24.8 miles, almost all in heavy timber, a private right-of-way was obtained and cleared of all trees and brush. All trees outside the right-of-way, liable in falling to reach the line, were also felled. At one point in this portion, the line crosses the St. Joseph River where it empties into the Cœur d'Alene Lake. The river runs close to a bluff on the west, while on the east side there is a marsh and the neck of an inlet. At high water several feet of water stands from bluff to bluff. To span this would require a span of 3,300 feet, so resort was had to setting the poles on a cluster of five piles. The center one being driven about six feet lower than the others, a socket was formed in which the pole was firmly clamped with heavy iron bands. By this means the longest span was reduced to 474 feet across the river channel, the wires being far above the smokestacks of the steamers that navigate the river. Number 0 B. & S. hard-drawn copper wire was used here for further security against a wire breaking. A row of single piles with a plank walk was placed across the marsh under the line, for patrolling purposes. Thus far, this construction has proved most satisfactory.

Leaving the reservation, the line follows up the valley of the Cœur d'Alene River and the south fork of the same to the mining region. It is largely on private right-of-way, but follows county roads in part, and goes through a mixture of swamps and meadows—sometimes several feet under water—timber-covered mountains, steep rocky mountain sides and around rocky cliffs. As far as possible it was considered best to avoid proximity to towns, railroad tracks, etc., where the youth with a 22-caliber rifle likes to walk and practice shooting, for the insulators offer a tempting target to those of a mischievous nature.

The poles of the present line are set 35 feet from the north or westerly side of the 100-foot right-of-way, leaving room for a duplicate line on the other side. The standard pole is 35 feet long, of winter-cut cedar, 12 inches at the ground line and eight inches at the top. They are set six feet in the ground. Special lengths are used in hollows at bottoms of ravines, etc., to avoid making too great a change in the slope of the wires on any one insulator; also at railroad crossings and in villages.

The wires are of No. 2 B. & S. medium hard-drawn copper, and are placed to form an equilateral triangle 42 inches on a side. The upper insulator is set on the top of the pole, the others at either end of the cross-arm. A complete set of three partial transpositions is made in each section where the condition varies in paralleling telegraph, telephone lines, etc.; otherwise in every mile. A private telephone line is run on the side of the poles below the power line and is transposed every few spans. The insulators used are of the double-petticoat type, 13-inch size, and are mounted on a metal pin. This pin is described by Mr. D. L. Huntington in the Transactions of the American Institute of Electrical Engineers for April, 1903, page 453, and has given entire satisfaction to date.

The sub-station buildings are of brick. The high-tension wires, entering near the top, go directly to knife-disconnecting switches, set on a gallery, thence to the transformers on the ground floor. One transformer of the three-phase type is used. The secondaries pass from a transformer to a switchboard, carrying oil circuit-breakers, recording wattmeters and indicating instruments, thence to the customers' circuits. The half-voltage taps, shown on the diagram, are for starting purposes only, for synchronous motors. There are eight of these sub-stations, six of which have been in continuous use since starting.

Several miles of long-distance telephone line parallel the transmission line at a distance of about 40 feet, and one of the telephone company's engineers was much worried, fearing trouble with the operation of these lines. Three days after the transmission was in operation, he asked when the current would be turned on, as he wished to notice how much the change was. Upon learning that the current was on, he admitted he could not detect it in the operation of the telephones. There is very little sound on the private telephone line from induction unless one wire becomes grounded, when it becomes almost impossible to understand a person at the other end.

A rather peculiar loss of from one to six feet of head in the draft tubes is encountered at ordinary height of the river. The center of shaft is then about 18 feet above tail-water. Not far above the intake to the power house the river divides into several channels, and falls over numerous small dams and cascades (composing the "upper falls") about 60 feet, reaching this level a few hundred feet above the intake. There being no quiet water whatever, considerable quantities of air seem to be taken into the flumes with the water, and no doubt are held there under pressure as the water flows down the flumes, to be instantly released upon passing through the wheels into the partial vacuum. This, no doubt, explains a part of the loss of head.

Another peculiar phenomenon is noticed every time one of the 4,000-horsepower wheels is started, of which the writer has found no satisfactory explanation, and would be glad to hear one. The following characteristic observations were recorded by him: The pressure at center of shaft, according to gauge, being noted as 24 pounds and the vacuum in draft tubes being zero, the gate of the wheel was opened slowly. Full speed was reached in about one minute, the gate being nine per cent. opened. The vacuum was noted as rising rapidly. The speed remained steady for two or three minutes and the vacuum increased to 10 inches of mercury; suddenly the wheel slowed down 20 per cent., the vacuum continuing to rise to about 13 inches of mercury, where it remained practically stationary. The wheel continued to run at steady speed and 20 per cent. low until the gate was further opened, it requiring 16 per cent. gate opening to bring the wheel back to speed. The pressure gauge showed a loss not to exceed one-tenth of a pound, while the vacuum remained about the same.

The power house being ready before the line was completed, 77 miles of line was first tested. All switches were closed and the generators started slowly from rest. The speed was gradually increased, the connections having been made for 60,000 volts pressure. The pressure was brought up to 42,000 volts and then cut down slowly to zero without any indications of trouble.

Next morning the machine was started again in the same manner, the voltage being raised to about 68,000 volts for a short time, and then lowered to about 58,000 or 60,000 volts, and held there all day while the entire line was patrolled and found to be in good condition. Along the line a discharge could be heard at a large percentage of the insulators. With 58,000 volts on the line, the amperes shown on the generator were 230 in each leg, while the wattmeter indicated 25 kilowatts per leg. This would show the charging current to be approximately 15 amperes, while, after the step-up transformer loss was deducted, the remaining energy lost in the line would not be over 10 kilowatts per wire, or a total of less than 30 kilowatts. In this test only one set of lightning arresters was connected, they being at Spokane; each division of the set was composed of 24 General Electric 2,000-volt, double-pole arresters connected in series, thus forming 96 spark gaps from each wire to ground. A steady stream of sparks could be noticed through the first few air gaps. These became less frequent as the number of gaps crossed became greater, and before reaching half-way down the arresters the sparks were no longer visible. The leading current exerted such an exciting effect on the generator that the exciter voltage had to be reduced to 85 volts and all the generator field resistance cut in, giving an exciting current of about 50 amperes, whereas, with the generator half-loaded with non-inductive load, the exciter was run at 115 volts with the generator rheostat handle in about central position.

After this test the line was shut down for four days, the transformers were connected for 45,000 volts line pressure, and the first sub-station 79 miles from Spokane, cut in. The voltage was brought up to 43,000 volts, and simultaneous volt readings were taken by means of telephone, the voltage being very steady. The voltage indicated at the sub-station was a little over 44,000. The voltmeters were new, but were not compared; however, the error should not have been two per cent. The amperemeters in Spokane on the 4,000-volt side of the transformers indicated 120 amperes, giving about 10.5 amperes for charging current at this voltage, there having been two more miles of line cut in and also an unloaded transformer and bank of lightning arresters at the sub-station since the test at 58,000 volts.

During the first test the neutral wire was not grounded at the power house, and the floating around of the neutral point was plainly noticed on the lightning arresters, the sets connected to the three wires showing considerable difference, sometimes one being most active and then another. Grounding the neutral wire stopped the greater part of this effect, although a slight varying difference still seemed to exist.

As induction motors were started, the amperes supplied to the step-up transformers decreased until a minimum reading of about 95 amperes was reached. The kilowatts were not observed, owing to the generator furnishing current to the city as well at this time, and the proportion of the total supplied to each could not be accurately obtained. After this time, adding more load increased the current, accordingly the minimum current is about 8½ amperes for 79 miles of the line at 43,000 volts.

The work was rapidly pushed to completion and the sub-stations were put in operation, each sub-station being put into service as soon as the line reached it. The power was cut off only long enough to make connections to each piece of new line. Accordingly, no opportunity to test the charging current and the kilowatts of the complete line was had; for one could never be sure that all the load was off at the various sub-stations. From two of these current is supplied for lighting purposes, the towns of Wardner and Kellogg being lighted from one.

The Luminous or Flaming Arc.[1]

By Welles E Holmes

The subject which I present for your consideration is a system of lighting by the use of a new and improved arc lamp lately brought out by the General Electric Company of Schenectady. In this paper I shall try to interest you with a description of the lamp, the generator and the results, not of a factory test under [illegible] of actual commercial conditions, as I have been operating some 30 of these lamps in connection with the plant of the N. & W. Gas Light Company now for about six months, the lamps having displaced 30 of the old open arcs on one of our circuits. Let me state that I think this is the first installation of the "luminous arc" lamp for strictly commercial purposes.

It is well known to you all that the design and

1 Paper read [illegible] at Boston Meeting [illegible]

production of electric generators has reached so high a state of efficiency as to leave little to be hoped for in way of any marked increase along this line. We have arrived at a point where we must look elsewhere in order more economically to turn our energy generated into useful light. We have but one other place to look, and that is to the lamp itself. The recognition of this is the cause of the advent of the luminous arc.

In order that you may with more satisfaction follow the details, I have had hung up here one of the luminous arc lamps. You will see that it is an open arc, that is, there is no enclosing inner globe, the exclusion of the air not being depended upon as a factor in the life of the electrodes and, except for its chimney top, the general appearance is not unlike that of other arc lamps, the outer globe performing the same office as has been customary heretofore.

The lamp, notwithstanding the fact of its being an open arc, is a long-burning lamp, the electrodes having a life of about 150 hours. In designing the lamp it early became evident that some substance or combination of substances must be used to produce an electrode of long life, low cost and good conductivity, and to the chemical research of Dr. Steinmetz of the General Electric Company we are indebted for the magnetite stick which forms the lower and negative electrode of this lamp. This stick, as its name implies, is made of magnetite, but may be compounded with other substances to obtain a desired result. We have been from the start experimenting with differently compounded sticks, some of them being solid like a section of steel rod and others being made by enclosing powdered magnetite in a thin iron sheath. Of the relative merits of the two, I would say that the filled stick or the stick made by filling a sheath with the magnetite compound has given the best results.

The life of these sticks has varied; purposely so from the fact that this six-month run has been wholly experimental. We have tried one-half-inch sticks and five-eighths-inch sticks. Taking the one-half-inch sticks, we find them varying from 63 hours to 95 hours life. On the five-eighths-inch stick we have already obtained an average life of 182 hours, with a maximum on an individual stick of 211 hours, so that it now seems possible to produce a stick with an average life of 200 hours. Just at present we are using a one-half-inch stick, having gotten an average life of 100 hours from it. Before leaving the subject of magnetite sticks, I would say that we can be assured of the supply of this article, as it is a very common iron ore, Pennsylvania being the largest producer, followed by New York and New Jersey, the total yearly amount mined in the United States being nearly 2,000,000 tons, the average value per ton at the mines being $2.24 and the magnetite stick from the General Electric Company is to cost us $50 per thousand, or five cents for each trim.

For the upper or positive electrode, we have two segments of copper, one segment which I will call the striking segment, from the fact that the arc is struck by contact with it, is made of cast copper. The other segment, made of rolled copper, I will call the burning segment, for the reason that the arc does not burn where it is struck, but the two segments change places, as it were, after the lamp is started; the reason for this change I will explain under "operation."

This positive burning electrode of rolled copper does not consume away, but rather is inclined to increase in weight, due to the deposit of oxide from the negative magnetite stick.

Coming now to the operation of the system, we have a direct-current lamp requiring four amperes and 80 volts, and having no four-ampere direct-current generator, we cut down the current strength of a multi-circuit Brush generator from 6.8 to four by passing some of the current through a rheostat and letting the regulator do the rest. This is successfully done, but we at first tried to run the lamps on 3.4 amperes, and when cutting the generator down to this figure it made the field so weak as to be unstable for good practice, sometimes causing the generator to "die" during its run; also the arc in the lamps was unsteady at 3.4 amperes.

It seemed best then to use four amperes as the current strength, and the General Electric Company is now building direct-current generators of the Brush multi-circuit type and wound for four amperes in 100-125 and 150-light sizes. These machines have an efficiency of about 89 per cent. and regulate one ampere either way from four. It is obvious that a generator wound for this current strength will be much more efficient than our present practice of using up the undesirable portion of the 6.8-ampere current by means of a rheostat.

The action of the lamps is as follows: When started, the pickup magnet draws the magnetite stick up until it strikes the cast-copper or striking segment before referred to, and immediately falls away to its burning position about one inch below the copper, at the same time drawing its arc. The striking segment then draws away, the burning segment taking its place, the arc following from one segment to the other. In the action of changing segments the arc is not interrupted, as the distance between the magnetite electrode and these segments is maintained the same, by reason of the segments swinging in the arc of a circle. The lamp now burns with an arc about one inch long, and a fine smoke is given off by the magnetite electrode, which smoke is taken care of by the chimney occupying the central portion of the lamp. The lower opening of this chimney is immediately over the arc, the top of the chimney being open to the air and provided with proper rain shield. On account of this smoking characteristic, the lamp may not be used for inside work unless we are some time to be provided with a smoke-consuming device that will take care of this "bad habit."

Some of this smoke or oxide dust is deposited on the burning electrode of rolled copper in the form of a fine powder. If this dust were deposited on the striking electrode, it would be liable to prevent the lamp striking its own arc again after it had started the first time. Therefore it is seen that the striking electrode, by reason of its drawing away after having struck its arc, is always maintained in a clean condition for striking the arc again, while the rolled-copper or burning electrode may become covered with dust without in any way affecting the ability of the lamp to strike its arc as many times during the night as it may go out.

Just over the arc and fitting around the base of the chimney is a nickel reflector inside the globe. In our observations of the lamp, this reflector is found to add about 10 per cent. to the light distributed and on account of the arc being fixed, this small reflector gives better results than would the larger reflectors commonly used.

In treating of comparisons, I use only the watts at lamp terminals. Our question now is this: Does this 320-watt luminous-arc lamp give more light than any one of the following lamps?

340-watt 6.8-ampere, open arc.
460-watt 6.6-ampere, series direct enclosed.
460-watt 7.5-ampere, alternating enclosed.

My answer is that it does but only by a small margin. We have determined this by the luminometer, a simple instrument for comparing the strength of illumination at points distant from the lamp by reason of the light being thrown upon a printed card within the instrument, and find that this card with a certain size type is readable 10 to 15 feet farther in the case of the 320-watt luminous arc than it is with any one of the other lamps mentioned.

With so small a margin of light to its credit, wherein lies, then, the advantage of this lamp? It is in the average distance we are able to read this card in the luminometer. Taking either of the 460-watt lamps, their maximum readable distance was 335 feet, while their minimum readable distance, because of their varying arc, was about 180 feet, giving their average readable distance as 267 feet, while with the 320-watt luminous arc the maximum readable distance was 350 feet, the minimum 300 feet and the average 325 feet.

We therefore see that the percentage of variation between maximum and mean and minimum and mean is in the luminous arc about eight per cent., but in the carbon arc about 30 per cent., and the average candlepower of the 320-watt luminous arc lamp is better than that of the other lamps considered.

I have given you the amount of energy expended at lamp for a result in candlepower as above shown, the difference between 320 watts over 460 being a very appreciable saving.

You have in the case of the luminous arc an illumination of one foot per watt expended and in the carbon arc an illumination of about .53 foot per watt expended, and, further, the reduction in C^2R loss is certainly an item to be considered for our line loss per mile, say No. 6 wire and 7.5 amperes would be about 120 watts, while in the four-ampere circuit about 40 watts per mile, a saving of 80 watts for the luminous arc.

As to the maintenance: I think I have already stated that the magnetite sticks are to cost $50 per thousand. There is no expense for inner globes or washing. The outer globe is the same standard article you now buy. The expense of lamp repairs should be no more than at present, as the lamp is not delicate or complicated in its mechanism. The globe pan with its consequent shadow is something we still have to keep, but this shadow can be in a great measure eliminated by the use of a half-ground globe. We must have a perforated globe pan, as the lamp is dependent on some slight draught to carry the products of combustion up the chimney. Stopping this draught will result in coating the globe with the red oxide given off by the magnetite stick.

Electric Light and Power Plants in Connection with Ice Plants.[1]

By C. L. Wakefield.

I offer an apology, to begin with, for approaching a subject of this kind with so little data, and practically all that I am about to say is based upon my own experience. Correspondence with about 50 plants supposed to be operating ice and power plants together resulted in showing that very few were actually doing so, and these, with three exceptions, without purpose—by accident, as it were. It is strange how many operate by accident, which proves how long-suffering is the Great Architect. I recommend that the association try to have careful data kept for the coming year on this subject and have the results tabulated.

It can be accepted as a general proposition that anywhere south of that much-heard-of Mason and Dixon's line electric-lighting and power plants can be operated in combination with ice-making plants, where steam is the motive power, advantageously to both industries.

To many members of this association the art of making ice is probably entirely unknown; therefore, I beg your indulgence to state briefly: Ice is made by the rarefaction of gases or the evaporation of liquids in enclosed pipes, the heat effort necessary to do this work being taken from a surrounding medium, a non-congealing heat conductor, which in turn gets its heat from water, in cans or on plates, which it is desired to have frozen.

Distilled water is generally used for making ice, for the sake of purity and clearness of appearance; more especially the latter. This water is distilled from the steam exhausted from the ammonia pumps where the compressor system is used, and from separate distilling apparatus where the absorption process is used. Nearly all modern ammonia pumps will freeze 20 per cent. more water than their exhaust will furnish, and as the absorption process requires a separate distilling apparatus all the water that can be obtained from other sources is an advantage easily seen.

Distilled water must be kept by itself, as any mixture, however slight, with undistilled water will cloud the ice. It is also true that the water must be kept as free of air as possible. Nevertheless, it is practicable to take distilled water from a pipe condenser maintaining a vacuum at the same time.

As to the question of labor. We operated a 300-kilowatt alternating-current plant with the addition of one oiler and one fireman more than our regular force. We were operating this in connection with a 100-ton ice-making plant of a compressor and can system.

It is, of course, not good business to start such industries except where a market is already prepared or on ground that will yield to the plow, but with these conditions in the right shape the advantages of the combination suggested are seen to be: First, the employment of labor for the year around that would otherwise have little to do, but still must be kept on hand; second, a saving in the use of water that would otherwise go to waste; third, a saving in the condensation in steam pipes and headers, which can be almost constantly employed; fourth, the steady load on boilers, with the advantages of which you are all familiar. Upon this last point the following is true:

In the warmer climates all business houses close early and people sit much out of doors in the summer time. The load on the electric machines, therefore, is very light; in our experience not much over half in summer what it is in winter, and not more than one-fourth in quantity and length of time. While the load on the ice plant increases as the summer advances and decreases as the winter comes on, it is also practicable to slow down or close down the ice machines for a short period during the peak of the load on the electric plant.

I believe it entirely practicable to operate the ammonia and water pumps electrically so as to give a more even load on the generators.

I have found it much easier to get an engineer posted in electricity than one who could operate an ice plant. Electricity seems to present so many possibilities to the imagination that men seek to follow that trade both as to theory and practice who should be writing "fairy stories" on other subjects. I present this as one of the minor difficulties in the way of these combinations.

The fuel cost per ton of ice has a wide range, from 350 pounds to 700 pounds of coal being necessary, depending, of course, upon the calorific value of the fuel and the manner of its use.

The value of cold-storage plants and the necessity for their existence in the South are being slowly grasped, and these offer a still larger field for growth and additions to both ice and electric plants.

The only hope I have in presenting this short paper is that it may stimulate more patient investigators than myself to examine this question, bringing to the work a scientific knowledge of both industries, which I do not possess.

[1] A paper read before the National Electric Light Association at Boston, May 26, 1904. The author is manager of a company in Dallas, Texas.

Chicago Street-railway Situation.

Acting on the advice of the corporation counsel, the Chicago City Council at its last meeting took no important action on street-car-franchise matters. All resolutions looking to an ordinance to give street-car companies a license revocable at the option of the city instead of passing franchise ordinances were sent to the committee on local transportation. The corporation counsel explained that the passage of an ordinance at this time and an attempt to enforce it might be construed as a violation of Judge Grosscup's injunction order, and he suggested that the proceedings pending in the federal court should not be complicated by any possible question as to the correctness of the attitude of the city toward the court and its orders. The committee probably will do nothing until the existing litigation is ended.

Large deposits of radium-bearing ore are said to have been discovered in the northern part of Emery County, Utah. The deposit of this rock is located on a ranch and can be traced to the surface for 3,000 feet. It is about 150 feet wide and has been several times located for copper, but always abandoned.

Independent Long-distance Progress.

An expert engineer, it is said, has been secured to go over all the properties of the Independent long-distance companies for the purpose of making a thorough investigation and pointing out such changes in the physical conditions and management as would be advantageous. He will make a report to the executive committee of the companies so that all may have the advantage of his work. The object is to secure a uniform system of doing business, so that should the lines be united there will be no difficulty in the operation.

At the St. Louis meeting of the inspection party which went over the ground from Pittsburg two weeks ago, the red-white-and-blue shield used by the United States Telephone Company of Cleveland was adopted as the trademark and emblem of all the long-distance Independent companies. Secretary Hoge has sent copies of the shield to all the companies that may unite under traffic arrangements, they being the United States Telephone Company of Cleveland, the New Long-distance Telephone Company of Indianapolis, the Home Telephone Company of Louisville, the Kinloch Telephone Company of St. Louis, the Pittsburg and Allegheny Telephone Company of Pittsburg, and the Western Independent Telephone Company of Kansas City.

The Situation at Evansville.

The telephone situation at Evansville, Ind., is making history rapidly. It recently developed that the plan by which the Citizens' Telephone Company is to pay the debts of the old municipal company is through the sale of the plans of the latter company, which are claimed to be worth $8,000 to any company coming into the field. But this plan is being interfered with by a stockholder, who has brought suit for a receiver for the municipal telephone company, alleging that the official representatives of Evansville have made a secret agreement with persons who have organized a telephone company, whereby the latter are to make good the losses of the municipal company in express consideration of a franchise for the new company. In consequence of public agitation over the three companies recently organized, each clamoring for a franchise, a resolution was introduced in the City Council at its last meeting providing that no action be taken on the telephone question until the court's decision relating to the Cumberland company's rights (now on appeal) is handed down. The passage of this resolution means that the Cumberland company's claim must be removed before the franchise can be let to advantage. This is taken to mean that the franchise will go to the highest bidder.

Telephonic Development in Proportion to Population.

The annual report of the New England Telephone and Telegraph Company of Boston contains some interesting figures comparing the growth of the telephone business in the territory served by this company with that of the general development in other countries. The system of exchanges and toll lines of the New England Company has grown to large proportions, and it is pointed out by the directors that few sections of this or any other country have reached so large a telephonic development, measured by the number of stations, the mileage of circuit or the number of conversations transmitted in proportion to the extent of population.

The latest reports of the systems of foreign countries which can be obtained show the German empire, with a population of 56,367,178, as having on January 1, 1903, 392,924 telephone stations; Great Britain, population 41,605,801, on January 1, 1904, had 294,881 stations; France, population 38,961,945, had June 1, 1903, 100,692 stations; Sweden, population 5,175,228, on January 1, 1903, had, including the government system and those of the private companies, about 95,000 stations; Switzerland, population 3,327,336, had on the same date 46,687 stations; Austria, population 26,150,708, had 38,225 stations; Denmark, population 2,449,540, about 38,000 stations, and Norway, poplation 2,221,477, had 37,519 stations.

The aggregate population of the four New England states, Maine, New Hampshire, Vermont and Massachusetts, is shown by the latest United States census as 4,255,041. The total number of stations within these states operated with the Bell telephones and connected with the system of the New England Telephone and Telegraph Company was, on January 1st of this year 136,089, a number larger than that of any foreign country, save only Germany and Great Britain.

Bell Output for April.

The monthly instrument statement of the American Telephone and Telegraph Company, just issued, shows a slightly decreased output, gross and net, for April, compared with the exhibit for the corresponding period in 1903. The figures, with comparisons, are as follows:

April—	1904.	1903.	1902.	1901.
Gross output	102,907	104,429	108,242	72,396
Returned	42,335	43,491	37,587	33,177
Net output ...	60,572	60,938	70,655	39,219
Outstanding April 30	4,032,667	3,400,573	2,761,720	2,118,717

Prizes for Improvement Ideas.

President F. S. Dickson of the Cuyahoga Telephone Company of Cleveland has offered three cash prizes of $15, $10 and $5 for the three best answers to the question, "What Can We Do to Improve the Business of the Cuyahoga Telephone Company?" The competition is open to all except the principal officers of the company and may apply to any department from the business to the operating and to construction and mechanical work. The object is to secure ideas on the detail work. It is stated that the managers and heads of departments can see the larger points of importance, but it is the little things in the detail work that often count for much, and it is believed the employes will be able to discover many methods of improvement.

Indiana Telephone Items.

The Lost Creek Mutual Telephone Company of Seeleyville has filed articles of incorporation. The capital stock is $3,500. F. H. Felling, F. C. Conway and M. A. Modesitt are the directors.

The Flora and Bringhurst Telephone Company has been incorporated with a capital of $12,000. H. J. Thomas and W. T. Wagner are interested.

The bitter rivalry between the two telephone companies in Hope and Hartsville is now at an end. Frank Bowman of Hope has purchased the Hartsville line, and the two have been consolidated.

The Anti-monopoly Telephone Company is the latest company to organize in Evansville. The company is organized by manufacturers and will have a capital stock of $500,000. The company will, its promoters say, incorporate at once and ask for a franchise to construct and operate a modern plant in Evansville. It will agree to pay the city a bonus of $125,000 for a 30-year franchise. F.

Telephone News from the Northwest.

Farmers of Lake Prairie and Lavasse, near St. Peter, Minn., have formed a rural telephone company and will build 18 miles of line.

The Renville Rural Telephone Company has been formed at Fairfax, Minn., to build a rural line.

The Consolidated Telephone and Telegraph Company has been granted admission to Red Wing, Minn., for a long-distance line.

The Belgrade (Minn.) Telephone Company has been organized with $12,000 capital and will install a local exchange as soon as possible.

The E. H. Martin Telephone Company of Webster City, Iowa, will increase its capital stock to $300,000. About $10,000 worth of cable has been received, to be used on the extensive improvements to be made on the system this year.

The telephone system of the Sumner (Iowa) Telephone Company is to be sold at auction.

A movement is on foot to form a stock company to purchase the Fowler Telephone Company's system at Pella, Iowa.

The Marshalltown (Iowa) Telephone Company has secured the lease of the franchise granted at Marengo to the Marengo Telephone Company, and will install a new exchange at that place. R.

Ohio Telephone Notes.

Within a short time the long-distance telephone lines of the Lake Shore and Michigan Southern railroad from Toledo to Youngstown will be completed. The plan embraces a continuation of the service to Buffalo, so that all points along the Erie shore and as far south as Youngstown may have the benefit. Lines will reach all yard offices and the private exchange will be connected with the Central Union local and Bell long-distance lines, so that employes may have the advantage of reaching points other than those along the main line of the road. The idea is to give telephone service for railroads a thorough test.

It is thought the new automatic switchboard, recently purchased by the Citizens' Telephone Company of Columbus, will be installed by the first of the year. Work on the building is being rushed.

The Alvordton Telephone Company of Alvordton has been incorporated with a capital stock of $10,000. The company will build a line from Alvordton through Pioneer and West Unity to Montpelier and another from Alvordton to Wauseon. The incorporators are P. C. Biglow, V. E. Cunningham, A. L. Biglow, D. C. Lord and C. F. Poulson.

The Mt. Vernon Telephone Company of Mt. Vernon has reincorporated in Ohio with a capital stock of $150,000. It formerly operated under a West Virginia charter. The incorporators are headed by Walter C. Curtis.

Henry A. Everett, president of the board of directors of the Cuyahoga Telephone Company, has made a proposition to the Board of Public Safety of Cleveland to install and maintain a police-signal system. Mr. Everett said that the expense of installation and the cost of maintenance would be light.

The defeat of the ordinance granting the Independent interests a franchise to build a plant at Norwood, near Cincinnati, is rather a disappointment to the Independents, as it will cause the trouble of going to the Probate Court in case the company considers it worth while to fight the matter out. The Bell interests seem to have complete control in the village and the council will not take action that will in any way oppose it.

Attorneys in the case of the Queen City Telephone Company which applied to the Probate Court for a franchise in Cincinnati have made their arguments before Judge Nippert, who has the question under consideration.

The Gilbert Telephone Company of Gilbert, Ohio, has been incorporated with a capital stock of $2,000. E. L. Roe, Charles Menefee and others are interested. C.

TELEPHONE MEN.

William T. Drake, manager of the Michigan telephone exchange in Marshall, Mich., died suddenly last week. Mr. Drake was a prominent resident of Marshall.

J. L. Jensen, chief engineer, and F. Johannsen, general manager of the Copenhagen and Seeland Telephone Company in Denmark, are making a tour of the United States for the purpose of gathering ideas for the improvement of their property. In Cleveland the gentlemen were much interested in the plant of the Cuyahoga Telephone Company, which is constructed on similar lines as the Denmark system.

GENERAL TELEPHONE NEWS.

The Wellington Independent Telephone Company is building a new toll line from Peck to Mulvane, Kan., besides a through copper circuit to Wichita.

The Sumter Telephone Manufacturing Company of Sumter, S. C., will increase its capital stock to $100,000 for further enlarging and improving its plant.

A company has been formed at Junction City, Ky., for the purpose of installing a local telephone exchange. J. B. Steele, R. H. West and J. D. Shelby are the officers of the company.

The Assumption (Ill.) Telephone Company, organized by S. S. Shafer, I. L. Long and S. J. Long, will construct a telephone system in Assumption. The company is incorporated with a capital of $2,400.

Bids will be received by City Clerk F. L. Wright of Santa Rosa, Cal., up to June 10th for a franchise to construct and operate a telephone system, together with poles and other appurtenances upon the crossroads in Sonoma County.

The Bell Telephone Company of Missouri has been granted authority by the secretary of state to increase its capital stock from $4,000,000 to $10,000,000. The company will improve and extend its lines throughout the state of Missouri.

The Town Council of Walkerville, Ont., has refused to renew the franchise of the Bell Telephone Company unless the company pays more for its privilege. The town of Sandwich, Ont., some time ago also refused to renew its franchise to the company on the same grounds.

According to a decision of the Kentucky Court of Appeals in the case of the Campbellsville Telephone Company against the Cumberland Telephone Company a few days ago the latter must transmit messages received from the Independent company. This decision is important, in that the laws of that state, if the decision is correct, would force the companies to interchange business.

Victoria and other places on Vancouver Island are soon to be connected with points on the mainland as far south as Portland, Ore., by the International Telephone Company. The company will lay a four-ply cable by way of San Juan, Orca and Lummi Island to Whatcom. It is understood that a rate of 50 cents will be charged for a one-minute conversation with Vancouver and 60 cents with Seattle.

The Kinloch Long Distance Telephone Company of Missouri has filed a first-mortgage deed of trust to the Mississippi Valley Trust Company of St. Louis, trustee, for an issue of $5,000,000 gold bonds, of which $1,000,000 is to be placed immediately. The mortgage covers all the lines of the company, being properties in Missouri, Kansas, Illinois and Indiana. It is one of the largest links in the talked-of general Independent telephone combination throughout the country.

The council for the city of Peterboro, Ont., has granted to the Canadian Machine Telephone Company a 10 years' franchise of the streets of that city upon which it may erect poles. The company must have its system in operation inside of 12 months, and the price for the telephones shall not exceed $15 a year for residences, and $20 a year for business use. The wires and cables must be placed underground on the principal streets. This is the first place in Canada to which the company has applied and received a franchise.

The Joplin (Mo.) News-Herald, in a recent special edition, in which is reviewed the growth and progress of Joplin, says of the Home Telephone Company: "In no city on this continent is there a better system maintained than here in Joplin, where the Home Telephone Company has made itself so useful to the people that it would be almost impossible to get along without it. * * * There is no company operating in any line in the city today that has been so completely and thoroughly successful in all its undertakings. Recently it has connected with the Kinloch system and is now giving its customers an excellent long-distance service.

A Modern Printing Establishment.

A printing plant of systematic arrangement and of high excellence in its mechanical and electrical equipment and methods of driving is that of the Sparrell Print, located on Congress Street and Atlantic Avenue, Boston, Mass. The business office is on the first floor of the building; the press and composing rooms are on the third floor. For the amount of machinery and the quantity of work that may be executed at one time, this plant has been arranged in a remarkably compact manner, at the same time leaving aisles and the center of the floor as clear as possible to facilitate the handling of material. The stock is received and finished work delivered very conveniently by means of two elevators, one at the middle of the north side of the room and the other at the middle of the east end of room.

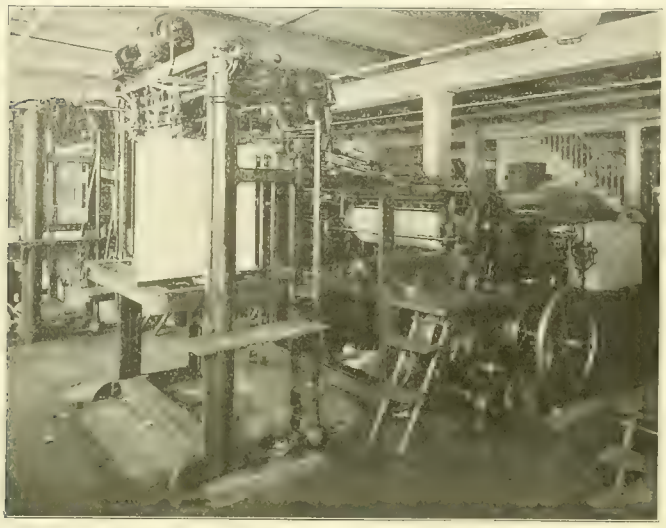


FIG. 1. A MODERN PRINTING ESTABLISHMENT.—NO. 4 K COTTRELL PRESS.

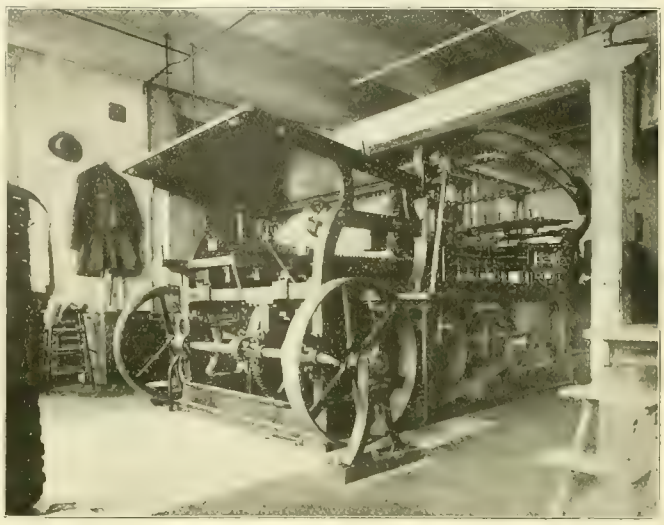


FIG. 2. A MODERN PRINTING ESTABLISHMENT.—NO. 4 COTTRELL PRESS

The Atlantic Avenue end of the plant accommodates the composing department, being provided with various cases, cabinets, imposing stones, plate tables, etc. Among these some 20 to 30 compositors are kept at work. The remainder of the room contains the machinery for which power is required, including presses, cutters, folders, stitchers, roughing machine, ink mill and saw. The large presses and folders are driven each by its own individual electric motor, while the job presses and other machines are furnished power by belts and shafting, driven in two groups by motors suspended from the ceiling. The equipment, more in detail, will be given in the description following.

On the Congress Street side is located the job department, in which are used nine job presses; four presses built by Golding & Co. of Boston, three by Chandler & Price of Cleveland, one by Tarbett & Phemister of Boston and one by the John Thomson Press Company of New York. These nine presses are driven by a five-horsepower, semi-enclosed-type Crocker-Wheeler motor, running at 2,300 revolutions per minute, and belted to a short line shaft, extending overhead between the two lines of presses and driving to either side by belt to a countershaft for each press. Just outside of this section there is an electrotyper's saw, driven by its own motor, and used for trimming blocks and electrotype plates. It was made by the F. Wesel Company of New York, which also manufactured the Wesel bed, used on all the large cylinder presses here, for mounting engravings and electrotypes without the usual wooden bases.

In an adjoining section is the pamphlet bindery and the machines which put on the final touches, such as the cutters, stitchers and pebblers, served by a Crocker-Wheeler motor of the same size as that which drives the job presses. Among these machines are two Acme self-clamping cutters, manufactured by the Child Acme Cutter and Press Company of Boston, a No. 1 Universal double-head stitcher, a No. 5, built by the R. H. Brown Company of New Haven, Conn., and a third, built by the New Jersey Wire Machine Stitching Company, Camden, N. J. The same shaft to which these machines are belted is extended and drives a rougher or pebbling machine, built by Emmerich & Vonderlehr of New York, and an ink mill for grinding the pigment used in the three-color process work. Two Dexter folders, located about the center of the large room, each driven by a one-horsepower motor, fold the printed sheets for magazines and pamphlets.

In the cylinder-press department are 12 presses, all of C. B. Cottrell & Sons' Company's make, eight of which are used for three-color printing. The following six presses are each driven by a size 3, form F, Crocker-Wheeler motor: A No. 2D, drum-cylinder press with 25 by 30-inch bed, printing a 22 by 28-inch sheet at the rate of from 1,000 to 1,800 per hour; a No. 2K, two-roller, two-revolution press, with a 26 by 34-inch bed, giving from 1,300 to 2,500 impressions per hour; two No. 3K, four-roller, two-revolution presses, with 26 by 39-inch beds, each giving from 1,300 to 2,200 impressions per hour (one of these presses is shown in Fig. 1); a No. 4, stop-cylinder press (Fig. 2), with a 29 by 43-inch bed, giving from 1,000 to 1,400 impressions; a No. 5F, four-roller, two revolution press, with 33 by 46-inch bed, giving 1,200 to 1,750 impressions, and a No. 5K, four-roller, two-revolution press, with the same size bed, giving from 1,200 to 2,000 impressions an hour. Two five-horsepower, form F, Crocker-Wheeler motors, each drive a No. 10K, four-roller, two-revolution, 43 by 62-inch press, capable of 1,200 to 1,800 impressions per hour, and a size 7½, form F, slow-speed motor drives a No. 10F, four-roller, two-revolution press, with the same size bed, at from 1,000 to 1,600 revolutions per hour. The largest presses are two No. 9 perfectors, each with two 43 by 62-inch beds, giving from 1,200 to 1,400 impressions per hour, on both sides of the sheet, and driven by size 10, form D, slow-speed Crocker-Wheeler motors. The last two No. 9 perfecting presses and the Nos. 10F, 3K, 5F and 4SC presses are all fitted with Dexter automatic sheet feeders, having their own special motors of small size, mounted over the top, well out of the way.

The presses which have been selected for illustration are typical of the entire outfit and have been photographed from the side on which the motor is placed to show the method of applying the drive. These motors are mounted in a protected position, yet within easy reach for attention of all sorts, and transmit their power by belt. There are several instances where unusually short distances between centers exist, but by providing idlers to keep an even tension in the belts the machines are operated without slip under regular running conditions, while, if something unexpected should happen to stop the press suddenly, the belt would slip and probably avoid injuring either motor or press, whereas a chain or gear would not.

For the layout of the equipment and the drive of the presses, much credit is due to Mr. Edward Day Baker, now in charge of the manufacturing department of the Sparrell Print, and formerly representative of the C. B. Cottrell & Sons Company.

Manager for Allis-Chalmers' New Power Department.

James W. Lyons, who has been for many years associated with the Allis-Chalmers Company in the capacity of engine salesman, has been appointed manager of the newly created power department of the Allis-Chalmers Company, with headquarters in Chicago. The appointment took effect Monday, May 16th. This newly created power department will control the sales of reciprocating steam engines, steam turbines (entire unit, including turbo-generators), condensers, gas engines, pumping engines, blowing engines, hoisting engines and air compressors.

JAMES W. LYONS.

Mr. Lyons' well-deserved promotion will gratify his many business friends throughout the country, for he is very well known, and it is an evidence that the management is determined to preserve the best traditions of the Allis-Chalmers Company.

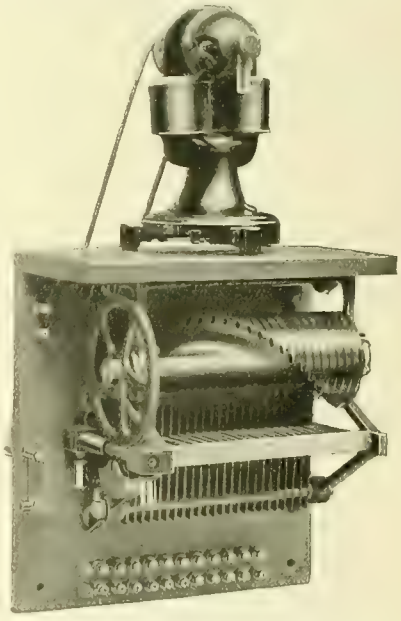
Knife-blade Sign Flasher.

Electrically illuminated signs, particularly where these illuminations are shifted to different combinations before the spectators, are one of the good methods of advertising. With a durable switch properly operated these results become possible.

The sign flasher illustrated herewith, designed and manufactured by the F. Bissell Company, Toledo, Ohio, is a tried one, noiseless, compact and durable. It can be placed on the wall and is self-contained. This regular design has 24 circuits, all or part of which may be used. These permit many combinations. More circuits can also be furnished. The revolving drum forces the knife blades into contact clips one after another, then releases them all simultaneously, then repeats.

Another design throws them in successively, then all out; then all in, all out; then repeat. Customers should specify the result they wish. When the switch blades throw out they cradle between two opposing springs, which prevent concussion and noise.

In both of the above designs the journals are lubricated by grease cups, and the worm gear is fed by a specially designed roller, which runs in an oil bath. For installations on roofs and other exposed places a design is made not only protected by a galvanized iron house but also containing a panel of enclosed fuses. It is said to be absolutely fireproof. The supporting frame is angle iron, rigid and strong against wind. Where any advantage is found in keeping the flasher out of the building it can be easily done with this house.



KNIFE-BLADE SIGN FLASHER.

The Massachusetts Trackless Trolley Company has been organized at Portland, Me., by J. C. Coombs and William Payson of Boston, B. F. Colby of Winthrop, Mass., and C. O. Barrows and W. E. Dunham of Portland. The company has a capitalization of $25,000 and proposes to operate electric vehicles.

House Wiring in Cape Town.

At a recent meeting of the Cape Town (South Africa) section of the Institution of Electrical Engineers a paper was read by E. G. Clifford-Jones on "House Wiring," which throws considerable light on the methods in vogue in that country regarding house wiring and points out the dangers which arise in leaving this part of the building contract to incompetent men. The following paragraphs are taken from his paper:

After many years of experience in electric lighting in every sort of position from municipal electrical engineer down to manufacturer's agent, I repeat that it is want of proper control of house installations that is preventing electric lighting in South Africa from making the enormous strides it should. Of course I do not say that there are not failures in supply through choice of wrong system or inadequate work, but I am thankful to say that these are few and far between, although municipalities are very fond of placing themselves unreservedly in the hands of contractors and employing drainage, hydraulic and other kinds of engineers to do the work. In fact the only profession that some of the municipalities seem to think is not yet quite competent to undertake electrical work is that of the sanitary contractor.

Now, the remedy for all this is very difficult to foresee, as there are many conflicting interests at work. For instance, I regret to find that some architects consider themselves quite qualified to supervise house wiring.

It may be said, however, that an architect has to control many trades in the exercising of his profession. This is perfectly true. But let me make a comparison between one of the trades controlled by an architect and electric lighting. The trade which I choose is that of the plumber. Now, suppose the plumbing of a building is badly done, what is the result? A leaky roof, a broken water pipe, or something of that kind, the spoiling of a few yards of plaster, etc., by the escape of water. There the damage ends, there is no danger and the faults are soon overcome. Now, let us take the matter of electric-lighting work. If this work be badly done there is probably, to say the least, a failure of light, but there is further the much more serious question of the danger of the destruction of life and property through fire. I am glad to be able to say, as far as my knowledge serves me, that the architects who consider themselves competent to supervise electric lighting are fortunately comparatively few, but they exist.

Now, let us consider for one moment the way in which an architect who considers himself competent to supervise electric lighting goes to work. Generally the specification, agreement and schedule are of a most meager quality, and the very necessary technical supervision is conspicuous by its absence. The contractor is left to pursue the even tenure of his way untrammeled with the consequences that if he be unscrupulous the work is "scamped."

I came across a case where the architect considered himself quite competent to supervise the electric lighting of a very large building. The representative of the owner of the building informed me that the electric lighting was in the hands of the architect, and that he would not interfere with the matter in any way. Some days afterward it came to my knowledge that a wiring contractor was drawing the necessary specifications, which the architect was going to publish and call for tenders upon, and which the contractor, who drew the specifications, was also going to tender upon. I think you will agree with me that there is something radically wrong here. The contractor who draws the specifications (I should think) has an excellent chance of having his tender accepted. Then the question comes in, who is going to supervise the contractor? The architect? Impossible! For he had not enough experience even to draw the specification; then how can he supervise the work? Therefore, the whole matter reduces itself to the point as to whether it is safe to leave a contractor unsupervised on work which if badly carried out will endanger not only the whole of the structure but human life as well.

If a properly qualified man were engaged in each case to look after the wiring contractors, there is no doubt that the class of wiring work would greatly improve. Of course, the real solution is in the hands of the consumer, but unfortunately human nature is such that it has very little foresight, is adverse to worry, and, therefore, quite prepared to leave itself in the hands of an untechnical man or wiring contractor, and to take no cognizance of the matter until trouble occurs through faulty work; then, put the whole of the blame on to electric lighting itself. Therefore, it appears to be necessary to force the consumer to safeguard his own interests. This might either be done by the supply companies or the fire-insurance companies, but my experience in this country teaches me that as the majority of the electric-supply undertakings are in the hands of the municipalities, the matter reduces itself to the only course, being that the fire-insurance companies must undertake the work, because municipalities have, through the nature of their constitution, very many conflicting interests. During my travels I came across one municipality which had among its members two wiring contractors. Therefore, what chance had any municipal technical officer of condemning any electrical wiring work carried out by either of those contractors, or even others?

Now, to approach, what in my opinion is the true and only solution of this problem, i. e., the fire-insurance companies. It is an unassailable fact that every building must be insured against fire, and it would be impossible for the owner of the smallest building not to cover this risk. Now, if the insurance companies would appoint inspectors there is not the least doubt, so long as the inspectors were adequate and competent, it would have the much-to-be-desired effect of saving the electric lighting throughout South Africa from falling into a deplorable state, which it is now rapidly sinking into. The fire-insurance companies have electric-lighting inspectors in England, India and other portions of the world, and I see no reason why the same course should not be adopted in this country, especially seeing that it can be brought about without cost to the insurance companies, and, in some cases, without extra cost to the consumer, besides meaning a large saving to both through greater immunity from fires. The first beneficial effect that the suggested inspection would have would be the weeding out of unsatisfactory wiring contractors, and to raise the price of the work. This is very necessary, as the present cost of the work has fallen so low, through the advent of the small contractor, that it is impossible for adequate work to be done. After all, the fees chargeable for this inspection would be no hardship to the consumer, as they would not much exceed those charged by the architect, and with a very material difference. The work would be well looked after, and the consumer would get satisfaction, immunity from fire, and value for his money.

The Mica Supply.

With the passing of the stove and the coming of the register and radiator, one of the chief uses of mica has declined. On the other hand, there is an increased demand for smaller pieces of mica that were formerly thrown on the scrap pile. The variations in use, production and importation of this familiar mineral are set forth in a report on the "Production of Mica" in 1902, by Dr. Joseph A. Holmes, an extract from the annual volume of "Mineral Resources," published by the United States Geological Survey.

The total quantity of mica produced in the United States during the year 1902, as reported to the Survey, was as follows: Plate mica, 373,266 pounds, valued at $83,843; scrap mica, 1,028 short tons, valued at $13,081; and rough mica as mined, or unmanufactured, 372 short tons, valued at $21,925, making a total value of $118,849.

The increase in the production of plate mica during the last three years is due to the increasing quantity of small-sized mica disks and rectangular sheets, that have been cut for electrical purposes. Some of the small, clear pieces obtained in cutting up the large sheets are now split very thin, rearranged, and cemented closely together, forming large sheets called micanite, which are then cut into the shapes and sizes desired. For some purposes these sheets of micanite answer as well as the natural sheets and have the advantage of being much cheaper. In recent years, scrap mica has been manufactured into a covering for boiler tubes and steam pipes, to take the place of the more expensive asbestos coverings. Waste mica, not available for other purposes, is used in the manufacture of wall papers and lubricants. During 1902 there was, however, a large falling off in the production of scrap mica, which in 1902 amounted to 1,150 short tons, valued at $14,606, as against 2,171 short tons, valued at $19,719 in 1901.

The tables which show the great increase in the importation of mica during 1902 are significant. This increase, valued at $131,278, is larger than the total value of the product of mica in the United States during 1902. It illustrates the increasing demand for mica in this country, but also suggests the fact that mica can be mined in India and landed in this country at a lower price than it can be mined in some places in the United States. Canada is also a large contributor to our mica supply. It is unfortunate for the industry that many of our mines are owned by small producers, who are entirely dependent upon one little mine. When the mica in this begins to give out or is poor, they have no means to carry on much dead work and have no other deposit to help fill out this deficiency.

Although mica is widely distributed in the United States, actual mining has been limited, during the last few years, to North Carolina, New Hampshire, South Dakota, New Mexico, Idaho, Virginia and Colorado. Some development work has also been carried on in California, Nevada, Maine, Alabama and Georgia. In several of these states good deposits of mica are known to exist that are not now available on account of their distance from railroads or other means of transportation.

The Outlook in Copper.

Notwithstanding the cessation of heavy buying, the copper market has maintained a remarkably steady tone, and producers are not disposed to sell under 13¼ to 13⅜ cents a pound for electrolytic wire bars and 13½ to 13⅝ cents for Lake brands. Domestic consumption is on a fairly large scale, though not booming. The state of the trade in Europe is very encouraging and large orders are looked for in that direction

CORRESPONDENCE.

Great Britain.

London, May 14.—The first large waterpower scheme in England for the generation of electricity and its distribution over a large area has just been sanctioned by the House of Lords. There is comparatively little opposition to the scheme now, and there is every likelihood of its becoming law in a few months. The following details of the proposal will no doubt be intersting: It is intended to utilize some water on Mount Snowdon in North Wales, where there is a fall of some 1,200 feet, and electrical energy will be distributed from a power station on this site over an area of 2,000 square miles. It is estimated that 8,000 horsepower will be available without expensive works, but the first installation which it is proposed to put down will be 6,000 horsepower. Pelton waterwheels and three-phase generators will be employed. The total capital which it is anticipated will have to be spent at the commencement is $1,500,000, upon which a dividend of 8 per cent. is expected, with an average price per unit of three cents. A system of tramways and light railways is also in the hands of the power company, so that at once there is an outlet for a supply of electrical energy. There are a large number of quarries in the area which it is proposed to cover. In another part of the area there is sufficient waterpower available for a further 8,000 horsepower, and the water rights on this spot have been secured. The chief point about the undertaking, apart from the use of waterpower, is the use of overhead wires exclusively for transmission and distribution, and it will be the first time in this country that anything upon so large a scale has been attempted.

A bill has been introduced by the government amending the electric-lighting acts of 1882 and 1888. These two acts, in the main, govern the electric supply of the country, but inasmuch as since 1888 vast strides have been made in the electrical industry, it is only natural that the provisions of the old acts are in many respects behind the times. Many have been the requests that amendments should be made to bring them more into line with the existing condition of things, and among other attempts a deputation from the Institution of Electrical Engineers waited upon the government a few years ago and urged that reforms should be made. Last session a bill was introduced having this object in view, but unfortunately it was too late in the year for it to have any chance of being passed. The bill brought forward now is more or less upon the same lines as that of last year, and it makes certain important modifications which have been needed for several years. They are of local interest, however, and need not be gone into here, but if the bill passes much good will result to the industry generally.

The London County Council is reported to have a huge scheme of electric tramways in hand for London. At present the great bone of contention is the fact that although we have a large number of bridges over the River Thames, permission has always been refused to the council to run its tramways over them. The result has been the entire absence of communication between the north and south of the river by means of tramways. It is now stated to be the intention of the council to reconstruct the narrow foot-bridge at Charing Cross in order that tramways may be run over it. If this is done and the steamboat service upon the river which is contemplated (it has been sanctioned by one House of Parliament) is worked in conjunction with it, we shall one of these days have a system of communication in London which will be worthy of the city. At present the average Londoner feels a little disgusted when means of communication are mentioned. It is very doubtful whether the policy of the council in insisting upon carrying out all the tramways itself has not contributed to the present chaotic condition of affairs, but the council having made up its mind in this matter, there is nothing more for the taxpayer to do than to wait on hopefully.

Both Musselburgh and Folkstone, which had decided to go in for the surface-contact system of electric traction, have withdrawn their decisions and now favor the trolley. In Musselburgh work is being commenced. At Lincoln, however, the electricity committee of the corporation has recommended the adoption of the "G. B." surface-contact system, and plans have been prepared for submission to the Board of Trade. The contractors have expressed themselves as prepared to indemnify the corporation against loss, and the terms of the proposed contract are for payment after 15 months' working.

The underground telegraph line from London now runs continuously to Carlisle, and that from Manchester to Leeds will soon be completed. Provision has been made in the government estimates this year for further extensions of the underground telegraph system.

The South Shields corporation, which recently put its electric tramway act up for public bidding, only received two offers, and these will shortly be considered.

An offer was recently made [illegible] out the Tunbridge Wells municipal electricity works, but it is to be refused.

[illegible] the National Telephone Company bought out the municipal telephone [illegible] for about 12 months.

The Fife Electric [illegible] authorized last [illegible] erection of its first power station at Dumferline. G.

New York.

New York, May 21.—As an additional means of obviating the unprofitable and irritating delays to the Brooklyn Bridge traffic a duplicate overhead trolley wire is being placed in position a few inches from the existing wire, so that in the event of the blowing out of a fuse or other accident the trolley rod can be almost instantly utilized on the second wire. This new wire, so far, has been stretched halfway across the bridge on the northern track, but naturally the work of erecting it is slow and dangerous on account of constant traffic both day and night.

With the opening of the pleasure season at Coney Island the Brooklyn Rapid Transit Company has commenced running an express through train direct from New York to the Island, the journey of about 11 miles being accomplished in 36 minutes. Last Saturday was the opening day, and it is estimated that the various lines serving Coney Island conveyed at least 120,000 persons to the famous pleasure resort.

Alderman Dowling is urging upon the Board of Aldermen the passing of an ordinance to provide that there shall be two motormen on every elevated train. The chief reason for this is a recent case of a motorman who died while on duty. Few accidents have so far arisen from the absence of a second motorman on the elevated line.

President William E. Bradley and Secretary-treasurer John Grosse of the Eastern Traction Company of Waterbury, Conn., are in town with a view to negotiating for the franchise for an electric loop to connect the Williamsburg and Blackwell's Island bridges via Roebling Street. They are very early in the field with their proposition, for the Blackwell's Island Bridge has only just been completed.

Much public excitement and not a little uncertainty exist over the action of President Robert C. Clowry of the Western Union Telegraph Company in announcing the withdrawal of his corporation from the business of collecting and distributing race-track information. On Tuesday Colonel Clowry gave it out on his own authority that the service to the New York poolrooms would be immediately stopped. The poolrooms, however, found but little difficulty in getting their information by telephone from Jersey City, and since Thursday this information has apparently been coming over the wires as private messages from the agents of a hastily organized association of poolroom interests.

Between 2,000 and 3,000 surface and elevated cars on the Brooklyn Rapid Transit system were stopped at noon on Tuesday under unusual circumstances. At that hour some wiremen were working on the cable tower at the rear of the Third Street power house, when some of the insulation ignited. The tower accommodates 42 feed wires, and as the fire spread to the woodwork, 40 of the circuits were affected. The fire brigade would not approach the burning structure until assured that the power was cut off, and this necessitated not only the stopping of the dynamos at the Third Street power house but also those at the central station. The fire was ultimately extinguished in about 30 minutes.

D. W. W.

Dominion of Canada.

Ottawa, Ont., May 20.—There is a persistent rumor to the effect that the Toronto and Niagara Power Company is negotiating with the Cataract Power Company of Hamilton, Ont., for the purchase of its plant and rights.

At a recent meeting of the provincial cabinet of New Brunswick the question of utilizing the water-power of Grand Falls came up for consideration by reason of several applications for the right. An order was passed granting the Electro Manganese Company of New York until July 11th to make a deposit of $50,000 and enter into a contract for the development of the waterpower.

The city of Ottawa about two years ago voted for a civic-lighting system, but at a recent meeting of the City Council, in spite of the voice of the citizens, the Ottawa Electric Company was given a contract for street lighting for a period of 10 years at $52 per light. Although this is a very favorable contract and a reduction of about $13 per lamp, yet there is much indignation manifested by the taxpayers, who assert that the report of experts showed that the city could do its own lighting for $38 per lamp per year.

The Montreal Street Railway Company is beginning to put into commission the new and unique cars it is now building. There are to be 50 of these cars and they will cost $6,000 each. They are of an entirely new design in Montreal, being of a semi-convertible type. The seats, which are individual, may be arranged either in pairs, facing front, or can be placed in line against the sides of the car. The cars are 38 feet over all, with two platforms of five feet each. With the completion of these new cars the Montreal street railway will have 460 cars in operation during the present season, an increase of about 100 cars over the number in use last season.

W.

New England.

Boston, May 21.—Judge Gaskill of the Superior Court on Wednesday last granted a decree permitting the sale of the Worcester and Southbridge electric road by the receivers for not less than $300,000 at private sale, and the long-pending deal whereby the syndicate headed by William E. Rice of Worcester is to obtain possession of the property is now in a fair way to be carried out.

So rarely does a transportation company raise the rates of fare on its lines that the proposition now under consideration by the Massachusetts Electric Companies attracts much attention. A new schedule is in preparation providing for a change from five to 10 cents on certain portions of the lines operated by the company. The New Hampshire Traction Company also announces a revision and increase of fares between certain points this week.

The lower branch of the Massachusetts Legislature has given E. Moody Boynton's bicycle-railway project a new lease of life by a large majority, extending his charter time limit. The bill will have more opposition in the state Senate, but is expected to get through that body safely also.

Announcement was made this week of the intention of the New York, New Haven and Hartford electric railway to consolidate all its trolley companies under the charter of the Worcester and Connecticut Eastern railroad, an electric-trolley company. A special meeting will be held in the near future to take action on the first of the series of combinations. The new fourth vice-president of the railroad company, E. H. McHenry, who has been connected heretofore with the Canadian Pacific railroad, is to have supervision over the electric properties of the company. He was chief engineer of the Northern Pacific railroad for a number of years and held a similar position with the Canadian Pacific prior to becoming an official of the New York, New Haven and Hartford.

B.

Ohio.

Cleveland, May 21.—The Lake Shore and Michigan Southern steam railroad has taken off the Cleveland and Conneaut accommodation train which has made the daily run almost since the line was built. After June 1st, it is said, the train will go only to Ashtabula. Beyond that point the business has grown so light that it does not pay the salaries of the crew. The country has a good system of trolleys by which people can make trips almost any time in the day they desire, and such accommodation caused the old train to lose prestige, and its run has, therefore, been cut down to a very short one.

It is said that President M. E. Ingalls of the Big Four railroad will set on foot a plan to use electric locomotives for drawing trains in and out of the union station at Cleveland in order to do away with the smoke nuisance. He spent some time at the station a few days ago and went over several plans, but the electric idea seemed the best.

The Western Ohio Railway Company has inaugurated its limited service over its own lines and those of the Dayton and Troy. The trip from Lima to Dayton is made in two hours and 30 minutes, which is more than an hour less than the trip could be made in going on the regular cars of the two roads.

The Springfield and Washington Traction Company has been granted a franchise by the village of Cedarville. It is said that the company will begin construction work shortly. John L. Plummer of Springfield is the leading spirit in the enterprise.

It is said that the committee on lighting of the Cleveland City Council will make a favorable report on the ordinance introduced some time ago for the purpose of reducing the price of electric current from 12 cents to 7½ cents per kilowatt to private consumers. The city authorities claim they have the right to regulate the price of lights. The company has protested against such action on the part of the council and claims that there is no profit in the business at the reduced price.

The Village Council of Milford has granted the Cincinnati, Milford and Loveland Traction Company a franchise to build and operate a line in East Milford. A franchise was refused the Cincinnati and Columbus Traction Company unless it would agree to pay for the part of Wooster pike it occupies in the event the courts decide that the village must pay for it.

The annual report of the Dayton, Springfield and Urbana Electric Railway Company for 1903 has been given out. It shows a surplus of $75,269.83. The gross earnings were $224,778.57, and operating expenses and taxes amounted to $121,508.74, leaving net earnings of $103,269.83. Track rentals were $9,500, making the total net income $112,769.83. Deducting the bond interest, $37,500, leaves the surplus given above. This does not include the Urbana, Bellefontaine and Northern road, which was opened in December.

It is said that arrangements have been completed by which the Cincinnati, Dayton and Toledo Traction Company will secure $1,100,000 to make contemplated improvements which have already been mentioned in the Western Electrician.

The Lebanon and Franklin traction line has been completed and is about ready for operation. It is 11 miles in length and connects Lebanon with Hamilton and Dayton.

The contract for building the electric line of the Youngstown and Southern railway from Youngstown to East Liverpool has been let to the White Construction Company of New York, the amount involved being about $1,500,000.

The Cincinnati, Lawrenceburg and Aurora Electric Street Railway Company has notified the secretary of state of an increase of capital stock from $750,000 to $1,000,000.

The Shaker Heights and Boulevard Traction Company is receiving bids for building its line. Although only four miles in length, the road will be a costly one, since it must be cut through solid rock to the depth of 18 feet for some distance. This cut must be 80 feet wide, as a boulevard is to be built along the tracks for the entire distance. It will connect the city lines with the Cleveland and Chagrin Falls line of the Eastern Ohio Traction Company.

O. M. C.

Indiana.

Indianapolis, May 23.—The Indiana Union Traction Company is reported to have acquired the Kokomo, Marion and Western Traction Company's lines, now in the course of construction.

The Highland electric railway has been purchased by the Louisville and Southern Indiana Traction Company. The Highland line extends from New Albany and is a most picturesque route. New cars will be put in service at once.

The Indianapolis and Northwestern Traction Company carried a large number of passengers to Lafayette yesterday and, by prearrangement, the Monon steam road carried them to Chicago, the round-trip fare being $2.50. The experiment proved so successful that similar excursions will be run during the summer.

The Rushville power house of the Indianapolis and Cincinnati Traction Company is being equipped with the Westinghouse alternating-current system. The company has five contracts of this kind, but this is to be the first completed. Two steam turbines of 1,500 horsepower will be installed this fall.

The officials of the Indianapolis and Northern electric railway and the Holland Palace Car Company assert that all records for overhead interurban rapid transit were broken last Friday on the trial run of the sleeping car Francis on the trip to Lafayette. Between Zionsville and Frankfort a speed of 75 miles per hour was attained. The party was made up of C. C. Reynolds and F. D. Norval of the Indianapolis and Northwestern, J. W. Chipman of the Indianapolis and Eastern, Messrs. Holland and Selvage of the Holland Palace Car Company and others.

The Lafayette Street Car Company is equipping its cars with a new emergency brake. With the use of the hand brake, in addition to the emergency device, stops can be made while in good speed in a car's length.

The Evansville and Princeton Traction Company has completed a survey of its extension from Princeton to Vincennes. With this line and the completion of the line from Brazil to Danville, trolley connection between Evansville and Indianapolis will be complete.

F.

Northwestern States.

Minneapolis, May 21.—The county auditor of Traverse County, Minn., will receive bids for the erection of a power house for the courthouse at Wheaton.

The Electric Power Company's dam at Brandon, Man., was washed away and fears are entertained for the power house.

An electric-light franchise will be granted to Dr. F. F. Kraemer of Minneapolis, Minn., to install a plant at Excelsior.

The electric-light system at Long Prairie, Minn., will be rebuilt this summer.

Hotel Dacotah at Grand Forks, N. D., will be lighted by a private electric-light plant, which will be installed shortly.

The Battle Lake (Minn.) Light Company has been incorporated with a capital stock of $4,000. J. A. Colehour is president and W. L. Winslow secretary.

J. F. Lemke has resigned as superintendent of the electric-light plant at Wadena, Minn., and George S. Chrysler of St. Paul was elected to succeed him.

The Stevens Point Power Company of Stevens Point, Wis., has been incorporated with a capital of $100,000. William Mainland heads the list of stockholders.

The McClintock Manufacturing Company may move its plant from St. Paul to Faribault, Minn. The company manufactures an electric signal to warn locomotive engineers of danger.

The North American Telegraph Company has opened an office at Mankato, Minn.

The federal contract for lighting the piers of the Duluth (Minn.) ship canal was awarded to the Crowley Electric Company of Duluth for $1,600.

The Minneapolis, St. Paul and Suburban Railway Company will erect a new building at Wildwood, in which to install considerable new electrical machinery for the transmission of power. This will do away with the steam-power plant there, power being transmitted from Minneapolis, a new pole line being now in process of construction.

The mammoth storage battery of the Twin City Rapid Transit Company of St. Paul is being moved from the old plant to the new power house on Hennepin Avenue. The battery consisted of 288 cells, each two by five feet and containing 43 lead plates. The battery completely fills a room 40 by 140 feet in size and can supply current at about 600 volts for over an hour. Twelve thousand gallons of sulphuric acid are necessary to fill the battery. It will take over a week to move it, as the battery had to be taken completely apart for removal.

The franchise granted for 10 years to the Fargo

and Moorhead Street Railway Company will be extended to 20 years by the city of Moorhead, Minn.

The Arnold Electric Power Station Company of Chicago will commence at once the building of a trolley line from Iowa City, Iowa, to Kalona and Washington. R.

Michigan.

Detroit, May 21.—The municipal lighting plant at Schoolcraft, Mich., was destroyed by fire on May 15th. This plant was considered one of the most complete in the state and was put in operation in December last. Steps will be taken at once toward rebuilding, but at the best the village will be in darkness for 60 days. The loss was about $7,000, with $5,000 insurance.

The Detroit corporation counsel has been instructed to draw up an ordinance compelling the street-railway companies to do the sweeping and sprinkling of the street-car tracks.

The street-car service at Lansing is greatly improved. Local papers now refer to the rolling stock as cars, instead of "Relic No. 22," etc., as they were in the habit of doing a short time ago.

The Board of Commerce of Detroit is advocating the use of the electric cars for hauling freight from factories to the depots and docks. The secretary of the board states that the objections to the freight traffic on the streets would undoubtedly be overcome, as the cars can be made attractive.

The trustees of the village of Grosse Pointe Farms, near Detroit, have granted a 30-year electric-light franchise to the Peninsular Electric Company of Detroit. The system will be extended from the city immediately, and patrons will be given city rates.

The new engineering building being erected at the University of Michigan, Ann Arbor, at a cost of $110,000, will, it is expected, be completed upon the beginning of the fall term. Part of the building is now being used.

The Detroit United Railway Company is asking for an extension of franchise in Delray. The company has been asked to pave between its tracks, involving a large expense, and for this the company asks a 30-year extension of the franchise.

Messrs. Moore, Everett, Hutchins, Brooks and others have made an inspection tour of the Detroit, Monroe and Toledo electric road. It is understood that preparation is being made to arrange through passenger traffic between Port Huron, Detroit, Toledo, Cleveland and to all other points on electric lines reaching these points.

The Detroit United Railway has surveyors at work running a line for a private right-of-way from Romeo to Almont. It is understood that if the land can be secured the road will be constructed this summer. C. G. W.

Rocky Mountain States.

Salt Lake City, May 20.—The Washington Water Power Company proposes the installation at Post Falls, Idaho, of an electric power plant with a capacity of 10,000 horsepower. It will be used for the operation of the Cœur d'Alene mines and the electric railway. The power from the Spokane and Post Falls is to be utilized. Plans for the development of the power will be submitted by Clemens Hershel of St. Paul, whose services have been engaged for that purpose.

The Pan Power and Electric Company, with a capitalization of $10,000, has filed articles of incorporation at Salt Lake City, Utah. Thomas C. Callister is designated as president and manager of the company.

Transformers and other machinery of the Utah Light and Railway Company were destroyed during a recent storm at Ogden, Utah, the damage amounting to $15,000.

A decision of the Supreme Court of Montana holds that the city of Red Lodge, Mont., must permit the erection of poles and stringing of wires through the city by the Rocky Mountain Bell Telephone Company, notwithstanding the fact that the city ordinances call for underground conduits.

C. J. Ambross, who will have charge of the construction of the electric railway between Reno, Nev., and Sparks, is now in San Francisco arranging for the purchase of supplies and building material for the new line.

The Utah Light and Railway Company of Salt Lake City has arranged for a third 1,000-horsepower supply with the Bear River plant in anticipation of the demands of the next fall and winter. A fourth 1,000-horsepower is expected to be added in the course of another year.

Garff & Son of Logan, Utah, have submitted to the City Council of Salt Lake City a proposition to establish an electric-lighting plant adequate for all the needs of the city, the plant to be deeded back to the city at the expiration of 10 years. While no definite action has yet been taken, it is considered almost certain that the council will accept the proposal, as the service of the Utah Light and Railway Company is said to be inadequate. It is estimated that the plant will cost about $200,000.

The Gold Development Company of Salt Lake has filed on the flow of the waters of Bullion Canyon, where the company proposes to establish a power plant.

W. H. Baker of the Postal Telegraph-cable Company has made a proposition to the Rocky Mountain Bell Telephone Company for the privilege of putting a cross-piece on each telephone pole between Salt Lake City and Cheyenne, Wyo., and Salt Lake and Butte. This would place the cities named on a transcontinental line. G.

Pacific Slope.

San Francisco, May 19.—A. A. Davis, construction engineer of the California Gas and Electric Corporation, has returned from a trip of inspection to Sebastopol, where it is proposed to establish a substation to transform the current from the high-potential lines of the company.

The United States Land Office at Washington, D. C., has approved of the application for rights-of-way for the proposed electric road to the Yosemite Valley, as filed by the Yosemite Valley Railroad Company.

The Siskiyou Electric Power Company has purchased the plant and business of the Ætna Electric Light Company at Ætna, Colo., and is now engaged in extending the main line from Fort Jones to Ætna.

A party of surveyors of the Bay Counties Power Company of San Francisco has left San Francisco for Carson, Nev., for the purpose of completing surveys for the construction of a power line into Tonopah and the gold fields of Nevada.

About 250 of the property owners on Broadway, Los Angeles, have signified their assent to the plan of permanently illuminating that thoroughfare. There will be 150 arc lights and 2,000 incandescent lights of 16 candlepower. The cost of the installation with maintenance for one year will approximate $25,000, which will be borne by the property owners.

The Fred E. Sander Company of Seattle, Wash., has commenced work on the construction of the Seattle-Everett electric railway.

D. M. Drumheller, owner of the Palmer Mountain tunnel property, located at Loomis, Wash., states that an electric plant will be installed on the property this summer. The electric plant will cost about $150,000.

The Condon Water and Power Company of Medford, Ore., of which Dr. C. R. Ray is manager, is letting contracts for a transmission line to extend from Ashland to Grants Pass. The company will devote special attention to the irrigation of farms by a system of electric pumps.

The Imperial Light and Power Company of Imperial, Cal., is about to install an electric power plant to be operated in conjunction with the water plant. A.

Texas and Mexico.

Austin, Texas, May 19.—A movement is on foot to build an interurban electric railway from Dallas to Grand Saline, Texas, a distance of about 65 miles. The proposed road will pass through the towns of Mesquite, Forney, Terrell, Wills Point and a number of smaller places. Schuyler Marshall and R. S. Kimbrough of Mesquite are interested in the project.

C. L. Rocker will install an electric-light and power plant at De Leon.

It is announced by F. M. Haines, general manager of the North Texas Traction Company, which has its principal office at Fort Worth, that the company will double-track its road between Fort Worth and Handley.

It is announced that the company recently organized for the purpose of installing an electric-power plant on the Naranja River on the San Antonio hacienda, state of Colima, Mexico, has acquired the street-railway system in the city of Colima and will convert it into electric traction. It is estimated that at least 1,500 horsepower can be developed. The electric current will be carried to Colima over a transmission line 24 kilometers long. This power plant will also furnish lights for the city of Colima.

The street-railway system in the city of Hermosillo has been purchased by the Sonora Bank of Hermosillo for $30,000. It is stated that a company will be organized to operate the property and that it will make extensive improvements.

W. T. Thornton, former governor of the territory of New Mexico, has made application to the government of the state of Jalisco for the establishment of an extensive system of electric street railway in the city of Guadalajara. The application is made on behalf of a syndicate of American capitalists, who offer as a remuneration for the proposed concession to contribute $300,000 toward the paving of the streets of the city. The application for the concession will, it is understood, be granted, and the work of constructing a complete system of electric traction here will soon be commenced. It is the intention of Governor Thornton and his associates to obtain the power for operating the proposed system from the Rio Grande de Santiago. The granting of this concession is being strongly opposed by Jose Maria Bermejillo, the wealthy Spaniard of the City of Mexico, who owns the existing street-railway system in Guadalajara.

The new electric-railway system in Aguascalientes, owned by Juan Douglas, has been formally inaugurated. Governor Rivas Mercado of the state of Aguascalientes participated in the ceremony. H.

A charter has been granted to the United Water, Gas and Electric Company of Sedalia, Mo. The company has a capital of $1,000,000 and has consolidated the water, gas and electric companies of Sedalia.

PERSONAL.

Samuel Hunt of Cincinnati, Ohio, has been elected a vice-president of the New York, Westchester and Boston Railroad Company, and will have the supervision of the construction of the Westchester and Boston (Mass.) electric road.

The Detroit, Monroe and Toledo Electric Railway Company has recently appointed George M. Henry as general passenger and freight agent and E. H. Faupp of Rochester, N. Y., as chief train dispatcher. Their headquarters will be in Detroit, Mich.

E. C. Ewer has resigned as manager of the Lansing (Mich.) exchange of the Michigan Telephone Company, to become assistant manager of the Lansing and Suburban Traction Company. G. L. Williams of Lapeer, Mich., succeeds Mr. Ewer as manager of the telephone company.

Much regret is expressed at the death of John Shaw Marshall, electrical engineer of the Chamber of Commerce, New York. His death was indirectly due to a fall sustained while in his office, which broke one of his ribs and afterward developed symptoms of blood poisoning. Mr. Marshall was born in New York 56 years ago.

E. H. McHenry, who recently resigned the position of chief engineer of the Canadian Pacific Railway, has accepted the fourth vice-presidency of the New York, New Haven and Hartford Railway Company, and will in the future be connected with the electrical development of this system, which has recently adopted electrical power upon many of its branches.

W. J. Lloyd delivered an interesting lecture on "Meters" at the recent meeting of the Pittsfield (Mass.) branch of the American Institute of Electrical Engineers. He thoroughly described the design and construction of the various instruments used for measuring current and used about 75 slides. Mr. Lloyd is a recognized authority on measuring instruments, having been for the last six years in charge of the instrument work of the Stanley Electric Manufacturing Company. He is leaving the Stanley company to accept a position with the British Thomson-Houston Company in England, to take charge of its instrument development.

ELECTRIC LIGHTING.

The $10,000 electric-light plant at Senatobia, Miss., has been completed and put into operation.

The Mitchell (S. D.) Electric Company will double its capacity to meet the demand for incandescent lights.

Fire recently destroyed the plants of the electric-light and waterworks companies at Addison, N. Y. The loss amounts to nearly $70,000.

The City Council of Woodville, Miss., will receive bids until June 7th for the erection of an electric-light plant and a system of waterworks.

Bids will be received by the quartermaster at Vancouver Barracks, Vancouver, Wash., for the construction of an electric-lighting system at the barracks.

J. J. Ferrell, who has a 50-year franchise and a 30-year contract for furnishing the city of Brinkley, Ark., with light and water, is erecting a $40,000 plant in that city.

A special election will be held in Burlington, Wis., to vote on the proposition to install an electric-light plant. The light commission favors the erection of a municipal plant to cost $27,000.

The Maryland Telephone and Telegraph Company is negotiating for the purchase of a $50,000 site for its electric-light and power plant in Baltimore. The company will expend $1,000,000 in this plant.

On June 14th the city of Aberdeen, Miss., will have a special election to decide the question of issuing $70,000 bonds for the construction of an electric-light plant, waterworks and sewerage system.

The Geneseo (Ill.) Electric Light Company has secured a contract with the city calling for 156 50-candlepower lamps for street lighting at the rate of $2 a month per lamp. The company will enlarge its plant.

The Chafee County Electric Light, Power and Railway Company of Salida, Colo., has been incorporated with a capital of $500,000. Among those interested are V. C. Davenport, F. L. Bateman and D. H. Craig.

ELECTRIC RAILWAYS.

The Kansas City-Leavenworth Electric Railway Company will run cars every half hour instead of every hour, owing to the increased traffic.

It is stated that the McKinley syndicate will invest $500,000 this year at Galesburg, Ill., and vicinity, in extending and improving electric-railway lines, building power houses, etc.

R. S. Kimbrough, Schuyler Marshall and associate capitalists are pushing a new interurban electric-railway projection from Dallas, Texas. The new line is to parallel the Texas and Pacific railway for ap-

proximately 100 miles, touching the important towns of Mesquite, Forney, Terrell, Will's Point and Grand Saline. Nearly all of the right-of-way has been procured.

The Omaha, Lincoln and Beatrice Electric Railway Company of Lincoln, Neb., projecting the new electric line between the cities named, has filed an amendment to its articles of incorporation, increasing its capital stock from $200,000 to $2,250,000.

There is said to be at present about 1,000 miles of electric railway in the state of Iowa. No movement in Iowa is considered of more significance to the farmers than the electric-railway movement, and it is hardly more than 10 years old.

The Arkansas Valley Transit Company is constructing an electric interurban railway connecting Hutchinson, Newton and Wichita, Kan. When the line is completed a modern system will be constructed in Hutchinson, to supersede the present horse-car line.

The Illinois Central Traction Company opened its new electric railway between Springfield and Riverton, Ill., last week. Superintendent Ambuhl of Decatur was in charge of the first car and was pleased with the indications for a good business from the start.

The St. Louis, Kirkwood and Manchester Railway Company has been granted a franchise to construct a double-track electric railway, beginning at the southwestern part of Forest Park and running through Kirkwood and Des Peres to Valley Park and Manchester.

The Southern Illinois Electric Traction Company has voted an increase in capital stock from $50,000 to $2,000,000. An extensive system of electric railways is planned for the southern part of the state, the present operations being in the vicinity of Mt. Vernon.

At the annual meeting of the stockholders of the Galesburg and Kewanee (Ill.) Electric Railway Company it was decided to move the headquarters from Galesburg to Kewanee. Plans were discussed for extending the system. The officers elected were: President, W. H. Lyman; vice-president, H. W. Crane; secretary and treasurer, F. M. Lay.

A deal is about closed for the merging of the electric street-railway system of the Alton (Ill.) Light and Traction Company with the interurban line being built from East St. Louis to Alton. The new company will be known as the Alton, Granite and St. Louis Traction Company. The principal office will be in Alton and the entire system will be under the direction of J. F. Porter.

A new system of electric traction in place of the overhead trolley or third rail will be used in operating the Nashville and Gallatin and Nashville and Columbia (Tenn.) electric railways. A feed wire carrying the current is run through an underground conduit parallel with the track. It is claimed that the system affords perfect protection and is more sightly than the overhead trolley.

In a special election at Marshalltown, Iowa, on the proposition of voting a three per cent. tax to aid the Marshalltown Electric Street and Interurban Railway Company in the construction of its line from Marshalltown to Grundy Center, the proposition carried by a vote of over two to one. This tax is payable one-half when the line is completed, and the balance the following year.

The Public Service Corporation of New Jersey has opened its trolley route from Jersey City to Trenton. The route is 63 miles long, while that traversed by the Pennsylvania railroad is 57 miles. The line passes through Newark, Elizabeth and New Brunswick. From Trenton passengers are forwarded by steamboat to Philadelphia. The fare is $2.

Superintendent Ralph Peters of the Pennsylvania lines states that the Cincinnati and Muskingum (Ohio) railroad is planning to equip the line from Trinway to Lancaster with electric power, so as to compete with interurban lines that are contemplated. Mr. Peters says that to meet such competition it is necessary to introduce electricity, as an electric line can be operated cheaper than a steam road.

The Southwest Missouri Electric Railway Company, according to the Joplin News Herald, is one of the prominent enterprises that have helped to build Joplin. The company has 46 miles of track running from Joplin to Galena, Webb City, Carterville, Carthage, Duenweg and Chitwood. The rolling stock and equipment are of the best and the track is mostly T rails. The present management of the company dates back from 1889, when the old mule road was in operation, and has been continued since that time. Mr. A. H. Rogers of Joplin is president and general manager.

As a preliminary to the establishment of fast through-car service on the Fort Wayne and Southwestern Railway and Wabash River Traction line between Fort Wayne and Logansport, Ind., a trial trip was made recently in a special car by officers of both lines. Brief stops were made at Wabash, Huntington and Peru, and slowdowns were made through these places as well as in the towns of Fort Wayne and Logansport, the purpose being to consume as nearly the actual time and no more than would be required in regular limited service. The running time from Fort Wayne to Logansport was two hours and 40 minutes, the distance being 79 miles.

The Louisville (Ky.) and Interurban Railroad Company expects to have three additional suburban lines in operation before the close of the summer season.

POWER TRANSMISSION.

Steel towers 200 feet high are being erected on the banks of the Calumet River by the Illinois Steel Company to carry an electric power cable to its new cement plant at Buffington, Ind. The elevation of the cable will permit vessels with the tallest masts to pass underneath. It is held that, by carrying the cable through the air instead of along the bed of the river, a great loss of electricity is done away with. The cable for the new transmission line is six miles long.

At a meeting of the board of directors of the Niagara, Lockport and Ontario Power Company, held on May 21st, in Lockport, the following action was taken: Paul T. Brady of Syracuse was elected to fill the vacancy existing through the death of the Hon. John E. Pound. The resignation of the Hon. Chauncey E. Dunkelberger was accepted and Cassius M. Wicker of New York was chosen in his place. The resignation of J. K. Perry, also of Lockport, was accepted and Robert E. Drake of Syracuse was elected in his place. The directors authorized the officers to issue a call for a stockholders' meeting to increase the capital stock to $10,000,000. The directors authorized the officers to issue a call for a stockholders' meeting to authorize the execution of a mortgage on the properties of the company for the purpose of a bond issue.

SOCIETIES AND SCHOOLS.

An electrical association for North Dakota has been formed at Grand Forks. J. S. Leary of Valley City was elected president and J. S. Fuller of Larimore secretary. The next meeting will be held in Fargo in October.

The Ohio Interurban Railway Association is scheduled to be in session at Columbus as the Western Electrician goes to press. The matter of one company running cars over the tracks of another will be one of the principal topics discussed. Not much attention has been paid to the question in the past, but with the multiplicity of roads and the frequency with which special cars are run over other lines, some means must be had for estimating the cost. The matter is in the hands of the transportation committee of the association. It is also probable that the coupon-book matter will be settled at this meeting, although there is such a variety of opinion that it may take some time to come to a decision.

The work of construction on the new Engineering School of the University of Pennsylvania in Philadelphia is now well under way, and it is hoped to have the major part done by fall. The building will be the largest on the university campus and will have a floor space of 128,000 square feet. It will have a frontage of 300 feet on Locust Street, a depth of 160 feet and a wing in the rear 50 feet square. The basement will be taken up with rooms for lockers, toilet rooms, the heating and ventilating plant and the heavy machinery for geodetic and hydraulic experiments. The upper floors will have more experimental machinery, class rooms and drawing rooms. When the building is completed and the entire plant installed the university will possess one of the finest plants for the teaching of engineering in the world. The cost will be close to half a million dollars, and the entire sum has been raised by subscription among the alumni of the department and the friends of the university.

In response to a letter received from Mr. Calvin W. Rice, chairman of the American Institute of Electrical Engineers building fund committee, the executive committee of the Iowa State College branch of the American Institute of Electrical Engineers appointed a local committee to solicit subscriptions from local members and "students" of the Institute. The committee consists of Mr. B. S. Lamphear (chairman), Mr. G. W. Bissell and Mr. F. A. Pielsticker. This committee decided to solicit subscriptions from the members of the Iowa State College branch of the Institute, each of these subscriptions to be a part of the subscription to the Institute building fund. The committee has been successful, having raised about $700, with several of the local members yet to be interviewed. It is thought that the interest which has thus been aroused in Institute matters will materially strengthen the local organization and thus eventually prove of even greater benefit to the local branch than to the fund.

PUBLICATIONS.

A substantial gift in the shape of a set of neat leather covers containing a copy of the "National Electrical Code" was given out at the National Electric Light convention by the Petingill-Andrews Company of Boston.

A tasteful folder with a postal card enclosed comes from the H. T. Paiste Company of Philadelphia, and is for the purpose of advertising the Pushin attachment plug, manufactured by the company. This plug may be detached by a slight backward twist or a straight pull. The line terminals are mounted on a porcelain base and covered with a fiber-lined cup of brass.

Dixon's Ticonderoga graphite grease is a product of the Joseph Dixon Crucible Company of Jersey City, N. J., which is made the subject of a little pamphlet issued by the company explaining the merits of grease which is used for heavy machine work.

Owing to the demand for Pass & Seymour's last catalogue, they found it necessary to issue a second edition, which has just been received from the printers and which will be mailed on application to their main office and works at Solvay, N. Y. The company is also sending out a pamphlet entitled "Just a Few P. & S. Specialties" which is devoted to sign receptacles, rosettes and transformer cut-outs.

Maps of the city of St. Louis and of the Fair grounds are contained in a folder issued by the Westinghouse companies with bits of information about the car service, the numbering of streets, etc., which will be of help to the visitor at the Fair. There is also a list of the typical Westinghouse installations located in the city. The principal buildings on the grounds are carefully indexed.

One of the well-prepared publications issued by the Faries Manufacturing Company of Decatur, Ill., is its catalogue No. 12 of brass castings and fittings for gas, electric and combination fixtures. Full-page half-tone cuts of brass castings fill over half the catalogue, and illustrate the high-grade work of the company in this line. This is the first catalogue issued by this company exclusively devoted to these lines and is distributed as a supplement to general catalogue No. 11.

Two little booklets of unique design are to be credited to the Columbia Incandescent Lamp Company of St. Louis. They are not over two inches wide by five inches long, but they attract the attention at once as being unusual. One is printed on dark red paper with a brown cover, through perforations in which may be seen the words "Read while you run" and a messenger boy following instructions at a lively "sprint." The other booklet is of much the same design in yellow and drab. Both contain reading matter on Columbia lamps.

MISCELLANEOUS.

The officials of the Oakland Transit Company have resumed their plans for establishing a big car-repairing and car-manufacturing plant at Emeryville, Cal. It is expected that the buildings and equipment will cost in the neighborhood of $100,000.

A process of preserving meat has been recently patented which consists of hanging the meat on an electrode in a preservative solution, in which is also hung the electrode of opposite polarity. A current of electricity is then passed from one electrode to the other through the solution and also through the meat.

The German government is planning the exploiting of waterpower in Germany on a large scale, the intention being to find out what there is in the country as to waterpower and to what extent it is being utilized. Besides compiling the water-level observations since the year 1896, water volumes will also be ascertained, and, furthermore, it is intended to obtain information as to the power used by manufacturing plants gaining their energy from waterpower.

The first test of the world's greatest organ, situated in Festival Hall at the Exposition, was made a few days ago, and it is said that the sounds resembled those of a "horde of shrieking, moaning demons" suddenly turned loose. The organ is operated by two motors of 10 horsepower each. The test was for simply "blowing out" the organ, as the builders say, for the purpose of getting all the machinery in smooth running order before the tuning of the pipes commences.

It is stated that a fleet of turbine-driven steamships is to be placed on the Great Lakes by British capital. Plans for vessels 250 feet long and of Welland Canal dimensions as to beam and depth have been drawn. The Georgian Bay Navigation Company and additional capital will build the ships, which are estimated to cost about $200,000 each. They will make the round trip from Toronto to Port Arthur or Duluth in eight days. The ships will carry 250 passengers and will run at a sustained speed of 16 miles an hour.

Among the interesting exhibits at the Mines and Metallurgy Building at the Fair will be a coal-testing plant operated by the United States Geological Survey. The test will be primarily for demonstrating the most economical methods for the utilization of the different coals. The testing plant will comprise two standard boilers, a gas producer, coke ovens, washery plant, and two or more briquetting plants. The material to be tested will be collected under the direction of M. R. Campbell of the Geological Survey, who will procure the co-operation of the various state geologists. Great care will be exercised to see that the samples sent for testing represent the commercial product of the mines or districts from which the coal is shipped and are not selected samples.

TRADE NEWS.

B. B. Cole, George Kaelberer and Harry Schrock have formed a partnership for the purpose of conducting an electrical supply business in Mattoon, Ill., Mr. Schrock is superintendent of the electric-light system of Mattoon.

The Martin-Reynolds Electric Company of Little Rock, Ark., has been incorporated to deal in electrical implements and install electrical machinery. Among the incorporators are E. T. Reynolds and T. B. Martin. The capital of the new company is $15,000.

The offices and salesrooms of the National Stamping and Electric Works of Chicago have recently been moved from Michigan Street and La Salle Avenue to more commodious quarters at 133 to 139 South Clinton Street. The company wishes to call the attention of the trade to its type-M multipolar motor, especially adapted for elevator service.

The Hazard Manufacturing Company of Wilkesbarre, Pa., announces that the sale of its wire-rope product in Chicago and western territory has been brought under its own management. Offices and warehouse have been established at 71-73 West Adams Street, Chicago, with Robert A. Peet as sales agent. Homer A. Wessel, Jr., will be Mr. Peet's assistant. A large and complete stock of wire ropes, fastenings and fixtures are carried in the warehouse.

BUSINESS.

The Trumbull Electric Manufacturing Company of Plainville, Conn., is manufacturing a three-panel cutout mounted in a neat box with connections for two or three-wire circuits, which fact is one of the advantages of the device. The individual panels are three by 6 1-16 inches. Each additional circuit would add three inches to the length of the box.

The H. W. Johns-Manville Company wishes to interest engine operators in its Mobilene sheet packing for cylinder heads of gas and gasoline engines. It is durable and efficient and, it is said, will not blow out. It comes in sheets 40 inches square or rolls 40 inches wide. It is one-thirty-second inch thick and weighs about 4½ pounds a square yard.

A. Bushnell of Kansas City, Mo., who has been in the lumber business since 1886, makes a specialty of cypress poles creosoted and treated with chloride of zinc. Mr. Bushnell claims that a pole treated in this manner will outlast any two poles not so treated. Mr. Bushnell has supplied many of the leading consumers in the West and Southwest and will be pleased to give full particulars to those in the market for poles.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) May 17, 1904.

759,858. Air-brake Mechanism. Guss A. Brooks, Covington, Ky. Application filed June 15, 1903.

The electric car motor is run as a generator in stopping or coasting and pumps the air for the air brakes.

759,876. Trolley Wheel and Harp. Frank W. Garrett and Joseph D. Forrer, Johnstown, Pa., assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed December 26, 1901.

Oil is retained in reservoirs back of and below the trolley-wheel journals. When the trolley is raised to the operating position the reservoirs are raised and the oil permitted to flow to the bearings.

759,880. Electric Arc Lamp. Otto Gross, near Manchester, England. Application filed December 11, 1903.

An arc lamp having converging carbon tubes contains carbons within the tubes, and fixed rotatable wheels engaging the carbons driven by positive gear. Angularly movable clutch wheels clutch the carbons. Solenoids located above the arc have cores actuating a rocking bar. A ratchet mechanism, vibrating bars and a rock shaft, an arm upon the rock shaft and a vertical rod working the angularly movable clutch wheels are further specified.

759,887. Process of Manufacturing Peroxides. Friedrich Hinz, Berlin, Germany. Application filed November 23, 1903.

Electrolytic production of the peroxides of magnesium and of zinc in an electrolyzer is accomplished by charging the anode-compartment with an aqueous solution of the corresponding metallic chloride and the cathode compartment with a neutral aqueous solution of the same chloride and of the hydrogen peroxide, and passing an electrolyzing current through the solutions.

759,900. Armature Winding. Frank A. Merrick, Johnstown, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed October 25, 1900.

The armature coil has its two sides equidistant from the axis of the armature, and its ends each provided with two reverse oblique portions disposed in different planes.

759,904. Regulating Apparatus for Theatrical Electric Lighting. Ernest F. Moy and Percy H. Bastie, St. Pancras, London, England. Application filed December 11, 1903.

A shaft carries two ratchet wheels secured thereon and a revoluble wheel loosely mounted between the ratchet wheels. The shaft operates the resistances of the various circuits.

759,909. Electrical Furnace. Richard M. Pelton, Detroit, Mich. Application filed December 3, 1902.

A dentist's furnace is described, the shell of which is provided with heating wires.

759,910. Electric Separator. Alonzo H. Perry, St. Louis County, Mo. Application filed February 28, 1903.

In an electrical separator is a receiving plate adapted to receive a charge of electricity. An inclined feed plate has its working face composed partly of conducting and partly of non-conducting material, the conducting part of the feed plate being within the inductive influence of the receiving plate. Means are provided for preventing the contact of the metallic particles with the receiving plate.

759,915. Electric Switch. Max von Recklinghausen, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed April 22, 1902.

Sets of electric terminals, the members of each set being relatively movable, are supplied with means for operating all the sets to close the circuit. One or more of the sets may also be operated to break the circuit by a quick movement. Positive means are added for separating the terminals of one of the sets on the release of the described operating means for all the sets.

759,916. Quick-break Oil Switch. Max von Recklinghausen, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed April 22, 1902.

In an electric switch are an operating handle and shaft and a pair of contact terminals with means connected with the shaft for removing one member of the pair from the path of the other during the rotation of the shaft in one direction, and for releasing the aforesaid member into contact with the other when a certain limit of motion has been reached.

759,924. Bracket for Desk Lights. Theodore Smith, Chicago, Ill. Application filed July 27, 1903.

A tubular member is adapted to receive an electric cord and a lamp socket is secured to one end of the tubular member.

759,925. Bracket for Electric Lights. Theodore Smith, Chicago, Ill. Application filed July 27, 1903.

The lamp is mounted on a swinging arm with a reflector so arranged that the rays are directed downward.

759,926. Bracket for Electric Lights. Theodore Smith, Chicago, Ill. Original application filed July 27, 1903. Divided and this application filed December 22, 1903.

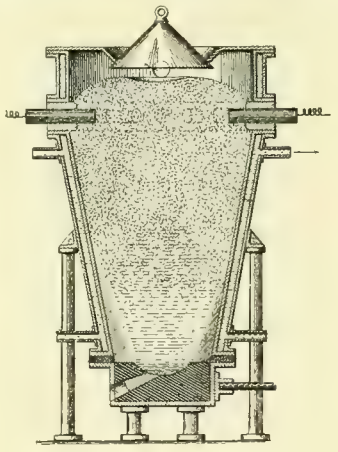
Secured to a bracket is a movable arm, which carries the lamp.

759,927. Coil Casing. Charles F. Splitdorf, New York, N. Y. Application filed July 24, 1903.

An insulating casing for induction coils is described.

759,941. Plug Receptacle for Electric Circuits. John H. Trumbull, Plainville, Conn., assignor to the Trumbull Electric Manufacturing Company, Plainville, Conn. Application filed October 9, 1903.

In a plug receptacle is a block of insulating material having a cylindrical depression, with grooves formed in the walls of the depression. A cylindrical contact member has means for holding it within the recess and is provided with ears arranged upon the exterior walls of the cylindrical contact and adapted to rest in the recesses of the depression.



NO. 760,057.—ELECTRIC SMELTER

759,962. Plural Lamp Socket. Reuben B. Benjamin, Chicago, Ill., assignor to the Benjamin Electric Manufacturing Company, Chicago, Ill. Application filed December 9, 1901.

A plug cluster comprises a base carrying a plug and associated contacts adapted to be inserted in a lamp socket, and a number of lamp-holding devices and associated contacts electrically connected between the plug contacts.

759,963. Plural Lamp Socket. Reuben B. Benjamin, Chicago, Ill., assignor to the Benjamin Electric Manufacturing Company, Chicago, Ill. Application filed July 18, 1902.

Lamp-holding devices are secured on an insulated base.

759,967. Alternating-current Motor. Alexander J. Churchward, Brooklyn, N. Y. Application filed March 29, 1897.

A single-phase alternating-current motor has an armature provided with a continuous-current winding and commutator and operated by alternating current passed to its armature coils through the commutator. An automatic regulator is responsive to changes in the speed of the armature while so operated, and is adjusted to keep the armature at a synchronous speed.

759,981. Electric Cable. Johannes Frisch, Mülheim-on-the-Rhine, Germany, assignor to Felten & Guilleaume, Carlswerk Actien-Gesellschaft, Mülheim-on-the-Rhine, Germany. Application filed May 5, 1902.

An air-space electric cable has a core of insulating material angular in cross section, and conducting wires are wound spirally about the core, so as to touch the apices of the core only.

759,987. Facsimile-telegraph Apparatus. Ernst K. Gruhn, Dresden, Germany, assignor to Telautograph, Gesellschaft mit Beschraenkter Haftung, Dresden, Germany. Application filed November 20, 1902.

A transmitting mechanism for facsimile telegraphs embodies the devices whereby the movement of the stylus is decomposed into orthogenal co-ordinates to effect a variation in the resistance of the line conductors.

760,012. Electric Self-registering Target. Theodore F. Oetjen, Augusta, Ga. Application filed April 14, 1903.

Circuit-closing devices are operated by the weight of the projectile, which operate signals.

760,023. Apparatus for the Electrolytic Refining of Metals. Alfred Schwarz, New York, N. Y., assignor to the General Metals Refining Company, New York, N. Y. Application filed November 22, 1902. Renewed November 20, 1903.

Electrolytic apparatus for the refining of metals consists of a cathode, consisting of a number of substantially parallel plates, and a soluble anode, the cathode plates being spaced apart and arranged at an angle to the face of the anode so that there will be a free circulation of the solution whereby the metal will be deposited on both sides of the cathode plates.

760,029. Telegraph Sounder. John F. Skirrow, East Orange, N. J. Application filed January 8, 1904.

A tension spring for the sounder armatures is provided and also a rotatable tension bar. A hollow post supports the bar and a spring within the post is adapted to exert a pressure on the tension bar.

760,057. Process of Electrically Smelting Materials. Alfred H. Cowles, Cleveland, Ohio. Application filed October 20, 1903.

Materials which are normally poor conductors of electricity, but whose conductivity increases with their temperature, may be smelted by supporting a solid charge of the material and a reducing agent in an electric furnace having a casing of electrically conductive material and then electrically heating the solid charge to the required temperature, and cooling those portions of the charge adjacent to the inner face of the furnace casing to an extent sufficient to prevent any substantial shunting of the electric current through the casing. (See cut.)

760,065. Base for Incandescent Lamps. Howard Gilmore, Boston, Mass. Application filed November 22, 1901.

A central frictional contact is electrically connected with one of the leading-in wires and an inner holder concentric with and inclosed within a screw shell carries the insulating body and central contact.

760,075. Electrical Resistance. George I. Leonard, Pasadena, Cal. Application filed October 27, 1902.

An electrical resistance comprises a non-conducting sheet of material, which is coated with a film of rubber and a film of graphite over the rubber.

760,076. Electric Heater. George I. Leonard, Pasadena, Cal. Application filed January 22, 1903.

An electric heater comprises a base, and a vertical, removable, thin resistance plate, supported with its lower edge above the base.

760,077. Electrical Switchboard. Arnest W. Müller, Brooklyn, N. Y., assignor to Hubert Krantz, Brooklyn, N. Y. Application filed November 20, 1902.

On the outer face of an upright switchboard are the usual electrical appliances. Posts in the rear of the board support the bus bars and board, and a rearwardly projecting platform to the board is supported by the posts

760,079. Trolley. Frank A. Overdier, Columbus, Ohio. Application filed June 30, 1903.

A trolley having two wheels, engaging the wire at the same time is described.

760,081. Automatic Switch Indicator. Dewey S. Rice, Weatherly, Pa. Application filed December 24, 1903.

In an indicator circuit is an electromagnet, a switch, means for normally holding the switch open and an armature adapted to be attracted to the magnet when the switch is closed temporarily and to complete the circuit through the magnet until it is broken from a point other than the switch mentioned.

760,086. Dynamo-electric Machine or Motor. Imle E. Storey, Amsterdam, N. Y. Application filed September 15, 1903.

A field magnet has a core and a continuous pole face, the core has a rectangular chamber whose walls opposite each other in the direction of armature rotation, converge at their inner ends [illegible] near the pole face.

760,091. Automatic Regulator for Electric Circuits. Montgomery Waddell, New York, N. Y. Application filed June 18, 1903.

Combined with a shunt-wound generator is a variable-resistance device in series with the field-magnet winding, electromagnetic means for controlling the resistance and a coil on the electr[illegible] working circuit [illegible] nected on one side [illegible] other side to the field-magnet windings between the windings and the [illegible]

760,096. Protecting Device for Vapor Electric Apparatus. James R. Baker, Arlington, N. J., as-

signor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed November 6, 1903.

An exhausted container of inelastic material contains one or more electrodes of mercury or other conducting liquid. Pieces or masses of glass wool are attached to the interior of the apparatus at such point or points as are specially subject to the effects of shock from the movement of the liquid. (See cut.)

760,119. Means for Protecting Vapor Electric Apparatus. Peter C. Hewitt, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed December 22, 1903.

Cushions are disposed at such points in the interior of the tube as are especially liable to shock from the moving mercury.

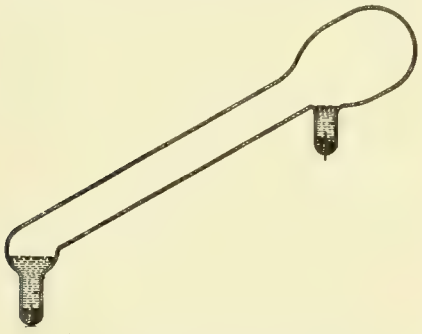
760,132. Circuit Closer. James W. Leech, Staunton, Va. Application filed October 10, 1903.

The device comprises a telegraph key and stand, a base-plate on the stand, a switch pivoted to the base plate and a strip of insulating material on the base plate intermediate the pivotal point of the switch and the key. A contact plate is arranged on the insulating strip adjacent the end opposite the key, and means for closing the circuit when the switch is thrown off the insulating strip toward the key or on the strip in contact with the contact plate are supplied.

760,143. Apparatus for Amplifying or Reinforcing Telephone Currents. Joseph J. O'Connell, Chicago, Ill., assignor to the American Telephone and Telegraph Company, New York, N. Y. Application filed August 22, 1903.

A transmitter is connected with a grounded circuit at one terminal station. A receiver is placed in a metallic circuit connecting the stations at the other terminal station. There is also a transmitter in a local circuit and a repeating actuating electromagnet for it in the grounded circuit. An induction coil for the transmitter has its primary winding in the local circuit and its secondary winding in a bridge of the metallic circuit, all at the intermediate station.

760,145. Guard for Trolley Wheels. Charles O. Phillips, Kalamazoo, Mich., assignor of one-half to Hiram C. Streeter, Kalamazoo, Mich. Application filed March 2, 1904.



NO. 760,096.—PROTECTIVE DEVICE FOR MERCURY VAPOR LAMP.

Upwardly extending arms on the trolley harp embrace the wheel and hold it against the wire.

760,159. Electric Block-signal System. Tony Silvene, Victoria, Canada. Application filed May 29, 1902.

Magnets release the counter weights which normally hold the signal in the safe position.

760,163. Trolley Catcher. Irwin W. Smith, Dayton, Ohio. Application filed January 25, 1904.

A pawl and ratchet wheel mechanism operates the reel which winds up the slack in the trolley rope.

760,173. Process of Curing and Preserving Meats. Augustus W. Ball, Richmond, Va., assignor of three-fourths to George Arms Tower, Hugh Archibald McCurdy and Frank Lee Jobson, Richmond, Va. Application filed June 24, 1903.

The process of curing perishable food consists in subjecting the food to the action of an electrical current while immersed in a preservative solution, the food being attached to the negative pole and interposed between it and the bath and being separated from the positive pole by the bath, whereby the food will constitute the cathode and have the entire current directed through it.

760,184. Trolley Pole Head. Robert I. E. Dunn, Dallas, Texas. Application filed August 29, 1903.

Rigidly mounted on the pole is a bearing pin. A wheel harp is rotatably mounted on the pin and a spring is secured to an arm on the harp and engages the bearing pin.

760,209. Circuit Controller. Paul H. Jaehnig, Newark, N. J., assignor to the Electric Motor and Equipment Company. Application filed March 1, 1904.

A circuit controller comprises an arrangement of brackets or supports, an insulated connecting bar between, single-pole contacts on the bar, an oscillating arm and a switch blade connected with the oscillating arm. The switch blade consists of members doubled upon themselves, insulating pieces arranged on opposite sides of the oscillating arm, and means for securing the end portions of the switch-blade members against the insulating pieces.

760,223. Electric Railway. Thomas D. Lovell, Beverly, Mass., assignor of one-half to Robert M. Bailey, Dedham, Mass. Application filed January 22, 1904.

In connection with a trolley wire divided into sections by means of insulating joints is a track block, the sections being subject to two distinct electrical circuits, one of the circuits containing the power current and the other a weaker or reduced current, each section being controlled by a preceding section. An electromagnetic influencer is provided with means whereby the passing of a car or train from one section or block will de-energize the influencer and simultaneously restore the power current to the immediate succeeding section or block, and take from it the weaker current. (See cut.)

760,231. Trolley Base. Peter D. Milloy, Buffalo, N. Y. Application filed November 16, 1903.

The trolley pole is held in position by two sets of springs on the base.

760,234. Electric Cab Signal. Edward McClintock, Merriam Park, Minn., assignor of two-thirds to F. E. Butler and Edward Mierke, St. Paul, Minn. Application filed September 5, 1903.

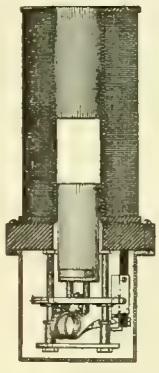
Connected with the track rails is a normally open alarm circuit which is closed by an arm on a passing train.

760,280. Electric Water Heater. Richard Toennes, Boonville, Mo. Application filed January 27, 1904.

Non-conducting members and conducting members are arranged alternately, with means connecting the conducting members to an electrical supply source to produce the heat.

760,281. Electric Alarm. Herbert Trull, Fernie, Canada. Application filed September 17, 1903.

To a stationary guide rod is connected a hollow member and means for adjusting the position of the hollow member relatively to the guide rod are supplied. Trip mechanism connected with the hollow member, contact mechanism connected with the trip mechanism and a heat-controlled device stationary relatively to the guide rod and provided with a movable member for engaging the trip mechanism are the other parts.



NO. 760,400. AUTOMATIC OIL SWITCH.

760,289. Electrical Apparatus for Working Reciprocating Tools. Alfred D. Williamson and Cecil L. Sumpter, Sheffield, England, assignors to Vickers Sons & Maxim, Limited, Sheffield, England. Application filed January 31, 1903.

Apparatus for electrically working reciprocating tools consists of a starting switch, switch arms attached to the collar of the switch, an electromagnet attached to one of the switch arms, a disk of magnetic material keyed on the shaft and in close proximity to the electromagnet, and contact pieces and circuits leading therefrom.

760,302. Purifying Apparatus. Pierre J. Boucher, Cleveland, Ohio. Application filed March 28, 1903.

Apparatus for purifying liquid by electrolysis contains a reversing switch for changing the direction of the electric current through the liquid, the switch being automatically operated by means independent of the flow of the liquid.

760,315. Combined Electric Heater and Battery. Jesse R. Davis, Parkersburg, W. Va., assignor of one-third to Charles A. Wade, Parkersburg, W. Va. Application filed December 8, 1903.

A non-conducting base, a resistance coil channel in the base, openings in the base extending from the outside into the channel, suitable electrodes in the openings, a suitable current-resisting material in the channel, and hoods or covers over the points of contact of the electrodes with the current-resisting material are the essential parts.

760,325. Electric Railway. William R. Fearn, Camden, N. J. Application filed December 16, 1903.

The conductor is buried in the ground and is connected at intervals along the track to contacts contained in boxes, the contacts being engaged by contact arms on the cars.

760,326. Universal Floor Box for the Distribution of Electric Wires. John Fountain, Jr., Elizabeth, N. J. Application filed December 16, 1902.

A floor box is provided with a polygonal box body having an annular outwardly projecting flange at its upper edge and a series of recesses in the flange, the recesses opening into the box body.

760,330. Trolley Pole. James Furgason, Montour Falls, N. Y. Application filed May 28, 1903.

Details are described.

760,361. Steadying Resistance for Arc Lamps. Louis Wolff, Berlin, Germany. Application filed December 16, 1903.

A solenoid regulates the feed of one of the carbons. A jacket of fireproof insulating material incloses the solenoid and a steadying resistance, consisting of a helically wound wire, is arranged in helical coils around the casing.

760,375. Electric Lamp Cluster. Reuben B. Benjamin, Chicago, Ill., assignor to the Benjamin Electric Manufacturing Company, Chicago, Ill. Original application filed December 9, 1901. Divided and this application filed March 3, 1902.

A base for several lamps is described.

760,376. Electric Lamp Cluster. Reuben B. Benjamin, Chicago, Ill., asignor to the Benjamin Electric Manufacturing Company, Chicago, Ill. Original application filed December 9, 1901. Divided and this application filed November 12, 1902.

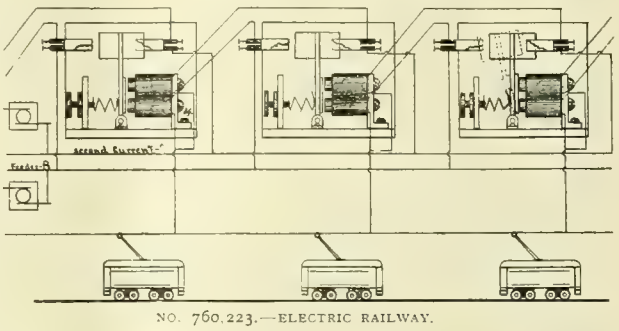
Details are described.

760,399. Selective Signal System. Fred C. Penfield and Olin Templin, Lawrence, Kan. Application filed March 17, 1902.

Two line conductors and a return conductor are embodied in the system, and associated with them is a circuit adapted to join one of the line conductors and the return conductor, including a signaling device. A circuit, including a responsive device, and a condenser adapted to join the other line conductor and the return conductor are also added, together with a shunt circuit around the condenser and a circuit closer operated by the responsive device to close all of the circuits.

760,400. Automatic Oil Switch. Max von Recklinghausen, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Original application filed April 22, 1902. Divided and this application filed January 6, 1904.

A snap or quick-break electric switch inclosed within a liquid-tight receptacle is provided with a solenoid outside the receptacle and a core for the solenoid, the core being itself wholly inclosed in a portion of the liquid-tight receptacle, and being mechanically connected with one of the switch terminals. The receptacle is partially filled with a suitable oil. (See cut.)



NO. 760,223.—ELECTRIC RAILWAY.

760,408. Dynamo-electric Machine. Leonard Wilson, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed June 1, 1903.

In a dynamo-electric machine are main armature coils, a commutator, leads from the coils to the commutator, brushes bearing on the commutator and short-circuiting a number of the coils, resistances inserted in the leads and means for compensating for the voltage drop in the resistances.

EXPIRING PATENTS.

Following is a list of expiring patents (issued by the United States Patent Office) that expired on May 24, 1904:

363,440. Secondary Electric Clock Movement. Charles D. Warner, Ansonia, Conn.

363,449. Telephony. John J. Carty, Cambridge, assignor to America Bell Telephone Company, Boston, Mass.

363,464. Electropneumatic Brake for Railroad Trains. Herman Hollerith, New York, N. Y.

363,466. Electric Motor and Dynamo-electric Machine. Rudolph M. Hunter, Philadelphia, Pa

363,498. Primary Electric-pendulum Clock. Joseph Zeiner, Munich, Germany.

363,500. Incandescent Electric Lamp. C. Gustav Anderson, Hartford, Conn.

363,559. Incandescent Electric Lamp. William Stanley, Jr., Great Barrington, Mass.

363,562. Electrolyte. Anson C. Tichenor, San Francisco, Cal.

363,567. Lightning Arrester. Merle J. Wightman and Herman Lemp, Hartford, Conn.

363,568. Incandescent-lamp Fixture. Merle J. Wightman and Herman Lemp, Hartford, Conn.

363,574. Mail box Indicator. Clinton M. Ball, Boston, Mass., and Thomas J. McTighe, New York, N. Y.

363,611. Electric Arc Lamp. Julian F. Denison, New Haven, Conn.

363,623. Electric Lock. Malon I. Flowers, Springfield, Mo.

363,644. Electric Temperature-controlling Device. Henry E. Jacobs, Fond du Lac, Wis.

363,645. Electric Temperature-controlling Device. Henry E. Jacobs, Fond du Lac, Wis.

363,669. System of Conversion of Electrical Energy Into Mechanical Force. Henry M. Paine, Newark, N. J.

SPECIAL MENTION.

The "Yellowstone Park Flower Book," published by the Northern Pacific, is a beautiful creation. It contains 11 specimens of real flowers, in natural colors, from Yellowstone Park, with names and places where found. Also six full-page, fine, half-tone illustrations of bears, the Grand Cañon, geysers, hotels, etc., found in the Park, the most wonderful spot on earth, 54 by 62 miles in size, and where President Roosevelt recently spent his vacation. The "Flower Book" makes a beautiful souvenir. Send A. M. Cleland, general passenger agent, Northern Pacific railway, St. Paul, Minn., 50 cents for a copy.

A $20,000 organ will be constructed in the new Thomas Hall, Chicago, by Lyon & Healy. The instrument will have electricity as a motive power and will have many new features, among them being a movable key bank, which can be played from any part of the orchestra or stage.

Fine decorative effects are possible with the Packard Zenith lamps. The rush of business at the present time is partly the result of orders for dining-room, pavilion and porch lighting at summer resorts. The Electric Appliance Company, Chicago, general western agent, has special circulars on these lamps.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, JUNE 4, 1904 No. 23

Electrical Installation for the New Minnesota State Capitol.

An important electrical installation is that of the Minnesota state capitol at St. Paul, which is just approaching completion. The building itself is a handsome structure, with an exterior of Georgia marble, and is located upon a commanding position on a hill somewhat back from the business section of the city. It is surrounded by an ample space of ground to set off its architectural beauties and will be a lasting credit to the state as well as to the Board of Capitol Commissioners, which has had the work in charge. The plans were drawn by a well-known architect of St. Paul and New York, and are very complete.

The building is laid out on an elaborate scale and its fittings and furnishings are all of the best. The selections have been carefully made after careful investigation and inspection on the part of the board. In this way the completed building will be a monument to the best workmanship in the various lines of its construction.

The working out of the details of the electrical system was handled with consummate care by Charles L. Pillsbury, who gave the installation his scrupulous attention. All the many miles of wiring are cased in iron piping for distribution and are buried beneath the flooring, which is of tile. The minuteness with which these details were worked out may be understood when it is known that all the parts of the entire system fitted just as they were planned, which cannot be said of every undertaking of this magnitude.

Five dynamos, built by the Electric Machinery Company of Minneapolis, furnish the current. Of these four are 150-kilowatt capacity and are direct-connected to Corliss engines speeded to 175 revolutions per minute, and one is 50-kilowatt, also direct-connected and of the same speed. A corner of the engine room is shown in Fig. 1, illustrating two of the 150-kilowatt units.

The plant is something of a departure in that it is of a construction which had been heretofore occupied almost exclusively by high-speed engines. A striking fact in this connection is that the original specifications under which the bids were invited called for high-speed engines, direct-connected to high-speed dynamos. After a careful consideration of the matter, however, the board of commissioners was induced to depart from the specifications in the call for bids.

The steam plant which operates the electric-lighting, heating and ventilating systems consists of five engines of the Twin City Corliss type, built by the Minneapolis Steel and Machinery Company. The engines were all designed by the company's mechanical engineer, Joseph Garbett. These engines are designed for heavy duty. Four are 18 by 36-inch size and one is 12 by 20 inches.

Instead of being placed in the building itself, the entire mechanical equipment is located in a detached power plant 360 feet distant from the capitol. The connection between the power plant and the main building is by means of a tunnel eight feet in diameter, running underground. It passes underneath residences and streets and into the building, having a total length of 360 feet. The steam pipes and the electric-wire cables are all hung on side brackets in this tunnel. Fig. 2 is a view in the tunnel showing the steam pipes and cables.

The boilers in the power station are two in number and are of the water-tube type, with stokers attached, Stirling make. The fire brick enclosing them is white enamel faced.

An unusually attractive design has been adopted for the switchboard, as will be seen by Fig. 3. The architectural features of the design of this board were worked out by the architect of the building, Mr. Gilbert. Circuit breakers of the I. T. E. make are used; the ammeters and voltmeters are Weston, and the switches were built in the factory of the Electric Engineering Company in Minneapolis.

There are two sets of bus bars, as seen by Fig. 4, a view of the back of the board—one for power and one for light—and any one or all of the five generators can be connected to either set of bus bars. The plant is a 250-volt, direct-current, two-wire system and furnishes either arc or incandescent lighting.

Motors for various purposes are used about the building. There are five motors of 25 horsepower, five of seven horsepower, two of 16 horsepower, and three of 11 horsepower. The first 10 are used for operating the fans in connection with the heating system. The ventilating fan motors are arranged to operate in pairs, at which time the armatures are thrown in series to obtain a slow speed. The two 16-horsepower motors operate the spray and circulation pumps. The three 11-horsepower motors operate the boiler feed pumps and are so arranged as to start and stop automatically, depending upon the amount of water in the boilers. The cost of the generator, motor and switchboard equipment was $35,000.

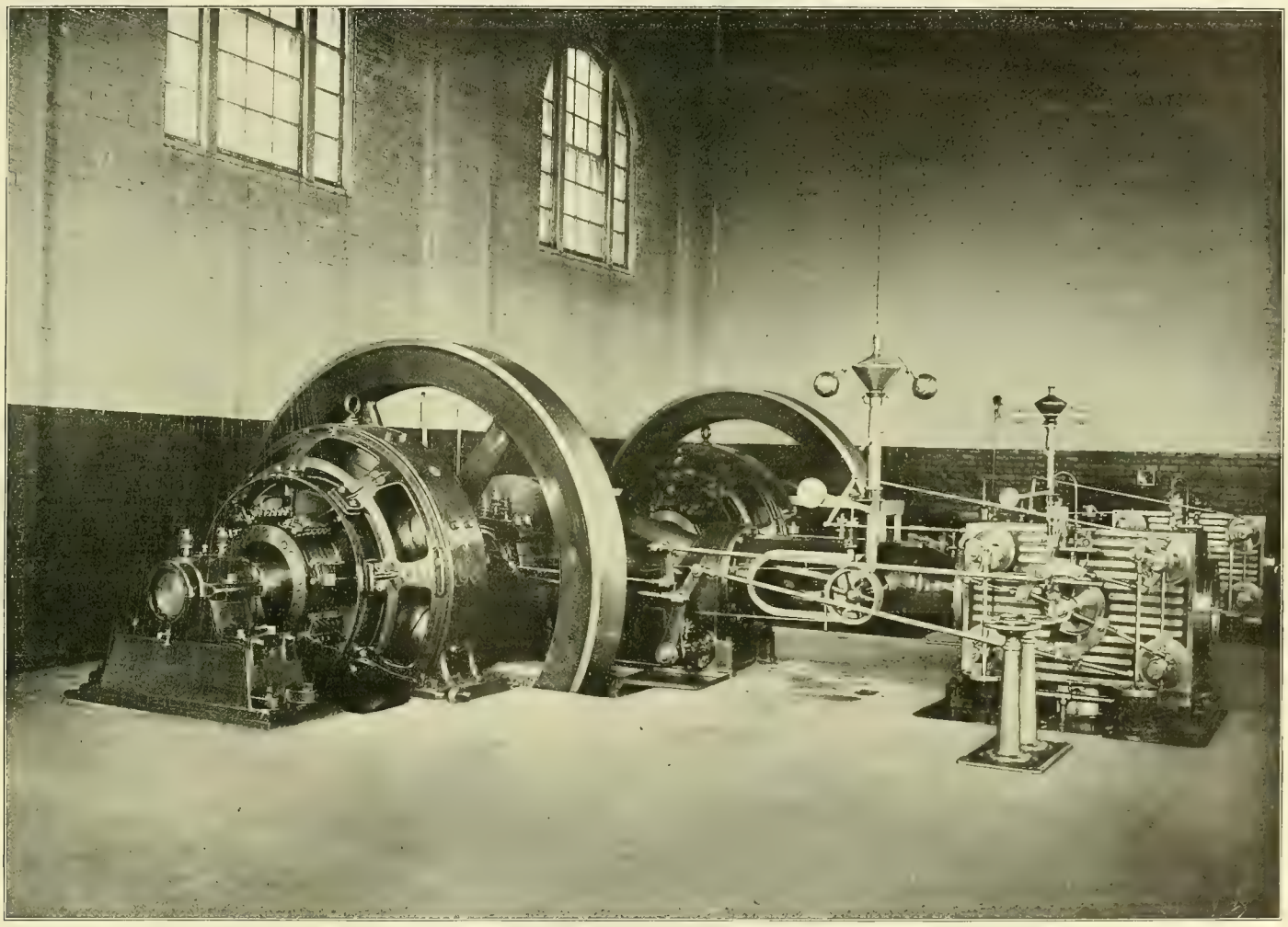


FIG. 1. ELECTRICAL INSTALLATION FOR THE MINNESOTA STATE CAPITOL.—VIEW IN CORNER OF GENERATOR ROOM.

In point of elaborate design and size this plant ranks with the more important direct-connected isolated lighting and power plants of the country. While there are larger plants, one of finer construction or more elaborate workmanship than this of the state capitol of Minnesota will be hard to find.

The capitol, which is shown in Fig. 5, has a length of 435 feet and a width of 230 feet, with wings of 135 feet. The height of the building itself is 75 feet, and to the top of the dome is 224 feet. The dome has an imposing effect, with an inside diameter of 60 feet. Construction was started on the building in 1896 and it is now approaching completion. The interior finishing work is now actively

in progress. Bids are to be opened in July for the electric-light fixtures and for the heat-register faces. It is expected to have the building completed by next winter, probably in time for the next session of the Legislature.

The general contract for mechanical equipment, including the electric-lighting, heating and ventilating, plumbing, water and sewer work and power station complete, with tunnel connections, boilers and fittings went to W. I. Gray & Co. of Minneapolis at an aggregate figure of $390,000.

Lost and Unaccounted-for Current.[1]

By C. W Humphrey.

The different losses in an alternating-current system may be classified as follows:

Transformer-iron losses.
Primary-resistance losses.
Secondary-resistance losses.
Meter-shunt losses.

I will begin with the transformer-iron losses, and show methods of calculating and keeping records. [Methods used by Denver Gas and Electric Company.] We have a card-index system, consisting of two sets of cards. One set has a card for each transformer on our lines and also those in stock, and shows the date of purchase, where set, manufacturer's number and type, iron and copper losses as shown by test, and also whether or not the transformer has been removed and for what cause, as well as a retest on its iron loss before it is again placed in service. In fact, these cards show the entire history of each transformer from the date of purchase up to the present time. The other set of cards which we will call the feeder index, shows the exact location, make and number of transformer, also the number of feeder on which it is located. These cards are arranged according to location and feeder, while the other index is arranged numerically, according to the make and number of the transformer.

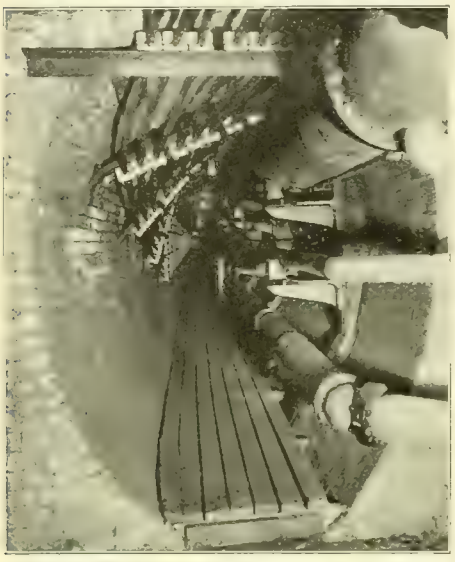


FIG. 2. TUNNEL FOR CABLES AND STEAM PIPES IN MINNESOTA STATE CAPITOL PLANT.

In a great many instances we have tested transformer-iron losses while in service. We do this in a very unique way and without interruption to service. We have a small testing board, which includes a wattmeter, voltmeter and a small variable resistance. To these instruments are attached two flexible duplex cables of sufficient length to reach from the ground to any transformer on any pole. The primary fuses of the transformer are pulled, the neutral of the secondary is disconnected (that is, if the transformer is on a three-wire network), one side of the secondary is left intact and the other side is cut, and the wattmeter and resistance are inserted in the circuit by means of one of the flexible cables, the other cable being used for pressure wires. The secondaries are kept alive by the other transformers on the system. The resistance is then so adjusted that normal voltage is impressed across the secondaries of the transformer. Readings are then taken on the wattmeter, which indicates approximately the iron loss, and may be corrected for instrument losses in the usual way.

We also keep up a transformer-record sheet for the purpose of more readily finding our transformer-iron losses as soon as possible after the first of the month.

The next known loss to consider is the primary-resistance loss. This loss has been more difficult to ascertain correctly and keep up from month to month than any of the other known losses. We have used four different methods of calculating this loss. The method we finally adopted and now use exclusively is a measured-resistance method. With the use of this method the feeder must be shut down at some convenient time, preferably during light load, and the primary fuses of all transformers pulled; that is, all those on the station side of the center of distribution. The primaries are then short-circuited at this point and the resistance of the circuit is measured by the "drop of potential" method with direct current, the direct current being supplied from a separate direct-current machine and the voltage varied so as to permit of a series of readings being taken. The loss is then calculated by means of ampere readings taken at the station at stated intervals, the same as in the first two methods. Or a better way than calculating each particular point is to calculate the losses for different amounts of current and plot a curve of watt loss and primary amperes. This curve also includes the primary copper loss of the transformer on the feeder, full load on the feeder being considered as the sum of the full-load capacities of the different transformers. The readings taken at the station may then be readily run off on this curve and summed up for a period of 24 hours, full-load copper loss of the transformers for the entire feeder being the sum of the individual losses for all transformers on the feeder.

FIG. 3. ATTRACTIVE SWITCHBOARD OF MINNESOTA STATE CAPITOL PLANT.

After losses are obtained for a period of one day the total loss for the month must be calculated. This is done by multiplying the output on the feeder for one day by the number of days in the month and dividing into the total output for the month as obtained on the feeder wattmeter. This result is squared and multiplied by the loss for one day and multiplied by the number of days in the month. These results will be as close as it is possible to calculate them and would be very accurate if it were not for the fact that the characteristics of the daily load curve change during the different seasons of the year. The peak is very sharp in the summer, with a very small morning peak, while in the winter the peak is quite broad and the morning peak is much more noticeable. For this reason these losses must be recalculated from time to time during the year, as these characteristics change.

The secondary-resistance losses are somewhat more difficult of accurate calculations. Following is the method we have used exclusively for our three-wire secondary network:

In this calculation we have had to assume some things in order to arrive at results. The total secondary load is assumed to be divided up in proportion to the sizes of the different transformers, one-half the load on each transformer to feed each way, and this amount of current to feed one-fourth the distance between transformers. The assumptions have, however, been verified in each case by the testing of all transformers on the line. This assumption would not hold true, however, before we began to test our transformers systematically and place them on our lines in accordance with the actual load carried, instead of depending, as is the usual custom, upon the connected load. We found that the actual load carried varied very widely from that calculated on a basis of connected load. With these assumptions and the size and length of secondary feeds being known, the losses may be figured for several different amounts of current flowing, and plotted in a curve.

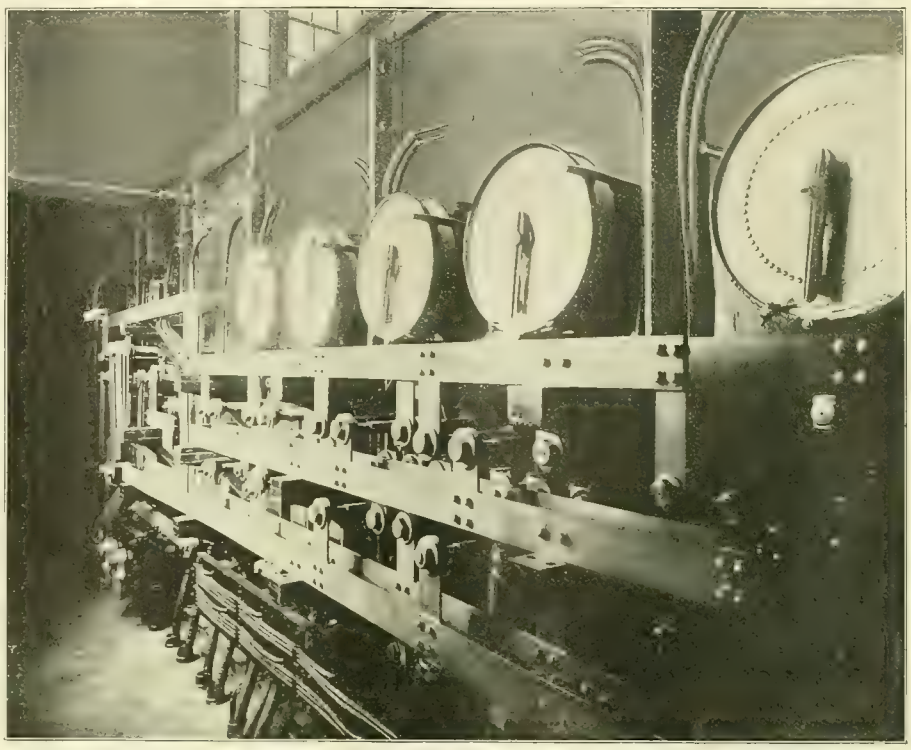


FIG. 4. BACK OF SWITCHBOARD IN MINNESOTA STATE CAPITOL PLANT.

It has been claimed that transformers banked together on a three-wire network would adjust themselves to the total unbalancing of the feeder. This is not true, as we have found transformers of the same make and size on adjoining poles considerably unbalanced on opposite sides; and even in cases where transformers are banked together on the same pole they will not divide their loads evenly. This was very strikingly illustrated by an occurrence that took place here some time ago. During a breakdown in an isolated plant furnishing power for a theater we were called upon to furnish them with light. In order to do this we placed six 10-kilowatt transformers and one 20-kilowatt transformer, all of the same make and type, just outside of the building and connected them up for 110 volts, tying them together with a 500,000-circular-mil cable which fed the theater. Following is the average load in amperes on each transformer during operation:

FIG. 5 MINNESOTA STATE CAPITOL.

Size	Load in Amperes at 108 Volts.
10-kw	106 amperes
10 "	15 "
10 "	120 "
10 "	112 "
10 "	90 "
10 "	90 "
20 "	138 "

I have also taken into consideration the resistance losses in the service loops. This is taken care of by assuming the secondary load to be equally di-

[1] Abstract of paper read before the National Electric Light Association, Boston, Mass., May 24, 1904.

vided between the different service loops, and taking the average length and size of service.

The secondary-transformer copper loss is taken into consideration in the same way as in the primary losses. A curve is then plotted of the secondary-resistance loss, secondary-transformer loss, and service-resistance loss, and then a curve of the total losses is plotted.

The all day losses are obtained in the same way as with the primary, using the station ampere readings in the same way, the station ammeter not being relied upon entirely, a standard portable instrument being cut in and used, and the switchboard meters being calibrated at the same time.

The only known loss now left to determine is the meter shunt loss, a loss that one might think at first hardly worth considering, but which is nevertheless of considerable importance and assumes very large proportions in some instances. The loss can be obtained with a greater accuracy and less trouble than any other of the losses. Each different type and size of meter must be tested and the average of a number of different tests taken. We use a meter-record sheet for our meter losses on each feeder very similar to our transformer record sheets. These sheets are kept up from day to day, and at the end of the month the daily losses are summed up, giving the monthly losses.

Our total sales are figured up at the end of each month, and as meters are read in three different divisions at different times, the results do not exactly correspond to the monthly output. The bills for one-third of our consumers cover a period from the first of one month to the first of the next month, one-third from the 10th to the 10th, and one-third from the 20th to the 20th. This variation might amount to considerable in one month, but, as we figure everything accumulative from month to month, our records are very accurate when figured over a space of several months.

I have now fully explained our methods for arriving at our known losses, and it will be interesting to note the results obtained in some of our feeders for the last year. We have 24 different feeders, on all of which the above records are kept up from month to month. I have plotted graphically the losses on some of our feeders, showing variation of losses from month to month and the gradual but steady decrease in the unknown losses. The first curve (Fig. 1) is that of a residence feeder, which we designate as 1 West. It will be noticed that the output and sales have increased very rapidly. A slight hump will be noticed in the output during October; this is due to some unknown loss, as the curve of sales does not show this characteristic, neither does the curve of known losses. It will be noticed that both the primary and secondary losses show a steady increase, due to the increase in the output. The transformer-iron loss remains about the same, and so do the meter-shunt losses. The relation that the sales show to the output varies from 59.3 per cent. to 80.5 per cent., being almost a steady increase from beginning to end, the unknown loss increasing at about the same rate as the output for the first two months, dropping off the next month, and then remaining about the same for the remainder of the period, although both the sales and output increased considerably.

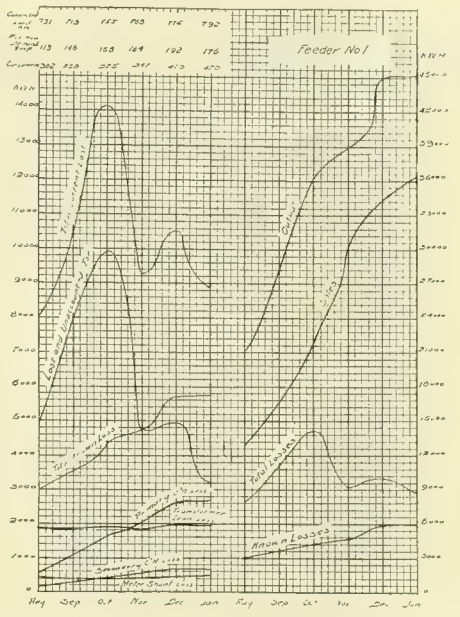


FIG. 1. LOST AND UNACCOUNTED-FOR CURRENT.

current was found to be due to thefts. These were found by systematic inspection of service loops and interior wiring. Theft of current was found to be done usually by tampering with the wiring, removing pressure wires and jumping out meters, installing lamps ahead of the meter, and in some instances tampering with the meter so as to retard its rotation. Some of these things are very difficult to find, especially in cases of concealed wiring. Some cases of slow meters were found by placing a check meter on the secondary of a transformer feeding a three-wire district, making an isolated district of it by opening up the junction fuses on each side of the transformer. We have quite a number of ampere-hour meters on our circuits, which accounts for some of the lost and unaccounted-for current, as an ampere-hour meter will not start on less than two to four 16-candlepower lamps. A check meter was placed on one district having nine ampere-hour meters and 11 integrating wattmeters. The results were as follows:

Registered on house meters.	321.3	kw.-hours
Shunt loss on 11 meters	6.14	"
Total	337.64	"
Consumption as shown by check meter	367.3	"
Loss	29.75	" or 8.1 per cent.

About the only absolute method of preventing theft of current, and as yet only adopted in isolated instances, is to place all meters on the pole. This could be accomplished in the business districts of the city by placing a number of meters in one box on a pole and running all services from this box and, where possible, bunching the wires in one cable. This would be especially advantageous where feeding a large number of consumers in a large business block, and where the running of such a cable would not be more objectionable than the present practice of 'bussing such a building. The principal advantage of such a system would be the impossibility of stealing current from the light company. We should be getting paid for all current distributed, and our losses would certainly be materially and permanently decreased.

TABLE SHOWING ECONOMY OF THREE-WIRE OVER INDIVIDUAL TRANSFORMER SYSTEMS.

Month.	Output.	Sales.	Per Ct. of Output.	Lost and Unaccounted For.	Per Ct. of Output.	Transformer Iron Loss.	Per Ct. of Output.	Primary C^2R Loss.	Per Ct. of Output.	Secondary C^2R Loss.	Per Ct. of Output.	Meter Shunt Loss.	Per Ct. of Output.	Consumers.
1	19250	7778	40.4	4877	25.4	5940	30.9	222	1.1	138	.7	295	1.5	273
2	15970	6630	41.5	2235	14.1	6475	40.5	229	1.4	92	.6	309	1.9	277
3	20042	10506	52.5	6140	30.6	2560	12.8	373	1.8	150	.7	313	1.6	281
4	35320	21166	60	9417	26.6	2390	6.7	1153	3.3	463	1.3	721	2.1	660
5	40140	28480	71.2	6421	16.1	2441	6.1	1440	3.5	580	1.3	770	1.8	642
6	40940	29113	71.2	6435	15.7	2425	5.9	1503	3.6	605	1.5	859	2.1	771

The above is a tabulation of an alternating-current feeder for a period of six months. During that time the feeder was changed from a 1,000-volt individual-transformer system to a 2,000-volt, with a three-wire secondary network, with the exception that there are still some instances where individual transformers are used, due to the sparsely settled territory it covers.

This tabulation shows several very interesting things. During the first two months the individual transformers were done away with and replaced with a three-wire network, showing a reduction in transformer-iron losses from 6,475 kilowatt-hours to 2,560 kilowatt-hours, a decrease of a little over 60 per cent. At the same time the lost and unaccounted-for current has taken a jump of nearly 170 per cent. The output and sales increased considerably the same month, due to combining another feeder with this one, adding 387 consumers, which were changed over at the same time to a three-wire distribution. In this instance we increased our sales to nearly double the original amount and decreased our transformer-iron loss to about one-half the original amount. The primary and secondary resistance losses were increased considerably, due to the increase in the output of the feeder.

Our lost and unaccounted-for current has been systematically followed up and decreased very materially. This unknown loss is due to leakage through grounds, faulty meter registration, errors and theft. These losses have been plotted graphically, as shown in Figs. 2 and 3. Each circuit is tested for grounds, and, when found, these are traced down and removed.

The greater part of our lost and unaccounted-for

Discussion.

Douglass Burnett, Baltimore: It would appear to me that the recommendation or suggestion to the effect that a number of meters be placed on a pole is a bad one. I think it is only fair to assume that the majority of customers would object to having the meters where they cannot be seen. Another difficulty would be that if they are placed on a pole any vibration caused by the wind might entail considerable difficulty.

F. G. Prout, Memphis: I ask Mr. Humphrey how he arrives at the amount $5,025.30, as being the value of the lost and unaccounted-for current? Was that the value of the coal required to produce the current or the selling price?

Mr. Humphrey: The actual cost of current distributed—that is, all the variable costs that vary with the output, which includes the cost of coal, oil, waste, and a part of the station attendance, and also the losses on the line.

Mr. Prout: At what rate per kilowatt hour?

Mr. Humphrey: That is about 1½ cents.

Mr. Prout: As I understand it, you figure the losses in the primary service from the volt and ampere reading?

Mr. Humphrey: We figure the losses in the primary circuit by the ampere readings, using the power factor, of course, corrected for the power factor at the resistance for that circuit, measured by the drop of potential method, and take the ampere readings at intervals of 15 minutes throughout the 24 hours.

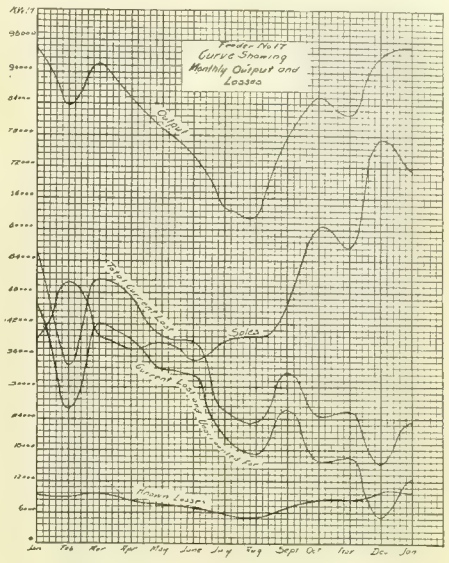


FIG. 2. LOST AND UNACCOUNTED-FOR CURRENT.

Mr. Prout: You have on the system primary wattmeters recording the entire outfit of the station?

Mr. Humphrey: Yes.

Mr. Prout: Comparing that with the current sold and the report from the customers' wattmeters, what would the loss be?

Mr. Humphrey: The difference between the sales and output?

Mr. Prout: The difference between the sales and output as recorded in the station instruments?

Mr. Humphrey: That would be the total known losses. That was 94,461 kilowatts per year.

Mr. Prout: I desire the percentage.

Mr. Humphrey: That is 10.8 of the output.

E. V. Matlack, St. Louis: I ask if there is 10.8 per cent. losses accounted for, what is the percentage of sales accounted for and percentage of stolen current or output on account unaccounted for? How much of the revenue are they not getting?

Mr. Humphrey: For the month of December the sales of output were 85.3 per cent.; current lost or unaccounted for, 5.22, and total loss unaccounted for, 16.5.

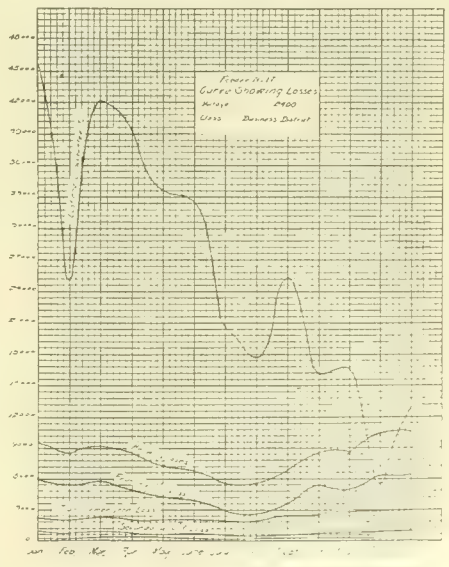


FIG. 3. LOST AND UNACCOUNTED [illegible]

Mr. Matlack: Assuming that the net earnings were about 40 per cent. of the gross earnings, if you had recovered the lost and unaccounted-for and stolen current, your net earnings would have been increased about 25 per cent.?

Mr. Humphrey: Yes, sir.

The building occupied by the United Electric Company of Birmingham, Ala., was recently damaged by fire. President M. T. Stradford of the electric company estimates the damage to stock of electrical fixtures at $2,500.

B. E. Sunny on Proposed New Charter.

As president of the Civic Federation of Chicago Mr. B. E. Sunny, western manager for the General Electric Company, delivered an interesting address before the Union League Club on April 14th upon the proposed amendment to the constitution of the state of Illinois, by which a new charter may be secured by the city of Chicago. Mr. Sunny is a strong advocate of everything which tends toward the betterment of civic conditions, and does much active work in this direction. He said in his address: "Chicago wants the present constitution amended so that it can secure, through a new charter:

B. E. SUNNY.

"First—An increase in the debt limit.

"Second—Abolition of the justice of peace and constable system, and the substitution of a District Court of Record.

"Third—Consolidation of the various municipal bodies, operating wholly within the present city limits."

"Every citizen, every taxpayer, every man who loves Chicago and has her best interests at heart, and would see her in the proud position which she should occupy among the foremost cities of the world, must vote for the amendment to the constitution, and he must see to it that his friends and neighbors throughout the state do the same."

Developments in Westinghouse Organization.

Two well-known engineers are to be added to the personnel of the Westinghouse Machine Company's organization. John B. Allan, formerly vice-president and general manager of the Allis-Chalmers Company, will shortly commence his duties as western manager of the Westinghouse Machine Company, with conveniently located headquarters in Chicago, Ill., having direct charge of the entire western district. Mr. Allan has been prominently associated with the Allis-Chalmers Company for the last 24 years and has filled positions of progressively increasing importance, including those of sales manager, general manager and vice-president. Mr. Allan was born in 1860, at Davenport, Iowa, and received a common and high school education in his native city, followed by a course at the Wooster Polytechnic Institute, from which he graduated in 1880 as a mechanical engineer. He immediately commenced practical work, entering the service of the Edward P. Allis Company, shortly after leaving college, wherein he was successively employed as a draftsman, machinist and erecting superintendent.

JOHN B. ALLAN.

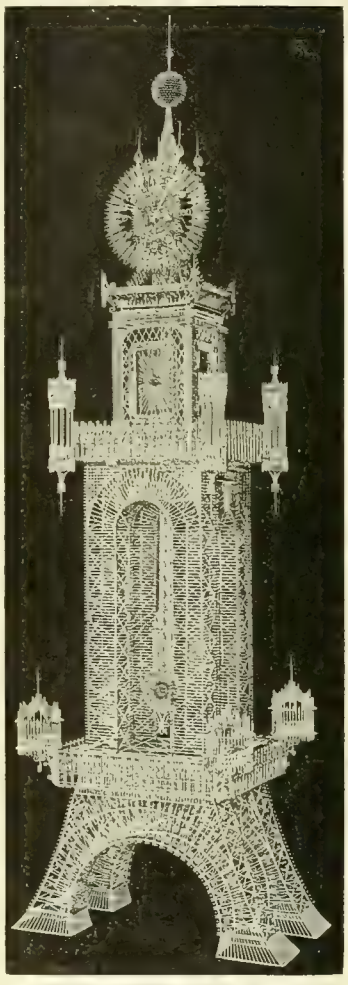
During this time Mr. Allan also had charge of making economic tests of engine and steam plants. In January, 1895, the company opened a general sales office in Chicago, of which Mr. Allan was made manager, the engineering as well as the selling departments coming under his supervision. Mr. Allan's subsequent career has been one of continuous advancement, and his wide acquaintance and popularity in the field to which he has devoted his main efforts peculiarly fit him for assuming his new duties in this same field. He is a prominent member of the American Society of Mechanical Engineers and the Engineers' Club of New York.

Arthur West, formerly engineer with the Allis-Chalmers Company, will also augment the organization of the Westinghouse Machine Company, as chief engineer. He will make his headquarters at East Pittsburg. Mr. West is eminently fitted for his new position by his experience with the Allis-Chalmers Company, with whom he has been associated for about 17 years, in various positions. For several years past he has had full charge of their entire pumping-station work. He was born at Milwaukee, Wis., in March, 1867, and received a common-school education at the Milwaukee public schools, supplementing this by a technical course at the University of Wisconsin, from which he graduated in the class of 1887. This was followed by post-graduate work at the same institution, and he then entered the employment of the Edward P. Allis Company as a machinist, and his career with that concern has likewise been one of continuous advancement. He has held important positions with that company, being finally advanced to that of assistant chief engineer. He is a member of the American Society of Mechanical Engineers and the Engineers' Club of New York. Mr. West recently started for Europe to investigate the latest practice of British and continental engine builders.

Electric Clock Made of Pins.

The accompanying illustration shows a unique clock, the unusual feature about it being that it is constructed entirely of pins, soldered together. The clock is to be seen in the exhibit of the Kester Electric Manufacturing Company of Chicago at the St. Louis Exposition.

The clock is driven by electricity, eight or 10 dry cells furnishing the necessary current. The pendulum is arranged so that its movement in one direction is obtained through the agency of a weight, the weight being lifted on the return stroke by an electromagnet brought automatically into circuit with the batteries at the proper time by the movement of the pendulum. Thus the energy of the battery is utilized to lift the weight, the potential energy of which is then ready to actuate the pendulum.



ELECTRIC CLOCK MADE OF PINS.

The clock requires no winding. There is no other material used in its construction other than pins of various sizes and Kester self-fluxing solder. This interesting novelty was designed by F. G. Dickerson of Chicago, manager of the company, the device being built to show the possibilities of the solder. Not quite a year was required for its construction, the work being done entirely by hand. The weight of the clock is 40½ pounds. The Kester exhibit, where the clock may be seen, is in the northeast corner of the Electricity Building.

The Fort Wayne (Ind.) Electric Light and Power Company is reported to have been sold to an eastern syndicate, headed by Thomas Wanamaker, for $500,000. The same syndicate, it is said, will also purchase the Fort Wayne traction lines and the bulk of the interurban connections which have recently been merged under the name of the Fort Wayne and Wabash Valley Traction Company.

Exhibits in the Palace of Electricity, St. Louis.

Last week witnessed great changes in the Palace of Electricity at the St. Louis Exposition and the installation is now nearly completed. The building is proving one of the most popular of the exhibit palaces, due in a large measure to the many working exhibits that are now in operation. The heavy machinery is nearly all in place and the few shipments that arrive daily are quickly placed on the proper space, the result being that the aisles are always clear, and, with the possible exception of a scanty air about some of the spaces, due to late shipments, the installations are very presentable. The installation plan given in the Western Electrician last week shows the apportionment of space to the exhibitors, both domestic and foreign. With the accompanying key it forms an easy means of locating any exhibit space.

One of the most attractive exhibits is that of the Automatic Electric Company of Chicago, which is nearly always surrounded by interested spectators. Occupying nearly 2,000 square feet of space, covered by a handsomely finished and equipped booth, it consists of a complete working automatic exchange of the 10,000-capacity type, with 200 stations installed. It is a model of the large automatic exchanges which have been installed in Chicago, Grand Rapids, Mich., Dayton, Ohio, and other cities of this country. It embraces all their special features, including a 10-station tollboard, the operator of which demonstrates the manner in which long-distance connections are given to automatic-telephone subscribers. Desk, wall and booth telephones are located about the exhibit and service is also given throughout the building.

A new and novel use of the telephone is made in the department offices, where each person on the staff is supplied with an automatic telephone. In addition to the ordinary business uses to which these instruments are put, practically all the letters written by the various officers are dictated through telephones to the stenographers, each of whom is supplied with an instrument with watch-case receiver and headgear. The peculiar arrangement of the offices makes this method a great convenience, as it makes it unnecessary for the stenographers to leave their desks and prevents the incident confusion. Automatic telephones are also placed about the building for the use of the Jefferson Guards, who can thus place themselves in communication with the chief of the department and with one another.

One of the most unique features of the automatic system, and one which has but lately been added, is the rotary connector. This is a sort of combination of the selector and connector switches, and is designed for use in private exchanges, or in any case where several telephones are placed on one number. This switch automatically passes over busy lines and selects one of the disengaged telephones. In the event that all are in use, instantaneous notice is given by the usual method. In this way if a private branch exchange has five trunk lines on a call the rotary connector would move so as to connect with the first trunk. If, however, this is in use, the contact would move to the second, and so on until a free line is found, when the final connection would be made. It is asserted that the addition of this switch brings the automatic system to a point where it has all the elasticity and flexibility of the manual system with the added advantages of secret and prompt service.

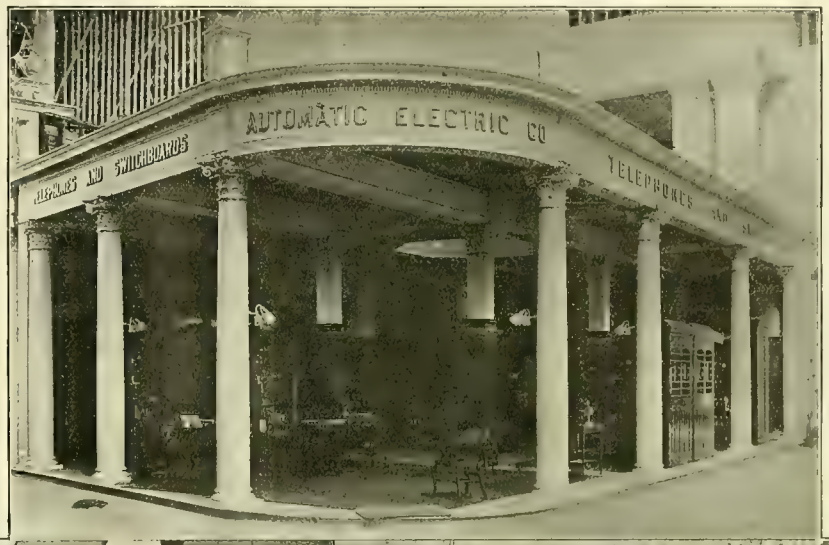
The station of the De Forest Wireless Telegraph Company is almost constantly thronged with curious people wondering how it is done. The exhibit in the space of the United States Signal Corps, in the Government Building, has been equipped with receiving apparatus and communication is maintained between it and the station in the Palace of Electricity, where incredulous ones hand in a message and then journey to the Government Building to find it waiting for them. In addition to these a wireless automobile is stationed in the Transportation Building, another in the Palace of Electricity, while the inventions of Dr. De Forest occupy a conspicuous position in the display made by the United States Patent Office in the Government Building.

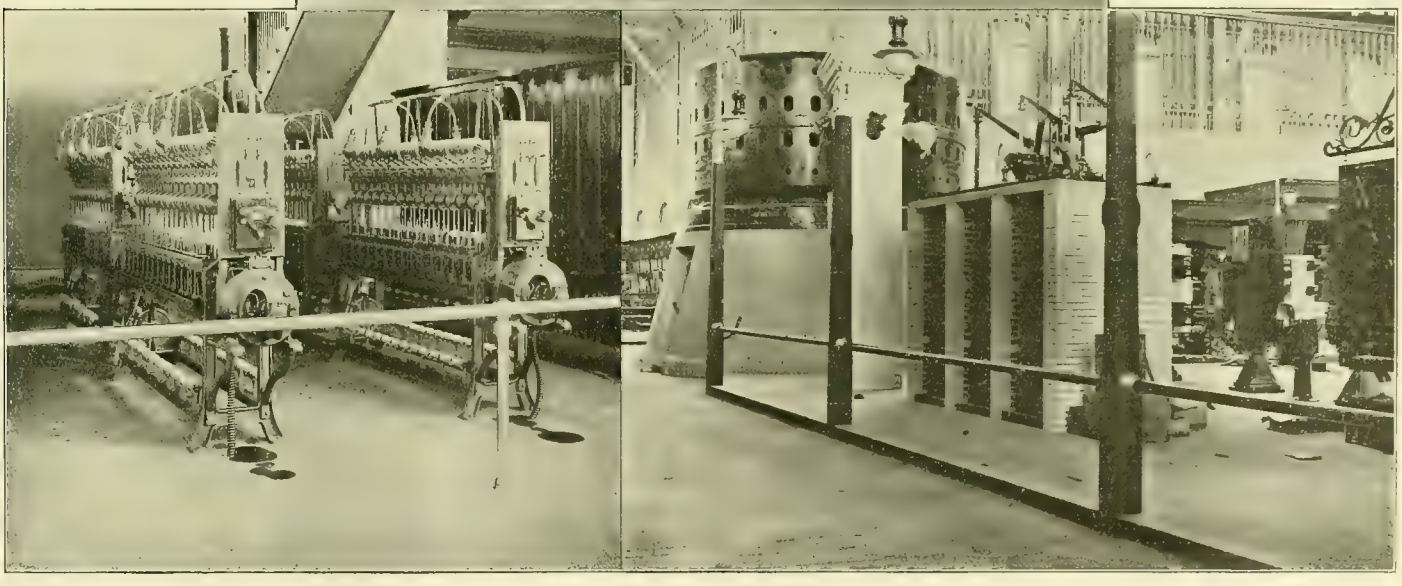
The De Forest transmitter now in use in the Palace of Electricity is of two kilowatts capacity, and the condenser consists of 18 Leyden jars of 0.003 microfarad capacity each. The spark-gap is enclosed in a mica drum or muffler and the discharge is hardly audible. The antennæ consist of three screens of wire, each containing 11 vertical wires 75 feet long and supported by the wooden towers. Two of these screens are used in transmitting and one for receiving. Electrolytic receivers are used in the De Forest system. Current is at present taken from the supply mains at 110 volts, 60 cycles, but will

later be taken from a small motor-generator set installed to demonstrate the methods obtained in naval work. A station is now being installed on the 104-foot platform of the steel observation tower near the Press Building, which will be tuned to the other stations, and from which, if the present arrangements are carried out, the bulk of the World's Fair press matter will be transmitted to the St. Louis daily papers. All told this company will have eight operating stations on the exposition grounds and one in its city office. It is interesting to note that thus far the discharges of the machines in the electro-therapeutic section have given the operators no trouble, although the induction coils and static machines have been in intermittent service since opening day.

It was expected, in view of the visit of Mr. Marconi to St. Louis last year, that he would make a comprehensive installation, but for some reason or other his extensive plans, outlined while here, have miscarried, and only a small display of his apparatus will be made. This is a great disappointment to many, as it was confidently expected that Mr. Marconi would give the exposition installation his personal supervision.

The General Electric Company has nearly completed the installation of what promises to be, from an engineering point of view, perhaps the finest display in the building. One feature is the electrical equipment for a large interurban car, mounted on a car frame, which is supported by iron pillars in such a manner that, walking under the car, one can follow the wiring and in-





Insulating Machines in Kellogg Exhibit. Automatic Telephone Booth. Portion of General Electric Display

EXHIBITS IN THE PALACE OF ELECTRICITY, ST. LOUIS.

spect the operation of the motors and accessories. The model of one of the Niagara generators is shown in the accompanying view, as is also a working oil switch for a three-phase line of 60,000 volts.

The Kellogg Switchboard and Supply Company has added an interesting item to its exhibit in the shape of two insulating machines, shown in the accompanying illustration. These double-insulate a fine copper wire, and the whirling spools and delicacy of operation prove attractive to many. The operating exchange in the same exhibit has been so railed off that a close inspection of the board can be made without interfering with the operators. With the simple explanations given by the attendant this portion of the exhibit has already become one of the "educational centers" of the building, especially to the rural visitors, many of whom have never seen a telephone switchboard in operation.

The National Clock Works of St. Louis has installed a small but attractive exhibit in the southern part of the building, which includes some artistic examples of stained glass clock dials, the works being exceedingly simple and efficient. This company is also installing a very elaborate electric clock in the center of the court.

The Electric Storage Battery Company of Philadelphia has taken a residence at 4472 Forest Park Boulevard, St. Louis, for the use of members of its staff attending the Louisiana Purchase Exposition. The company's exhibit is practically complete. It contains many interesting features, showing the recent developments in storage-battery practice.

Electrical Exports for April.

Electrical exports from the United States for the month of April last amounted to a total value of $841,716. This is an increase of $91,114 over April, 1903, when the amount was $750,602. April, however, shows a decline to the amount of $98,581 from the figure for March this year. But goods classified as electrical machinery show a good increase over April, 1903. The figures in this class for April of the present year are only $65,797 below the record month of March, 1904, when the total value of electrical machinery exported reached $596,073. Electrical appliances (including telegraph and telephone instruments) show a slight decline, comparing April, 1904, with the corresponding month last year. The figures are as follows: Electrical appliances—April, 1903, $383,288; April, 1904, $311,440. Electrical machinery—April, 1903, $367,314; April, 1904, $530,276.

Classified according to destination the following countries were the principal buyers of electrical machinery exported from the United States during April, 1904: British North America, $122,022; United Kingdom, $121,110; Hongkong, $117,561; Japan, $41,071; Mexico, $35,245; Brazil, $15,138; British East Indies, $14,099; Germany, $13,183; British Africa, $11,209; France, $5,749; Argentina, $2,287.

Japan, which suddenly sprang into first place among the importers in February and March last, heading the list in March with a total of $201,617, has again dropped to its more normal position with $41,071, representing the value of its electrical machinery imported in April this year as compared with $9,306 for April, 1903. Hongkong shows the greatest gain, with the unusual amount of $117,561 worth imported. But is is probable that most or all of this amount is engaged for re-shipment. The United Kingdom, it will be seen, has nearly reached its former position at the head of the list, being second only to British North America in the April figures.

Chicago Street-railway Situation.

Several steps have been taken toward clearing the legal side of the traction tangle in Chicago. Judges Grosscup and Jenkins have given their decision in the 99-year case, and while it is not a decisive victory for either the city or the Union Traction Company, its effect, if upheld by the Supreme Court, may be regarded as advantageous to the city. By the decision all rights acquired by the traction company prior to 1875 are still held to be protected by the act of 1865, and the company has a right to operate until 1964 all lines operated before April 26, 1875. In that year Chicago abandoned its old charter and incorporated under the Cities and Villages Act, drawn as a result of the new constitution of 1872, and which provided that thereafter all franchise rights should come from the City Council, and a 20-year limit was put on all such franchises. Consequently all rights acquired by the street-railway company since 1875 are subject to the requirements of the franchise granted by the city and are not protected by the 99-year act. Therefore, while the traction company is given the right to operate many important lines for more than 50 years longer, without their feeders and connections (probably 50 per cent. of the entire system), they are practically useless under present conditions. Fifty per cent. of the bridge entrances to the downtown district from the North and West Sides are unprotected by the act of 1865, and many of the important trunk and feeder lines are subject to short-term franchises, many of which have already expired. The local transportation committee of the City Council feels that the decision places it in a stronger position for future dealing with the traction companies.

A decision just handed down by the Supreme Court leaves the minority stockholders of the North and West Side lines free to attack the leasing of these lines to the Union Traction Company. The court's decision affirms and makes final the opinion of the United States Circuit Court of Appeals, which had reversed Judge Grosscup's decision in favor of the receivers. In reversing Judge Grosscup the Circuit Court of Appeals held that he had no jurisdiction to interfere with the litigation of the minority stockholders.

The litigation, under the ruling of the Supreme Court, is now remanded to the state courts, where the pending bills not only attack the new leases but also charge that all the proceedings in the federal court before Judge Grosscup were prearranged and collusive between the plaintiffs and defendants in the receivership cases.

J. C. Barnegger [illegible] constructing [illegible] Thomas, Okla.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.

Canadian Electrical Association (annual meeting), Hamilton, Ont., June 15th to 17th.

High-pressure transmission convention of the American Institute of Electrical Engineers, Chicago, June 21st and 22d.

Indiana Mutual Telephone Association (annual meeting), Lafayette, Ind., June 28th and 29th.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

POETIC justice appears to be meted out to the tenants of the new Railway Exchange Building in Chicago, who are loudly complaining against the smoke-and-cinder nuisance of the soft-coal-burning locomotives of the Illinois Central Railroad Company. The Railway Exchange Building has a fine location at the corner of Michigan Avenue and Jackson Street, overlooking Grant Park and Lake Michigan, but the tenants are finding the clouds of smoke and flying cinders from the locomotives on the nearby tracks very unpleasant, to say nothing of the noise of escaping steam. The joke of the affair is that many of the complainants are prominent steam-railroad men, including high officials of the Milwaukee and St. Paul, the Chicago and Alton and the Santa Fe systems. This is where the poetic justice comes in. It is said that the railroad tenants of the building are urging the Illinois Central management to use electric power for its suburban service, but perhaps they are told that a practical demonstration on their own roads would go farther than long arguments. Of course the Illinois Central will be compelled to come to electric power in time for its suburban service, but it must be confessed that it is moving with exasperating deliberation. If the suffering railroad men in the office building can expedite the improvement by their lamentations and representations, more power to them!

CAREFUL review of the Boston convention of the National Electric Light Association will deepen rather than lessen admiration for the manner in which it was conducted, its valuable results and its all-around success. The general character of the papers was excellent, and they were of such diversified nature that no one interested in the central-station business, technically or commercially, could fail to find something of direct application to his needs. Every paper was printed in advance—not so far in advance, in some cases, as they should be for the best results, but at any rate in advance of presentation—every paper but one was read in full or in abstract, and in every case was there opportunity for discussion. When it is considered that, excluding the "Wrinkles" department, the "Question Box" and the reports presented in executive session, there were 26 papers and standing-committee reports laid before the convention in five sessions, this accomplishment reflects the greatest credit on President Charles L. Edgar and his fellow officers, both for the arrangement of the programme and the manner in which it was carried out.

While all the papers dealt with live topics, and none was merely perfunctory, two stand out as having particular value. These are the report of the committee on the investigation of steam turbines, presented in abstract in this issue of the Western Electrician, and Mr. Hancock's treatise on "Underground Construction," which was awarded the gold medal offered by Mr. H. L. Doherty, past president of the association, for the best paper on the subject. The first of these is particularly valuable from the importance of the subject and from the high standing of the men preparing the report. The gold-medal paper is especially interesting from the circumstance of the award and from its thoroughness and intrinsic usefulness. It will be presented in full in this journal in three installments, the first of which appears in this issue.

A change was made in the by-laws by which two new classes of membership—individual active and individual associate—were added to the three already existing—member companies, associate member companies and honorary. This step was taken to widen the scope of the association and to broaden its influence, and is in line with the reduction of membership fees to company members in the smaller cities and towns made at the Cincinnati convention two years ago. In recognition also of the smaller companies as well as of his individual deserts, Mr. Ernest H. Davis of Williamsport, Pa., who had made an efficient secretary, was elected president. Mr. Davis is placed at the head of the association when the swelling tide of its usefulness has reached a mark never before reached, and as he is a capable and energetic man, familiar with the needs and opportunities of the society, it is not to be doubted that he will carry forward successfully the progressive policy of the three past-presidents—Doherty, Ferguson and Edgar—who have infused new life in the association and who have had so much to do with its present proud position.

Another striking feature of the Boston convention was the record-breaking attendance—nearly 1,200. The meeting drew together a larger number of men interested in electric-lighting than any other ever held in the United States and was noteworthy in that respect. The entertainment, too, was lavish, yet intelligently planned not to interfere with the business sessions, so far as the men were concerned. The Boston electrical people were truly hospitable, anticipating the needs and comforts of their guests in every way. They earned the gratitude of their visitors, who were unanimous in expressions of appreciation. It is pleasant to reflect that, on their part, the local people had the recompense of entertaining such an exceptionally large and successful convention as that at Boston proved to be.

WATERPOWER development in some parts of the West is encountering opposition on the part of advocates of irrigation for the reclamation of arid lands. A bone of contention is the proposed use of the Snake River in Idaho. In an article in Forestry and Irrigation, Mr. F. H. Newell, chief engineer of the United States Reclamation Service, says, in part:

Irrigation development at its very inception in the Snake Valley is threatened by the proposed construction of a power plant, the promoters of which claim the right to use the only supply of water available for irrigation. Already more than four times the low-water flow of Snake River is claimed for the development of power. A few promoters have been quick to take advantage of imperfect laws and have obtained power rights on the stream. These power plants are to be located at Shoshone Falls, a point where the river makes a vertical drop of more than 200 feet. The choice of a site for this enterprise is most unfortunate, as it is below practically all the irrigable lands in Snake River valley. It would require the use of all the storage facilities on the south fork of this stream and more, or about 1,000,000 acre-feet, to furnish the water claimed for this purpose alone. If the splendid storage facilities are to be used for this purpose, there would be a supply of water in the river for irrigation for only about three months of each season, or during the flood discharge of the stream. On the other hand, if these lands are to be reclaimed, there will not be any water in the river at this point for power purposes for several months during each season, as all the water will be diverted above this point.

Mr. Newell adds that the impending conflict might be easily obviated if a site for power development were selected above instead of below large bodies of irrigable land. American Falls, he thinks, offers an ideal location for the development of waterpower. It is located above nearly 400,000 acres of irrigable land, the late water supply for which, to the extent of nearly 3,000 second-feet, will have to be furnished from reservoirs.

Of course in many cases, as in California and elsewhere, the water of streams can be used both for power and for irrigation purposes, thus benefiting the farmer and the manufacturer alike. But where such a joint development is not practicable, as appears to be the case at Shoshone, some disinterested tribunal—say the United States Supreme Court—may have to decide, as a matter of public policy, whether power or irrigation shall have precedence. Waterpower men have long looked with covetous eyes on Shoshone Falls, with its splendid possibilities, but we have understood that it has remained undeveloped owing to its remoteness from a market for the power. Indeed, in his interesting lecture on "Types of Large Waterpower Installations" in Boston last week, Dr. F. A. C. Perrine alluded to this fact. Of course, if the power men have acquired riparian rights these rights must be respected, but it is to be hoped that the matter can be amicably adjusted, for who would not like to see the desert "bloom as a rose" as well as "echo the hum of industry"?

NATIONAL ELECTRIC LIGHT ASSOCIATION.

A classification made by the Boston Edison Company shows that the attendance at the twenty-seventh convention of the National Electric Light Association held in Boston on May 24th to 27th, inclusive, was 1,190, divided as follows: Representing Boston Edison Company, 92; other delegates and visitors from Boston and other places in Massachusetts, 510; from outside of Massachusetts, 558; unclassified, 30; total, 1,190. This shows the largest attendance at any electric-light convention ever held. The character of the papers presented and business transacted and the profuse but well-managed entertainment provided were in keeping with the attendance. The association and electrical Boston have both reason to congratulate themselves on this fine, record-breaking convention. Mr. Charles L. Edgar, the retiring president and the president of the Edison Electric Illuminating Company of Boston may well be proud of it, for it was largely his work, although he was very ably assisted by James I. Ayer, the chairman of the local entertainment committee, Charles L. Hodskinson, chairman of the hotel committee, and other Boston gentlemen. Former Secretary E. H. Davis and Miss Billings, assistant secretary, of the New York office, also deserve the thanks of the association for their efficient work.

A general running account of the proceedings, largely by telegraph, was given in the Western Electrician last week, together with President Edgar's address in full and four of the papers. This is supplemented in this second-report issue by a more detailed report of some of the features briefly treated in the telegraphic account, together with a portrait and brief sketch of the new president, a group pictures of delegates on the wharf of the L Street station, an abstract of the important report of the committee on steam turbines, the first instalment of Mr. Hancock's paper on underground construction (which was awarded the Doherty gold medal), a mass of convention notes and other interesting material. Abstracts of other papers and discussions will be given in future issues.

The New Officers.

Ernest H. Davis, the new president of the National Electric Light Association, is not a technical man, but he is nevertheless a central-station administrator of experience, acumen and demonstrated executive ability. He is greatly interested in the affairs of the association, which he served most acceptably for a year as secretary before his promotion at Boston. He is capable, energetic and wideawake, and with the assistance of his fellow officers, including such a secretary as Dudley Farrand should prove to be, he should prove a worthy successor even to such stars as Doherty, Ferguson and Edgar.

Mr. Davis is treasurer and general manager of the Lycoming Electric Company of Williamsport, Pa. He is a native and long a resident of Philadelphia, the date of his birth being November 13, 1859. He received his education in that city and studied law, being admitted to the bar in due course. He afterward practiced law and later was interested in the steam-railroad business for a time. In 1894 he removed to Williamsport, where, with his brother, he secured control of the company with which he is now connected. Mr. Davis is also prominent in street-railway affairs in Williamsport, and he has served as president of the Pennsylvania Street Railway Association. He is a capable and popular man of affairs.

In thanking the association for the honor conferred upon him Mr. Davis said: "So far as my personal efforts are concerned, they shall be wholly and entirely and fully devoted to the success and best interests of the association. To achieve a full measure of success in the coming year I must have, and shall certainly expect, the heartiest co-operation from all the members. I shall feel I have the right, within reason, to get from every person connected with the association such information, papers and other data to make the association a great success, and such co-operation is certainly necessary. Small companies have not the same facilities for obtaining information that will be of value to the association as the larger companies, and the smaller companies, one of which I have the pleasure of representing, appreciate, as I do, to the fullest extent, the tremendous benefits that have been derived in the association from the untiring and unselfish work of those representing the larger companies in the association, who have been in the field so long. I thank you very much, gentlemen, for this honor, and shall do my best to repay your confidence."

W. H. Blood, Jr., credited to Seattle, the new first vice-president, is connected with the Stone & Webster interests. He is electrical engineer of the General Electric Company of Minneapolis. The second vice-president, Arthur Williams, is general inspector of the New York Edison Company—a man of much ability, who has become conspicuous in the association at the last three conventions. Dudley Farrand, who has consented to accept the secretaryship, is general manager of the great Public Service Corporation of New Jersey, which has its headquarters in Newark. The new members of the executive committee, Samuel Scovil of Cleveland, A. J. DeCamp of Philadelphia and W. F. White of St. Louis, are all well known. Messrs. Scovil and DeCamp have been connected with the central-station interests of their respective cities for a number of years; but Mr. White, while an experienced electric-light man, is a comparatively recent acquisition for the Union Electric Light and Power Company of St. Louis.

Discussion on 100-mile Transmission.

An abstract of Robert Howes' paper of Tuesday afternoon, on "A 100-mile Transmission Line" was given in the Western Electrician last week. After reading the paper Mr. Howes said: "Since I wrote this paper we have received the regulator, and it was installed in time for me to know the results before I left Spokane. We succeeded in holding our voltage at Spokane practically steady. There was a variation not to exceed three-fourths of a volt above or below the normal on a 116-volt basis. At the other end of the line this cut down the variation to a trifle over one-half of what we had before. Then the controller for the motor arrived, but without a time-relay device. When that was installed we cut down the variation at the other end to one-half of what it was then, leaving us with a variation of one-fourth at the other end of the line to what it was when we wrote this paper. We now have variations of five to six per cent. on either end of the line in extreme cases.

R. S. Kelsch, Montreal: I ask how many times

ERNEST H. DAVIS, PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

it has been necessary to shut down this high-tension transmission line to make repairs or any other changes in addition to the seven times in the eight months which have been referred to?

Mr. Howes: The power has never been cut off except to cut in the sub-stations. We made the best of our time while we cut in these seven sub-stations after we started. Each time we shut down we made use of the time to renew any of the insulators found broken, caused by boys throwing stones or shooting small-caliber rifles at them. They were contemplating one more shutdown as I was leaving, and it has probably been made by this time, but we have not made any shutdown for any other purpose since that time.

P. G. Gossler, New York: I notice that you refer to having three banks of lightning arresters operated, one at the end of the line, one at Spokane, and one about 20 miles from the end of the line. Have you had any lightning storms since the line is in operation, and, if so, what has the effect been on the line? Also, what the amount of transmission has been at the time of the storms, if any?

Mr. Howes: A day or so before I left there was quite a severe storm. We never have such severe storms as in the East or in the Middle States, but we have had a number, without any effect whatever. The last storm punctured the insulation on a current transformer for operating the high-tension circuit-breakers in the sub-stations and caused a shutdown of 15 minutes. There had been just before that time a shutdown of nearly an hour, caused by a road supervisor putting several pounds of dynamite under the stump of a tree and blowing it through the wires. He twisted the wires all up, but we had the power on again in a little over an hour. These are the only two instances of trouble which we have met with in two or three months' operation.

Dr. Louis Bell, Boston: Mr. Howes' experience with that big induction motor at the end of the line is one which should be carefully borne in mind by everyone running a big transmission system. For some reason—a psychological reason, inexplicable to me—people expect of induction motors a degree of immunity from troubles produced on the line and from the other ills that motors are heir to which are quite different from anything we have been led to expect with continuous-current motors. A big motor of that kind is bound to make trouble unless the starting rheostat is laid out with an understanding of every possible trouble which may come to it. If it is laid out on general principles, as a rheostat might, could, or should, be laid out, if the motor is going to some unknown place, and the motor is put on the end of a 100-mile line, it is almost certain that there will be constant trouble from it, for the simple reason that the lower steps of the starting rheostats are not, in three cases out of four, made for the fine gradations that are necessary. Mr. Howes has found it necessary to make an emergency supply, or regulator for just that purpose, so that in every case of dealing with the induction motor at the end of a long line, particularly big induction motors—and all big ones are slow-speed motors, in which the power factor is liable to be low at times—it seems to be a matter of prime necessity to get at the question of the rheostat and look at it with some intelligence and care, as in the case of a continuous-current motor of the same rating. Under these circumstances, relatively little trouble will be encountered from these big motors. Corresponding to the conditions of regulation imposed by that unfortunate rheostat, comes the question of the power factor of the circuit, and it is worth while calling attention to that unit power factor as a point where the system becomes a bit hypersensitive. I believe one can do better by running a little under the unit power factor all the time, never giving the current a chance to cross and become leading current.

W. L. Abbott, Chicago: I think the success of the Spokane company with its line has been very good, considering the experience the Commonwealth Electric Company has had with the only overhead 9,000-volt, 25-cycle line it has, which is about nine miles long. Where that line runs in the city we had trouble at least as often as once a month, due to malicious interference. It was put out of business once by lightning and twice by boys with hay-baling wire, and in one case with a trace chain, and again by someone who needed the copper. In a recent instance, about 10 days ago, a boy who knew how to make a Fourth of July celebration, threw a trace chain over the wires of the three-phase line. Two of the wires were burned off and one of them came down, struck him on the shoulder and burned him severely. I believe he is now in the hospital.

Award of the Doherty Gold Medal.

As stated in the Western Electrician last week, the award of the H. L. Doherty gold medal for the best paper on underground construction was an interesting feature of Wednesday's proceedings. In introducing the subject President Edgar said: "As you all know, past-President Doherty, when he was president two years ago, in his presidential address, suggested that he would be glad to offer a gold medal for the best paper on 'Underground Construction.' This offer was accepted by the association, and it was intended to have the paper last year. Various delays occurred, and the matter remained open until I came into the presidency. During the winter we issued circulars announcing that the matter was open to competition, not only to our own members, but the public at large. A number of papers were presented, and I appointed on the committee on award Dr. Schuyler S. Wheeler, who is here and will make the report, Louis A. Ferguson, past-president of the association, and Henry G. Stott of the Manhattan Elevated Railway Company, New York. I take pleasure in introducing to you Dr. Schuyler S. Wheeler."

Dr. Wheeler: The committee took the greatest pains in reading the several papers presented on the subject of "Underground Construction," and while there was another paper that commended itself in many ways to us—one by Mr. Blood, which was very good, exceedingly well put together, quite remarkable in that respect—yet there was another paper which, on account of its great mastery of detail and covering the whole subject so completely, we decided should have the preference. I might say that this conclusion was reached independently by each member of the committee. The author of the paper selected is Mr. W. P. Hancock of Boston. Is Mr. Hancock present? (Mr. Hancock came to the platform.)

Mr. Hancock, I can testify that you have a very complete understanding of all the details of underground construction—a subject I am somewhat familiar with myself, having earned the first part of my livelihood in that work. I was much impressed with your paper and learned a great deal from it. It gives me great pleasure to hand you the medal.

In his speech of acceptance Mr. Hancock said: "I am surprised to know that so few persons have entered this competition, and especially so, when I call to mind the names of a number of gentlemen who could have given us interesting papers on the subject in hand. I also wish that a greater engineering interest might exist in connection with this type of construction. I think all will admit that the underground portion of a system is an extremely important one, and if that is true, it seems to me that we should lose no opportunity to improve in this direction, as well as in the lines of steam and electrical apparatus."

President Edgar: Mr. Hancock has not had anything to do with underground construction for some years. He graduated from that, and, as you know, he is now general operating superintendent of the Boston Edison Company. Before closing the subject we would like to hear a word from Mr. Doherty.

H. L. Doherty: I was prompted to offer this medal to stimulate a study of underground methods. There seemed to be a lack of harmony in the methods in the various stations doing underground work. It seemed to me that unnecessary expense was incurred and that the practice was not standardized, and I hoped to secure the contribution of a number of papers and that [illegible] formulated, based on these papers. If the thing has

been accomplished, I feel very well repaid for my efforts to secure the result. I thank you.

President Edgar: I do not think it is necessary for us to say that we already have thanked Mr. Doherty in a formal manner for offering this medal. We are not lacking appreciation of what he has done. The medal was formally accepted in a vote of thanks given him two years ago.

The Doherty medal was passed around among the delegates, who were greatly interested. It is a large medal containing $84 worth of Colorado gold and enclosed in a suitable case. On one side is the inscription "The Doherty Medal—National Electric Light Association," and a design in relief showing Knowledge instructing Youth, with various forms of electrical apparatus grouped about. On the other side is this inscription, "Awarded to W. P. Hancock for Best Paper on Underground Construction, 27th Convention, Boston, Mass., May 25, 1904." Below is the formula for Ohm's law, which is the well-known emblem of the association. Mr. Hancock has had a wide experience as an erecting and operating engineer in widely separated parts of the country. He has been with the Boston Edison Company for several years, and before that he was employed by the parent Edison company. Publication of his paper is begun elsewhere in this issue.

Gas Engines and Steam Turbines.

Gas-engine, steam-engine, steam-turbine and mechanical-stoker papers were presented on Wednesday, as set forth in the Western Electrician last week. An abstract of the report of the committee to investigate the steam turbine is presented in this issue, but, owing to lack of space, the other papers and the discussion are reserved for future consideration.

Report on the President's Address.

On Thursday morning, among other things was presented the report of the committee on president's address, signed by H. L. Doherty of Denver, G. W. Brine of Atlanta, and H. T. Hartman of Philadelphia. It was as follows:

We compliment our president on his able presentation of matters important to the association and the electrical fraternity.

History and Growth of the Business.—The reference to the enormous and rapid growth of the electrical business is timely and points a possible lesson upon the ease with which this business might be further developed by proper managerial methods, and modesty perhaps restrained our president from referring to the excellent results he is securing from his efforts in behalf of the Boston company. We call attention to this matter in order that none of the delegates will overlook the advantages to be gained by studying the methods in vogue here.

Convention Proceedings.—Your committee wishes to congratulate the association upon the excellence of the programme for this convention and the effective work done by the president in the association's behalf.

Growth of the Association.—The president has referred to the extensive growth of the association and has predicted a continued normal growth. Your committee believes that the larger the membership the more effective the influence of the association can be made, and that the association should not only be national in name, but national in character. We therefore recommend the appointment of a committee on membership, to secure the co-operation in our association work of all of the central stations in the country, if this is possible. A similar association increased its membership to the extent of 188 new members last year, and the American Institute of Electrical Engineers did even better. The funds for this work are to be provided and the work of the committee to be governed by the executive committee.

Change of By-laws.—We find that a change of by-laws, as suggested by the president's address, requires the election of a special committee. We recommend the appointment of this committee at once, with instructions to report recommendations at the evening session.

Taking Quarters in Union Engineering Building.—Referring to the suggestion of our president, we recommend that quarters be taken in the Union Engineering Building.

Central-station Directory.—We bespeak the support of all central-station men and any assistance which will provide a reliable directory of central stations.

Electrical Congress.—We recommend the acceptance of the invitation to participate in the Electrical Congress, and urge that the papers to be furnished by the members of this association be distinctly and directly related to the central-station division of the electrical business.

Printing Papers in Advance of Meeting.—We commend the plan adopted at this convention of printing the papers and distributing them in advance of the meeting, and recommend the continuance of this practice.

Relation of the Question Box and Wrinkle Department.—After careful consideration, we see no way of consolidating the Question Box and Wrinkle Department. We believe that these two branches of work are distinctive, and any change might impair the efficiency of one or both.

Advertising.—We note the remarks of the president regarding advertising, and reiterate the opinion of the committee on a former presidential address to the effect that this work should be handled by a suitable editor and a progress report made at each convention.

Municipal Ownership.—We heartily concur in the recommendation of our president regarding the appointment of a committee upon municipal ownership. This committee should be active and aggressive and should have the unqualified support of all officers and members of the association.

Thawing Out Water Pipes by Use of an Electric Current.—This practice, while not new, is not generally in vogue. It was started in Madison, Wis., some five or six years ago. We suggest the appointment of a reporter to collect data regarding the methods in vogue for doing this work, proper charge to be made and instructions for doing the work. The report to be made by September 15th, and to be printed and sent out to all members in pamphlet form not later than October 1st.

Executive Committee.—We consider the proposed plan of our president to revamp the executive committee upon more active lines as a step in the right direction. We find, however, that such meetings will cost, approximately, $500 each. We therefore have considered it advisable that but three special meetings be held each year, and that the fourth meeting be held at the time of our annual convention. Assuming that three special meetings be held each year, the expense to the association will be, approximately, $1,500 per annum. We recommend that these three meetings be held the nearest Wednesday to the middle of August, November and February in New York city, or at such place and approximate time as the president may designate.

The report of the committee was adopted, and the same committee was appointed to revise the by-laws and report in executive session.

Dr. Perrine's Lecture.

One of the thoroughly enjoyed features of the convention was the lecture of Dr. F. A. C. Perrine of Pittsfield, Mass., on "Types of Large Waterpower Installations." This was delivered on Thursday evening, before the executive session, and was illustrated by about 100 lantern-slide pictures. Dr. Perrine's familiarity with the subject and ease as a public speaker enabled him to make his lecture entertaining as well as instructive. The lecture was delivered at the personal request of President Edgar and was warmly applauded by a large audience. It will be given in a later issue of the Western Electrician.

Thursday Evening's Session.

The executive session held on Thursday evening lasted until 11:40 p. m. The reports of the executive committee, secretary and treasurer and the committee on finance were presented.

The treasurer's report showed the following:

Balance, 1903		$ 8,651 90
Receipts		11,214 00
		$19,865.97
Expenses		10,392.17
Balance, 1904		$9,473.80

William Brophy of Boston presented the report of the committee on standard rules for electrical construction and operation.

Samuel Scovil presented the report on "National Electrical Code."

James I. Ayer presented the report of the committee on relations with kindred organiations.

The committee on amendments to the constitution and by-laws reported that the membership was to be divided into five classes: Class A. Member companies; entrance fee, $25; annual dues, member companies in towns of less than 20,000 population, $10; 20,000 to 300,000, $25; over 300,000 population, $50. Class B. Members; entrance fee, $5, and annual dues, $5. Class C. Associate member companies; entrance fee, $25; annual dues, $20. Class D. Associate members; entrance fee, $5, and annual dues $5. Class E. Honorary members; no entrance fee, annual dues $4. The foregoing changes were adopted.

The executive committee recommended that three papers be presented at the International Electrical Congress, at St. Louis, on behalf of the National Electric Light Association, as follows: "American Practice in High-tension Line Construction and Operation," by Dr. F. A. C. Perrine, Pittsfield, Mass.; "American Meter Practice," by G. Ross Green, Philadelphia, Pa.; "The Protection and Control of Large High-tension Distribution Systems," by George N. Eastman, Chicago. The recommendation was adopted.

On motion a vote of thanks was passed to the New England electrical interests for the very elaborate entertainment and many courtesies received by the delegates; also to the local and long-distance telephone companies for the use of the telephone service.

A vote of thanks was passed to President Edgar for the efficient manner in which he presided over the convention, and for the very great amount of work he performed in the interest of the association during the term of his presidency.

Election of Officers.

Officers were elected as follows, on recommendation of the nominating committee:

President—E. H. Davis, Williamsport, Pa.

First vice-president—W. H. Blood, Jr., Seattle.

Second vice-president—Arthur Williams, New York.

Secretary and treasurer—Dudley Farrand, Newark, N. J.

Executive committee—Samuel Scovil, Cleveland; A. J. De Camp, Philadelphia; W. F. White, St. Louis.

The place of next meeting was left to the executive committee, with the chances in favor of Detroit, although New York, Chicago and Philadelphia are also mentioned.

Entertainment.

Boston was most hospitable in entertaining the electric-light people. The programme was not only elaborate, but it was admirably arranged and faithfully carried out. It did not interfere with the business sessions but afforded just the proper amount of play to add zest to the work. Naturally, special arrangements were made for the ladies, and the comfort of all was anticipated in a manner that put the visitors under a debt of gratitude to the electrical interests of Boston and vicinity. Space will not permit a detailed enumeration of the various drives, automobile rides, steamboat excursions, historical pilgrimages and other trips that were enjoyed. One especially pleasant feature was the concert of Wednesday evening at Symphony Hall. The high-class music was greatly enjoyed and the large and beautiful building was worth visiting in itself. Light refreshments were served with the compliments of the entertainment committee at the little tables about which the guests sat, and between the numbers there was visiting and social interchange. The electrical decorations were tasteful and so pleased the managers of the hall that many of them are to be retained permanently.

The group photograph reproduced on page 461 was taken in front of the L Street station of the Boston Edison Company on Wednesday afternoon. Less than half of the delegates and visitors attending the convention are shown in the picture. The party had taken a harbor trip on the steamboat Nastasket, shown in the picture, and the photograph was taken from a window of the station building overlooking the harbor. The coal-conveying apparatus shown at the end of the pier lends an added interest to the picture.

A dainty pamphlet, giving the programme of entertainments, was distributed at the convention. It is pleasingly illustrated with small but excellent pictures of points of interest in and around Boston and forms a very acceptable souvenir, including a sketch map by Mr. S. C. Clough.

The following from the Boston Herald of May 28th, if not literally true as to the anecdote, is certainly true in spirit: "Even up to the departure of the trains, the watchful eye of the entertainment committee was upon the delegates, and one Cleveland man who received a bag of doughnuts just as his train pulled out of the South station was overheard to say, 'Ah! this is indeed hospitality.' Four days of hustle, four days of electricity, 1,200 delegates from all over the United States and Southern Canada, and not an accident, not a word of complaint and not a single omission on the programme. That is the record that the National Electric Light Association has charged up on the books to the credit of the Boston members. And for the Boston people? Oh! they say, in return to the visitors, 'Ladies and gentlemen, the pleasure is mutual, we assure you.'"

Convention Notes.

C. J. Field, the well-known conduit man, was on hand.

President C. W. Holtzer was on hand for the Holtzer-Cabot Company.

Manager Webster Bruce was on hand for the Lynn incandescent lamp.

Martin Insull arrived on the last day, but not too late to meet many of his friends.

George Cutter of Chicago attended the convention, and, as usual, was accompanied by Mrs. Cutter.

The Alphaduct Manufacturing Company of New York was represented by President Russel Dart, Jr.

David W. Eyman, representing the Bryan-Marsh Company's Philadelphia office, appeared on Wednesday.

J. J. Lowthian, as usual, did good work for platinum, representing, of course, Baker & Co. of Newark, N. J.

Manager F. B. Parsons was daily looking after the friends of the National Wire Corporation of Boston.

Okonite was, of course, well to the front with its princes of entertainers, Captain Candee and George T. Manson.

President Charles F. Munder, accompanied by C. J. Purdy, came on from Springfield, Mass., and talked lamps.

Non-arcing fuses were talked most entertainingly by Secretary Sisson of the D. and W. Fuse Company of Providence.

The Electric Storage Battery Company of Philadelphia was, as usual, represented by Charles Blizard. Mr. Blizard was accompanied this time by F. J. Stone.

Western Manager James Wolff for the New York Insulating Wire Company and for Mr. Paiste of Philadelphia came on with the Chicago delegation on the Chicago convention train. Mr. Wolff was

joined at Boston by Secretary Jenkins of the Paiste company; neither of the two companies made any exhibit.

Messrs. Jackson, Eckert, Sias, McQuale and Honan were on hand for the National Conduit and Cable Company.

President B. S. Barnard, the popular exploiter of conduits, carried the flag for the Standard Vitrified Conduit Company.

General Sales Agent A. P. Munning came up from New York on behalf of the Cutler-Hammer Manufacturing Company.

President Gerald W. Hart of the Hart Manufacturing Company of Hartford, Conn., put in an appearance on Wednesday.

The poster entitled "Lumino," brought to the convention by Manager Whiteside of the Sawyer-Man Electric Company, proved its designer an artist.

A GROUP OF DELEGATES TO BOSTON ELECTRIC-LIGHT CONVENTION IN FRONT OF L STREET STATION.

This tasteful little poster evidently came from the hand of someone skilled in creating good impressions.

M. E. Baird, accompanied by Mr. McGuire, was daily on hand on behalf of the National Electric Company of Milwaukee.

The Phœnix Glass Company was represented by Vice-president Patterson, Secretary and Treasurer E. P. Ebberts and E. H. Peck.

President Clark of the American Circular Loom Company and T. H. Bibber appeared on Tuesday in the interests of their products.

The irresistible Francis Raymond came on from Chicago and was indefatigable in his persistent yet dignified presentation of the "G. I."

John A. Stewart, the well-known Cincinnati dealer in electrical equipment that has "seen some usage," was on hand all the time at Boston.

Electrical Engineer H. G. Issertel of the sales department of the Sprague Electric Company says that Boston was his twenty-fourth convention.

Secretary and Treasurer James Porter Gilbert of the Standard Electrical Manufacturing Company came from Niles, Ohio, to look after the interests of the Standard company. Mr. Gilbert is an old "tech" man and seized the opportunity to combine a meeting of his alumni with the national gathering of electrical men.

General Manager Schofield, as has been his custom, appeared at the convention on behalf of the Bossert Electric Construction Company of Utica, N. Y.

The Osborn Flexible Conduit Company, as usual, came to the front in the persons of Vice-president C. E. Corrigan, Calvin Roulet and Manager H. G. Osborn.

Sample cord adjusters and circulars carrying the advertisement of the Pardridge Shade and Reflector Company of Chicago were distributed throughout the Vendome.

President W. E. Phelps of the Phelps Company of Detroit, Mich., kept Hylo lamps well to the front with a most comprehensive exhibit. The Phelps Company has made wonderful strides in the introduction of Hylo lamps and specialties all over the civilized world. Mr. Phelps was accompanied by F. L. DuBroy, the company's sales manager.

Of course Philadelphia Manager T. E. Hughes was indefatigable on behalf of the Standard Underground Cable Company, as were C. J. Marsh and W. C. Waldron.

Secretary and Manager C. R. Bishop, with Henry C. Eddy, were on hand daily looking after the interests of the American District Steam Company of Lockport, N. Y.

The H. W. Johns-Manville Company exhibited quite a comprehensive line of its specialties, the merits of which were presented by Joseph Sachs and James Humphreys.

An oft-repeated compliment, but nevertheless a true one, is the remark to the effect that there could hardly be a convention without Miss Billings and Miss Douglas, the assistants to the convention's secretary.

Stephen A. Douglas made one of the hits of the convention in the interest of the H. B. Camp Company. When he reminded a prominent delegate interested in underground work that it was time to purchase Camp duct, he was generous enough to present him with a real watch. Mr. Douglas is nothing if not original, and has for years been known as a prince of entertainers and one of the "best fellows in the world."

Naturally, past-President Henry L. Doherty was in attendance. It was whispered about that Mr. Doherty is beginning to look with disdain upon old-time adherents to bachelorhood.

Of course Dr. Habirshaw appeared with Manager of Sales James B. Olson of the India Rubber and Gutta Percha Company. Dr. Habirshaw and Mr. Olson are always warmly welcomed.

J. H. Hallberg, who has just opened an office at 45 Broadway, New York, as consulting engineer, was in attendance. Mr. Hallberg's specialty is electrical distribution in the line of arc lighting.

Jesse Scribner, the popular manager of the lighting department of the General Electric Company of Chicago, took in the Boston convention, accompanied by Mrs. Scribner. Mr. Scribner has been for years a constant attendant on behalf of his company at most of the electric-light conventions, and his habit of bringing Mrs. Scribner with him in recent years has added much to his popularity.

Hale & Codman, Boston general sales agents for the Holophane Glass Company, were in attendance with a full equipment, dark room, etc., to illustrate the light-distributing qualities of Holophane.

John A. Roebling's Sons Company came to the front in full force. On hand were Albert Man, G. W. Swan, M. R. Cockey, F. W. Harrington, W. G. Tingley and Charles B. Cushing; no exhibit made.

The G. I. Company was represented by the following-named gentlemen: P. H. Klein, Jr., S. H. Blake, Francis Raymond and Almon Foster. The company made a special drive on behalf of Paragon fans and motors and also presented a complete line of the company's other specialties.

Manager Sawyer of the Buckeye Electric Company of Cleveland was in daily attendance during the Boston convention. This was Mr. Sawyer's first convention as manager of his company and he received congratulations on all sides. Mr. Sawyer has only been at the home office in Cleveland for a few months, but his

large increase in the company's sales. "Better buy Buckeye" is now heard from one end of the United States to the other.

B. G. Tremaine appeared for the Fostoria Incandescent Lamp Company. Mr. Tremaine's company made no attempt at an exhibit, but its principal spent the day mingling with delegates at the Hotel Vendome.

The Westinghouse Machine Company came to the front with two well-equipped technical men in the persons of E. E. Arnold and Francis Hodgkinson. Mr. Arnold read a paper on gas engines and Mr. Hodgkinson one on steam turbines.

President W. H. Edgar and wife of the Dearborn Drug and Chemical Works of Chicago were among the most welcome at the convention. Mr. and Mrs. Edgar were joined in Boston by W. B. McVicker, the company's second vice-president.

Of course George F. Porter was on hand and did himself proud through his systematic and successful handling of transportation arrangements. Mr. Porter looked after the interests of the Atlantic Insulated Wire and Cable Company.

General Manager J. S. Speer of the Speer Carbon Company of St. Marys, Pa., was at the Touraine during the convention. Mr. Speer has a host of friends in the electrical business and spent a day mingling with the delegates at the Hotel Vendome.

The service given by the Lake Shore railway under the direction of Passenger Agent Vosburg and Assistant City Passenger Agent Keeler won many praises, and the members of the party that left Chicago on Sunday voted the trip a perfect success.

The National Carbon Company of Cleveland was satisfied this time with a handsome personal exhibit, headed by Sales Manager N. C. Cotabish. Accompanying Mr. Cotabish were Assistant Sales Manager J. F. Kerlin, F. H. Murray, F. C. Park and A. C. Spear.

The Bryan-Marsh Company made no attempt at an exhibit, but was represented by General Western Manager George C. Keech, Eastern Manager Guy Williams, E. H. Haughton of the company's Cincinnati branch office and F. W. Godfrey, Ohio state representative.

District Sales Manager George C. Ewing of the Cooper-Hewitt Electric Company's Boston office, made a hit with the gratuitous photographs and presented many pictures of groups of delegates to show them the remarkable qualities of the mercury light in photography.

John F. Gilchrist of the Chicago Edison Company and the Federal Sign Company "threw light" on the convention in more ways than one. Mr. Gilchrist, although a young man, is now one of the most highly thought of central-station men and one of the most popular in the field.

F. S. Terry arrived on Thursday morning from Cleveland looking after the interests of the National Electric Lamp Company. Mr. Terry was warmly welcomed. His large number of acquaintances that had arrived from over the entire United States kept him busy shaking hands.

President B. C. Kenyon of the Diehl Manufacturing Company made his initial bow at an electric-light convention under the title of "president." Mr. Kenyon a few months ago received the high compliment of being elected to the presidency of his company, a well-merited appointment.

James I. Ayer of the Simplex Companies was certainly indefatigable in his courtesies and kindly attention in helping delegates in their business interests and pleasures while the convention was in session in Boston. An interesting exhibit was made in the line of electric-heating devices.

The Crouse-Hinds Electric Company of Syracuse, N. Y., this time made no exhibit, but came nobly to the front with four representatives as follows: F. M. Hawkins, A. F. Hills, S. S. Grady and Cornell Blanding. The Crouse-Hinds contingent interested many people in the guy anchor, of which the company is selling such great quantities.

E. L. Draffen, accompanied by Mrs. Draffen, joined the Chicago convention party and came to Boston over the Lake Shore, arriving Monday evening. Mr. Draffen has done most excellent work in the West for the Gould storage battery. This was Mrs. Draffen's first convention, but a host of new friends "hope that it won't be the last."

The Massachusetts Chemical Company was represented by President E. C. Green, Sales Manager Duclos and Chief Engineer Farrington. These gentlemen made a great hit by distributing a souvenir in the shape of a high-grade cuspidor mat, manufactured by the company to show the quality of the rubber used in its rubber-insulated goods.

The Nernst Lamp Company's exhibit in the circular parlor of the Vendome Hotel proved to be one of great interest to the central-station man. The attention of the visitor was first attracted by the sunlight effect given by eight Nernst lamps in the domed ceiling of the parlor, and, next, to a practical test, demonstrating the "ruggedness" of the Nernst lamp when operated on commercial circuits of fluctuating voltage. The interests of the company were cared for by M. W. Hanks, George C. Ewing, E. R. Roberts, Mr. Gibbs and Mr. Vredenburg. Mr. Roberts showed keen insight into his company's advertising needs, and the intelligent manner in which the advantages of Nernst lamps were impressed should redound greatly to the company's credit.

Rumor reached the convention that a large and well-known eastern concern now engaged in the manufacture of a line of insulators and insulating material which does not compete with mica products but which, nevertheless, is closely related thereto, is now negotiating for the purchase of the entire plant and business of the Chicago Mica Company of Valparaiso, Ind.

Pass & Seymour, Solvay, N. Y., manufacturers of P. & S. electrical specialties and porcelain of special design, were represented at the National Electric Light Association in Boston by B. E. Salisbury, secretary and general manager; John W. Brooks, sales manager; W. Brewster Hall, New York sales agent, and A. M. Little, Boston sales agent. No exhibit of any sort was attempted.

The Fort Wayne Electric Company occupied one of the most conspicuous parlors at the Vendome, exhibiting meters, fan motors and its other well-known specialties. The company, too, presented a souvenir paper weight in the form of a cable section, showing the method of insulating its transfer coils. The company was represented by General Manager F. S. Hunting, A. A. Serva, T. L. Sturgeon, J. C. Lott, J. Allan Smith, James Kent and J. Helgerman.

The popular secretary of the Northwestern Electrical Association, Thomas R. Mercein, left Chicago with the western delegates and spent the entire convention time with the people at the Vendome. Mr. Mercein was sent by the association with the special mission of representing it at the national meeting. Rumor has it that he did most excellent work in gathering in a number of new members for the western association.

General Manager W. A. Layman of the Wagner Electric Manufacturing Company appeared from St. Louis on Wednesday. Mr. Layman read an interesting paper on single-phase power motors for electric-lighting stations. As is well known, Mr. Layman is competent to speak as an authority on this subject. His work in the upbuilding of the Wagner company to its present enviable position as one of the leading manufacturers of alternating-current apparatus gave additional weight to his words.

Mr. McCarthy, as usual, was indefatigable in his efforts in behalf of the Diesel engine, as was Assistant Chief Engineer J. D. McPherson. Mr. McCarthy is one of the most experienced exploiters in the electrical field and his work for the American Diesel Engine Company has already brought remarkable results. The Diesel engines now in service in the Tyrolean Alps at the St. Louis World's Fair have excited the greatest interest among engineers interested in economy and efficiency.

The Chicago Edison delegation consisted of Louis A. Ferguson, second vice-president; W. M. Anthony, comptroller; W. L. Abbott, chief operating engineer; John F. Gilchrist, contract agent; Robert L. Elliott, assistant secretary; P. Junkersfeld, assistant mechanical engineer, and George N. Eastman, testing engineer. Mr. Ferguson, past-president of the association and member of the executive committee, was one of the busiest men at the convention; Mr. Eastman read a paper, and nearly all participated in the discussions.

Sales Manager Arthur Hartwell of the Westinghouse Electric Manufacturing Company of Pittsburg was in daily attendance and indefatigable in his successful efforts on behalf of his company. Mr. Hartwell is one of the most experienced men on the executive force of the Westinghouse company, having been in its service for many years, and was for a long time one of the most popular electric-light managers in the West when in charge of the company's Chicago office. His highly responsible position at Pittsburg gives him much greater scope for his well-known abilities.

The Stanley Electrical Manufacturing Company of Pittsfield, Mass., although making no attempt at a special exhibit, appeared at the convention in the persons of the following-named members of its staff, headed by Dr. F. A. C. Perrine, the company's first vice-president and general manager: William C. Canfield, A. W. Henshaw, Major F. B. Barnes, N. C. Ross and A. A. Morton. Mr. Morton, who is manager of the company's supply and advertising departments, had the matter of entertainment well in hand and did himself proud in looking after the many friends of the Stanley company. Dr. Perrine's interesting illustrated lecture, too, was much talked about and he was favored with many well-deserved compliments.

The Minerallac Company of Chicago had a very interesting operative exhibit of its electrical speed-limit and reverse-current protective devices applied to a rotary converter. Although many of these devices have been in satisfactory operation in the stations and sub-stations of the Chicago Edison and Commonwealth companies, this is the first time they have been exhibited as ready for the market. Besides these two protective devices several other novel specialties attracted considerable attention. A small pocket indicator and portable electroscope for indicating dangerous potential and faults, etc., on cables, a patent cable cleat, insulating compound for high-tension cable installation, and an emergency medical outfit for first aid to the injured. L. A. Ferguson, president of the company, attended the convention. W. E. Weinsheimer, manager, was in charge of the exhibit.

The Duncan Electric Manufacturing Company of Lafayette was represented by Thomas Duncan and William H. Sinks, who were kept busy showing visitors the latest type of Duncan direct-current meter. This meter embodies several new ideas that are worthy of recognition and are meeting with the approval of meter engineers. The meters exhibited also included a variety of switchboard types finished in nickel, copper and dull black. The business of the company has grown to such proportions that it is preparing to open an eastern depot in Boston. The company has a neat prepayment meter, which is about ready for the market, as well as a new induction meter, which possesses an exceptionally high torque and very light-moving element.

F. H. Taylor, vice-president of the Westinghouse Electric and Manufacturing Company, arrived from New York on Thursday and was warmly welcomed by his host of electrical friends. Mr. Taylor's executive work in the organization and management of the Westinghouse sales departments is well known. But perhaps it may not be so well known that Mr. Taylor was one of Harvard's most famous cricketers and captained the team in '77. His sons are now distinguishing themselves at the same sport and in general athletics. W. N. Taylor was captain in '93 and '94. F. C. Taylor is captain this year, and during the Decoration Day game, when Harvard defeated Cornell 223 to 56, Cornell's downfall was credited to Captain Taylor's bowling. F. H. Taylor remained over from the convention to umpire Monday's game.

The Allis-Chalmers-Bullock interests were represented by Arthur Warren, manager of the department of publicity; G. H. Berg, manager of the Boston office of the Bullock Company; H. E. Rundlett, manager of the Boston office of the Allis-Chalmers Company; J. R. Jeffrey, assistant secretary of the Bullock Electric Manufacturing Company; E. W. Goldsmith, manager of the Bullock offices in New York; E. T. Pardee and Mr. W. N. Ober, both of the Bullock Boston office. Mr. Warren made no attempt at an exhibit, but his skilful organization of advertising forces in his necessarily hurried work of covering this event showed itself in many effective poster cards and other devices that attracted much attention. The new Allis-Chalmers trade-mark, too, that has just been designed and put in service by Mr. Warren was much admired.

To say that the General Electric Company was "there" in full force would be literally putting it mildly, judging from the following list of representatives: J. R. Lovejoy, general manager of railway, lighting and supply department, Schenectady, N. Y.; C. B. Davis, manager of Boston office, Boston, Mass.; E. D. Mullen, manager of Philadelphia office, Philadelphia, Pa.; A. F. Giles, manager of Atlanta office, Atlanta, Ga.; J. B. Pevear, manager of Cincinnati office, Cincinnati, Ohio; E. H. Mullin, New York, N. Y.; A. D. Babson, New York, N. Y.; C. D. Haskins, Schenectady, N. Y.; H. W. Hillman, Schenectady, N. Y.; E. E. Gilbert, Schenectady, N. Y.; P. D. Wagoner, Schenectady, N. Y.; D. R. Bullen, Schenectady, N. Y.; F. G. Vaughen, Schenectady, N. Y.; G. T. Bridgman, Schenectady, N. Y.; W. C. Fish, Lynn, Mass.; R. Fleming, Lynn, Mass.; F. M. Laxton, Atlanta, Ga.; J. C. Calisch, Buffalo, N. Y.; W. J. Hanley, Cincinnati, Ohio; J. Scribner, Chicago, Ill.; W. T. Wooley, Denver, Colo.; H. L. Monroe, Dallas, Texas; A. D. Page, manager of lamp sales department, Harrison, N. J.; H. J. Buddy, Philadelphia, Pa.; T. E. Bibbins, San Francisco, Cal.; H. H. Crowell, Syracuse, N. Y.; F. W. Wilcox, Harrison, N. J.; J. P. Felton, Boston, Mass.; F. M. Kimball, Boston, Mass.; S. B. Paine, Boston, Mass

The Westinghouse Companies' display was of especial interest because of the number of new appliances shown for use in electric-lighting and central-station practice. These included the type A integrating wattmeter, a new type of high-grade portable testing instrument, five different types of arc lamps, several groups of fan motors, a type B oil circuit-breaker for switchboard use and a new series of precision instruments. The Sawyer-Man Electric Company of New York, under Sales Manager Whiteside, made its first public display of the Lumino lamp. The lamp is of 54 candlepower and shows a remarkably low wattage. The Westinghouse exhibit was in charge of R. L. Warner, New England manager of the Westinghouse Electric and Manufacturing Company, who was ably assisted by the Boston men. A number of the officials and representatives of the company were in attendance, including F. H. Taylor, Arthur Hartwell, W. H. Whiteside, R. L. Warner, C. B. Humphrey, W. F. Fowler, H. D. Bayne, C. W. Underwood, G. B. Dusinberre, D. E. Manson, Andrew Raeburn, C. C. Chappelle, L. L. Brinsmade, H. P. Davis, F. F. Rohrer, C. W. Regester, J. B. Comstock, Henry Watts, A. Goodby, George W. Pulver, Frank B. Erwin, O. T. Smith, C. E. Skinner, E. E. Arnold, F. E. Conrad, Francis Hodgkinson, J. H. Smith, Edwin Yawger, H. R. Stuart, R. L. Rathbone, C. S. Jennings, C. G. Wilson, S. M. Bramman, F. F. Breed, J. W. Lucas, C. L. Abbott, E. D Mills, M. H. Merill, G. M. Bates, R. S. Brown, F. S. Perry,

G. L. Osborne, G. S. Gibbs, T. W. Varley, C. P. Wahm, M. N. Davis, W. H. Baldwin and T. B. Sweeny.

The Stanley Instrument Company of Great Barington, Mass., exhibited a line of recording watt meters of its well-known magnetic-flotation type and also a number of balance-thrust, jewel-bearing-type wattmeters. Included in its exhibit a handsomely finished switchboard type of magnetic-suspension wattmeter was shown, designed for use on high-grade switchboard service and for services of any voltage and ampere capacity. Something new in a special standard test meter was shown, designed to be used for commercially checking recording wattmeters either in service or under station conditions. It embraces the well-known magnetic-flotation type of recording wattmeter, but is so arranged that it can be conveniently put in circuit. The instrument is put up in a neat, portable form, with carrying case, flexible leads, etc. The initial cost is considerably less than that of good indicating instruments and stop-watches, and in addition it maintains its initial calibration under severe conditions of use. The representatives of the company were S. O. Ochs, W. C. Andrews, F. J. Alderson, F. H. Sanford and E. W. Gough.

Steam Turbines.[1]

By W. C. L. Eglin, F. Sargent and A. C. Dunham.

In the DeLaval type of turbine the steam is expanded by means of a nozzle so as to obtain the maximum velocity which the pressure is capable of transmitting to the steam and utilizing this velocity by impinging the steam against buckets arranged on the periphery of a wheel. The steam may be subdivided and expanded through a number of nozzles arranged at various points on the periphery of the wheel. On account of the enormously high velocity of the steam, it is necessary that this wheel should revolve at a high speed, the more nearly it approaches the velocity of the steam the greater the efficiency, the economical speed of the buckets being half the velocity of the steam. These high velocities present three difficulties: First, mechanical difficulty of building a wheel to withstand stresses set up by this high velocity; second, the balancing of the wheel so as to rotate in bearings without vibration; third, arranging the machine so that the speed of the shaft can be reduced in order to adapt itself to the operation of the commercial generators.

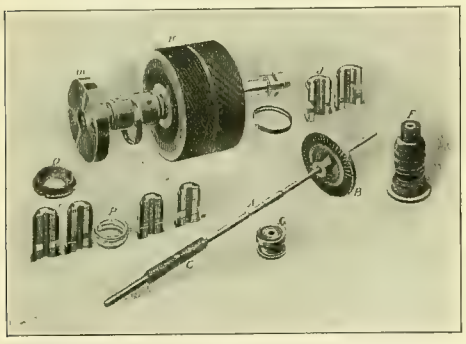


FIG. 1. STEAM TURBINES.—WORKING PARTS OF THE DE LAVAL TURBINE.

DeLaval has carefully worked out the proportion of this wheel so as to withstand the stresses, and has overcome the difficulty due to vibrations by means of a flexible steel shaft. The case of the turbine wheel is made of cast steel, and the wheel is recessed near the rim, so that in the event of the wheel exceeding the speed limit by 100 per cent. it will break in small sections and the broken parts will be kept within the case, and therefore will not damage surrounding property. Safety devices are also attached to the governor, to prevent the machine "running away." The flexibility of the shaft necessitates that it be small in diameter, thus limiting the size of this type of turbine. These turbines are being very successfully built from designs of the European DeLaval Company, with some important modifications to suit American demands. We believe the machine to be efficient and commercially successful.

Referring to Fig. 1, (B) is the turbine wheel mounted upon the slender flexible shaft (A), and in such position relative to the wheel case as to revolve entirely free, liberal space being allowed on each side, as shown. The wheel case and the wheel-case cover are so shaped as to form "safety bearings" around the hub of the wheel for the purpose of catching and checking its speed in case of an accident to the shaft.

The steam, after passing through the governor valve, enters the steam chamber, where it is distributed to the various nozzles. These, according to the size of the machine, range in number from one to 15. They are generally fitted with shutting-off valves, by which one or more nozzles can be cut out when the turbine is not loaded to its full capacity. This allows steam of boiler pressure to be almost always used, and adds to the economy on light loads.

The flexible shaft is supported in three bearings (Fig. 2). (Q) and (R) are the pinion bearings and (S) is the main-shaft bearing, which carries the greater part of the weight of the wheel. This latter bearing is self-aligning and is held to its seat by the spring and cap shown. (T) is the flexible bearing. This bearing is entirely free to oscillate with the shaft, and its only purpose is to prevent escape of steam when running non-condensing, or air from entering the wheel case when the turbine is running condensing. All the bearings of the flexible shaft, as well as the gear wheel, are lubricated from a central oil reservoir, mounted upon the gear case; all other bearings are self-oiling. The bearings are plain and simple in construction and made in two halves, so as to easily be taken out and examined. They are lined with the best quality anti-friction metal, are reamed true, round, and to exact size, and have the outside surface ground, to insure perfect fitting and alignment. The bearings, even in the largest sizes, are removed and replaced without raising the shaft from its seat.

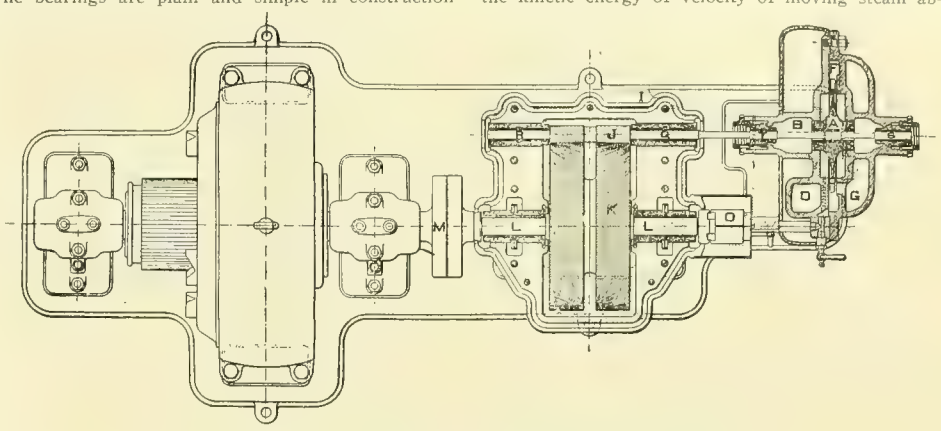


FIG. 2. STEAM TURBINES.—SECTIONAL PLAN OF THE DE LAVAL TURBINE.

The gear wheels are made of solid cast steel, or of cast iron with steel rims pressed on. The teeth, in two rows, are set at an angle of 90° to each other. This, while insuring smooth running, at the same time checks any tendency of the wheel and shaft to move lengthwise, thereby making a troublesome thrust bearing unnecessary.

The flexible shaft is mainly supported on each side of the pinion by main bearings (Q) and (R); the shaft is at the same time made very slender, which gives it a certain amount of flexibility and allows the turbine wheel, when the so-called critical speed is reached, to revolve around its true center of gravity. This critical speed, dependent upon the flexibility of the shaft, occurs well below the normal speed of the turbine and marks the disappearance of all vibrations.

The turbine wheel is by far the most important part of the DeLaval steam turbine, and is in its present form the result of numerous experiments, both as to shape and material. It is made of forged nickel-steel, and will withstand more than double the normal speed before showing any signs of distress. In the smaller sizes the turbine wheels have a hole through the center and are forced upon a taper sleeve shrunk on the shaft. The larger wheels are made solid with the shaft in two pieces screwed to the flanges of the wheels. The buckets are drop-forged and made with bulb shank fitted in slots milled in the rim of the wheel. By this method the buckets can easily be taken out and new ones inserted, should occasion require, without damage to the wheel.

With the high speed employed in the DeLaval steam turbine, a governor of small dimensions, and yet very effective, can be used. The governor is compact and simple in construction. Two weights are pivoted on knife edges, with hardened pins bearing on a spring seat. The governor body fitted in the end of a gear-wheel shaft, has seats milled for the knife edges. It is afterward reduced in diameter to pass inside of the weights, and is in its outer end threaded for the adjusting nut, by means of which the spring and eventually the speed of the turbine is adjusted. When the speed exceeds the normal, the weights, affected by the centrifugal force, spread apart and, pressing on the spring seat, push the governor pin forward, cutting off part of the flow of steam.

The vacuum valve is only necessary when running condensing, as in this case it has been found that the governor valve alone is unable to hold the speed of the turbine within the desirable narrow limit during sudden and great changes in the load.

The Westinghouse-Parsons Turbine.

All turbines operate upon the broad principle of the kinetic energy of velocity of moving steam abstracted by the vanes of a rotating bucket wheel placed in the paths of the jets. The Parsons construction, however, differs from the various other types using steam as a simple impulse waterwheel, in that it combines the action of an impulse turbine with that of a reaction turbine, thus bearing a much closer resemblance to the ordinary hydraulic reaction turbine; furthermore, the Parsons type employs the principle of multiple expansion for the reduction of steam velocities in contradistinction to a single expansion, as in the simple impulse turbine. This may be perceived from Fig. 3, which shows the general construction of a Westinghouse-Parsons steam turbine.

Three essential elements may be observed: (1) the rotor, (2) the stator, and (3) the balancing pistons.

The rotor consists of a cylinder of three or more drums of increasing diameter, upon the periphery of each of which are mounted numerous rings of radial vanes.

The stator comprises a split casing of interior proportions conforming to those of the rotating cylinder. The interior walls of the casing are studded with rows of stationary radial blades corresponding to those on the moving cylinder, but assembled with a reverse pitch.

High-pressure steam enters the turbine through the annular orifice (A), expanding to the right through the several stages to the exhaust (B). The rotating-balance pistons, designated by the letter (P), are equal in number to the number of drums, and each piston is of such diameter that the axial thrust resulting from the impact of the steam upon the blades of any drum is exactly balanced by corresponding pressure against the pistons. These pressures are at all times equalized by means of the ports and the pipes (E), so that the balancing of the rotating element is entirely independent of the absolute or relative pressures in the various stages. The adjustment bearing (J) is therefore entirely relieved of axial thrusts. Its only function is to preserve the proper mechanical clearances between moving and stationary parts.

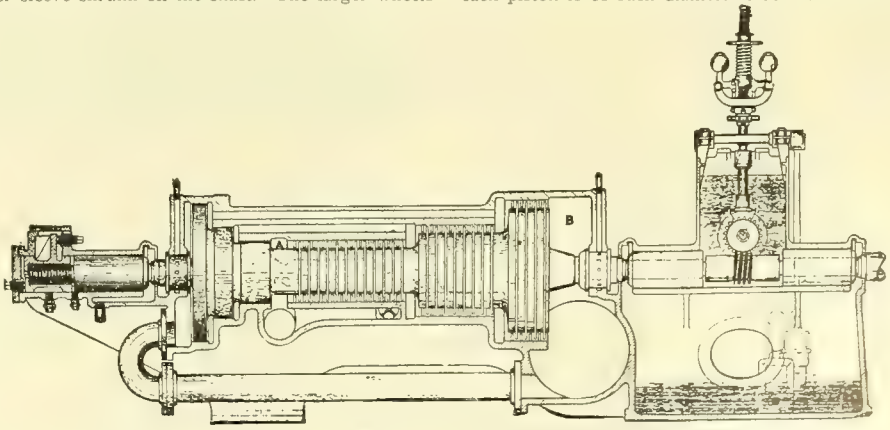


FIG. 3. STEAM TURBINES.—SECTION OF WESTINGHOUSE-PARSONS TURBINE

The balance pistons revolve within the casing with a close fit, but without mechanical friction. Leakage of steam past the pistons [illegible] in the periphery, which [illegible]

1. Abstract of a report made to the National Electric Light Association at Boston on May 25, 1904.

to the steam as to render loss from this source quite inappreciable.

In this form of turbine the area for the expansion of steam is secured by gradually increasing the annular volume between rotor and stator, which may be regarded as single annular nozzles. Starting from (A), blades of increasing length are employed in the first drum until a mechanical limit is reached, when the diameter is abruptly increased and a second progression begun with shorter blades, these again lengthening to the end of the second drum.

The form of blade used is the result of both theory and extensive experiment. They are usually made of a special bronze, cold-drawn, of tensile strength averaging 75,000 to 80,000 pounds per square inch, with 20 to 30 per cent. elongation. This material is drawn out into long strips and the blades are then sawed off to the proper lengths. They are assembled by a calking process in grooves turned in the steam surfaces of rotor and stator. This method has proved so effective that the force required to pull out the blades exceeds the elastic limit of the material. It also greatly facilitates repairs, should such ever prove necessary. In comparison with the ultimate strength of the blades, the pressure exerted upon them from the impact of steam is minute, varying from 0.055 to 0.065 of a pound in a 400-kilowatt turbine, which is obviously but a small percentage of their bending strength. The very multiplicity of blades employed in this type, therefore, results in great inherent strength of construction. Running clearances, both axial and radial, are ample to insure freedom of motion in all directions.

In the turbine approximately adiabatic expansion is realized, as no heat is taken in or given out, and the temperature of the casing remains approximately equal to that of the steam in each expansion stage.

Oil-cushioned bearings are employed on all turbines running at speeds above 1,200 revolutions per minute, in order to provide sufficient flexibility to absorb vibrations occurring while the turbine is passing its critical speed; that is, changing from its geometric to its gravity axis. This construction consists of a nest of loosely fitting metallic sleeves surrounding the shaft and resting in a self-aligning seat in the pedestal. Oil circulates between the sleeves and, by capillary action, fluid cushions are formed which restrain vibration and at the same time give the desired flexibility. The shaft is therefore built as rigidly as is necessary to prevent flexure within the prescribed limits.

Two steam-admission valves are employed—a primary or main valve, and a secondary valve. Both are of the balanced, double-beat poppet type, and removable, together with their bonnets, through openings in the steam chest. On all loads, the primary valve is in operation, but the secondary valve opens only when a predetermined degree of overload is reached. It then permits the entrance of steam to the second drum of the turbine in proportion to the overload, thus increasing the internal pressure and consequently the power. Each valve is operated by a small steam piston, controlled by a relay valve, which in turn receives reciprocating motion from an eccentric driven from the worm shown at the end of shaft, which also drives the governor. High-pressure steam is thus admitted to the turbine in short puffs with a constant frequency of about 150 strokes per minute.

The function of the governor is to vary the amplitude of this reciprocating motion as transmitted to the valve, thus in turn varying the period of steam admission to the turbine in proportion to the load. At full loads, the puffs of steam merge into nearly continuous blast, while at light loads the steam is admitted only during brief periods. The ultimate objects of this method of governing are: (1) To utilize high-pressure steam as far as possible at all loads; (2) to impress upon the governor mechanism a slight oscillatory motion sufficient to prevent the sticking of parts, due to friction, thus improving the regulation.

Precautionary measures have been adopted in order to prevent the attainment by the turbines of excessive or destructive speeds. In machines of all sizes, the pilot valve controlling the main admission valve is so designed that an abnormal oscillation in either direction from mid-position will result in permanently closing the admission valve, so that the turbine will come to rest, as in the case of a serious and prolonged short-circuit, or the breaking of the governor mechanism.

Curtis Turbine.

In the Curtis type of turbines the work is subdivided into a series of stages, each stage consisting of expanding nozzles and a series of moving and stationary buckets, the object being to maintain lower velocities of steam at the wheels and to obtain the pressures at various points in the turbine consistent with the velocity of steam desired, avoiding unnecessary friction, due to a great number of wheels or rows of buckets. This admits of the machine operating at a much lower speed. A great deal of experimental work has been done on both the shape of the nozzle and the shape of the buckets. The wheel has been built of a much larger diameter, thus increasing the velocity of the buckets without relatively increasing the speed of the shaft.

Two difficulties early presented themselves—first, the trouble with the bearings, due to vibrations and other causes; second, change in position of the material of the turbine, due to expansion, caused by variations of temperature of the steam. The change of the design undertaken by Mr. Emmet from horizontal to vertical has overcome these two serious objections. This reduces the bearings to practically one bearing, i. e., step bearing, the other bearing acting practically as a guide. This radical change in the design immediately removes the difficulty due to vibration and also, in a very large measure, the difficulties due to variation in temperature at various points in the machine. As each part of the turbine is practically cylindrical, with uniform thicknesses of material, a gradual change of temperature takes place from the point of inlet of the steam to the exhaust outlet. The expansion which takes place may increase the diameter without detrimental effect, and the only variations due to expansion which require consideration are those due to expansion of the shaft. This is relatively small and well within the limits of the clearance between the moving and fixed buckets. It might be interesting to point out that a turbine of either the Parsons or Curtis type is a very excellent example of conversion of heat into mechanical work, the high temperature as indicated by the thermometer at the point of inlet being gradually reduced until at the point of outlet the hand may be placed on the shell without being affected.

For turbines of large capacity the General Electric Company has applied these principles to the development of a turbine with a vertical shaft. The step bearing at the end of the vertical shaft supports the weight of the revolving part and maintains the revolving and stationary elements in exact relation. It consists of two cylindrical cast-iron plates bearing upon each other and with a central recess to receive the lubricating fluid, which is forced in by steam or electrically driven pumps, with a pressure sufficient to sustain the weight of the revolving part. It is apparent that the entire weight of the machine is thus carried on a film of lubricating fluid, and that there is no appreciable friction. When the flow of liquid is interrupted, the bearing is slowly worn away, but experience has shown that interruptions in the flow seldom cause any deterioration which prevents the continuance of the machine in service after the flow is re-established. The tendency of the bearing in such cases is to wear itself to a new surface, so that it operates normally. In consequence of the exact relation maintained between the revolving and stationary elements by the step bearing, it is possible to operate the turbines with very small clearances, between the moving and stationary buckets.

The Curtis turbine is governed by changing the number of nozzle sections in flow, and the efficiency of the machine is therefore about the same under

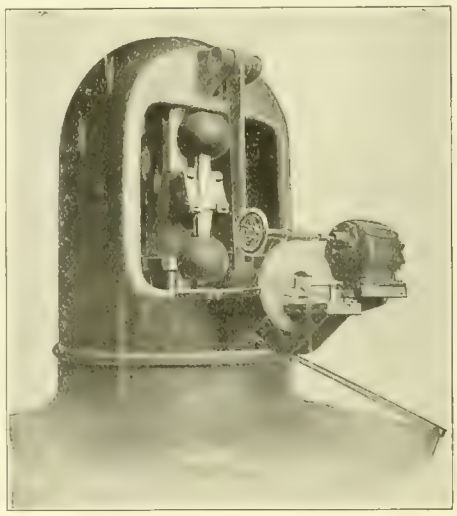


FIG 4 GOVERNOR FOR CURTIS STEAM TURBINE

one condition of load as another, except that friction, windage and generator losses tend to slightly reduce the light-load efficiency.

The speed of these turbines with variable load is controlled by the automatic opening and closing of the original admission-nozzle sections, the number of nozzle sections corresponding to the load always being kept in flow. A centrifugal governor attached to the top of the shaft (Fig. 4) imparts motion to levers, which in turn work the valve mechanism. There are a number of valves, each communicating with a single nozzle section, or, in some cases, two or more nozzle sections. These valves are connected to long pistons, by which the valve can be opened or closed by steam. The motion of each of these pistons is controlled by a small pilot valve which is worked by the governor mechanism. The movement of the governor mechanism moves the pilot valves successively, and the main valves are opened or closed by the steam. The mechanism is simple and durable in its character, and imposes a very light mechanical strain upon the centrifugal governor. By suitable adjustment, almost any degree of accuracy in speed control is obtainable.

The Manufacture of Steam Turbines.

The manufacture of steam turbines presents many problems which differ from the manufacturing of steam engines, each particular type of turbine necessitating a special shop equipment suitable for its manufacture, the class of work and the problems differing so materially. One of the matters of the first importance in the manufacture is perfect balancing of parts and uniform thickness of metal.

The various shops of the manufacturers were visited. At the Westinghouse Machine Company's works in Pittsburg very marked advances have been made in its shop equipment and improvements in the detail of construction of the turbine within the last year. All of the material entering into the manufacture of the turbine is carefully tested before being worked. The turbine has ample clearances, so that the cover and shaft may be removed with ease. A filling piece of mild steel is now used between the buckets, which are also caulked in position.

Buckets are made from hard-drawn brass, the shape being given to the rod in drawing, and the rod is cut off at the proper length for each size of turbine. After the casing has been rough machined it is heated several times with live steam, so as to eliminate any local stresses, so that no further distortion is likely to take place after the final machining. The joint between the two halves of the casing is scraped to fit, so that no packing is necessary. After the machine is assembled it is tested at full load and from 25 to 50 per cent. overload. The thrust bearing is then adjusted and the machine is ready for shipment.

All of the work put on the turbine is of a very high class, and the machine as built should give satisfactory service both as to operation and low cost of repairs.

The shops of the DeLaval company are located at Trenton. This factory is a new one, equipped with modern machinery and tools and laid out so that each part of the turbine is made separately from jigs and gauges, and returned to the storeroom and assembled from stock. A very comprehensive system of inspection has been adopted by which each piece is examined and measurements checked by standard gauges and, after approval by the inspector, is turned into stock in the storeroom. Each machine is tested at its rated load.

All of the material is ordered under specifications of the company and tested, special care being given to the quality of the material entering into the manufacture of the machine. The workmanship on both the turbine and the pumps is very high class, all of their bearings, shafting and gearing being ground to fit. This shop practice admits of very rapid filling of orders, as the majority of the parts of the machine are held in stock, the bed plates and casing castings practically limiting the time of completion of any machine.

The Curtis turbine is manufactured at the works of the General Electric Company, Schenectady, N. Y., and Lynn, Mass. Large shops have been erected exclusively for the manufacture of turbines. The shop equipment consists of a large number of special machine tools designed to cut the buckets. These buckets are made in three styles: First, buckets are cut in the periphery of a steel disk; second, the buckets are cut in sections and attached to a steel disk, and, third, the buckets are cast of bronze and attached to the steel disk. The first class is used in the small sizes; the second and third in the larger sizes of turbines. So far as the company has been able to determine, there is no difference in the life or efficiency between the cast bronze and the steel buckets. There is less machine work on the bronze buckets, but the material is more expensive, and is adopted principally because it reduces the time of manufacture. Each disk is machined all over and carefully balanced before being assembled. The nozzles are cast in the case and usually finished by chipping and filing. On account of the slower speeds of the Curtis turbine and its vertical shaft, the flexible bearing is not considered necessary.

Wearing of Buckets.—Your committee has endeavored to obtain information regarding the wearing of the buckets. It is acknowledged by the manufacturers that the buckets do wear. We have been, however, unable to find any case in which the wear of the buckets is a serious matter. It would appear that the excessive wear is due to two causes. First, defective metal, and, second, to moisture in the steam. We do not believe, however, that the wearing of the buckets will be a serious item of maintenance of cost, and the buckets can be renewed in all of the types of turbines.

Superheated Steam.—All of the manufacturers of turbines advocate the use of the highest superheat of steam, the reason being the apparent greater economy of the turbine. The objections to using highly superheated steam are the difficulties of operating superheaters for high superheat, and the additional expense involved in the cost of installing and operating the plant. It would appear from our investigations that the gain in superheat in turbines is almost parallel with that of a steam engine, and that there is a very decided advantage in using superheat even as low as 60°, and from 60° to 150° can usually be obtained without separate superheaters. This insures dry steam in the turbine and obviates the cutting of the bucket, due to moisture.

Generators.—The generators for turbines have been specially designed both by the Westinghouse Electric and Manufacturing Company and by the General Electric Company. In certain size units the economical speed of the turbine imposed conditions which were very severe and apparently at variance with an efficient generator, types of generators designed for reciprocating engines not being suitable for this purpose. The difficulties which had to be

overcome in the design of a turbine generator were, first, mechanical stresses set up by the high speed of the revolving part; second, providing suitable space for the conductors and the insulation and preventing their movement or rubbing against each other; third, the ventilation of the machine. The conditions changed so materially with the various sizes of units that a number of different designs have been tried. The generator difficulties have undoubtedly interfered materially with the more rapid development of the turbine. The problem, apparently, was simpler in the design of the alternating-current generator than in direct-current generators, as the field could be made the revolving element. The principal difficulty in the design of direct-current generators was the inherent structural weakness of the commutator when operating at high speed.

The Westinghouse Electric and Manufacturing Company has developed a revolving-field type of al-

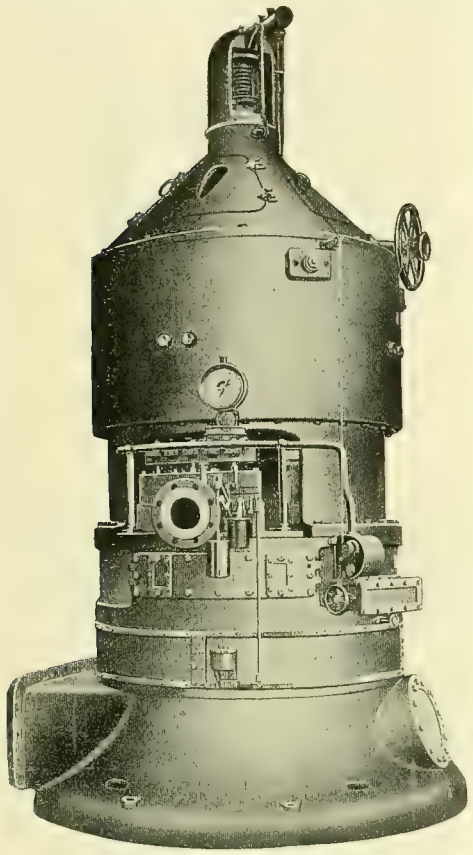


FIG. 5. CURTIS STEAM TURBINE DIRECT CONNECTED TO 500-K. W. DIRECT-CURRENT GENERATOR.

ternating-current generator of unique mechanical construction, which very satisfactorily fulfills the requirements of Parsons turbine. It has also developed a direct-current generator for the smaller sizes, the commutator used being grooved in order that a greater surface may be obtained from a minimum length of bar. One of these machines with the grooved commutator was in operation when your committee visited Pittsburg, there being no sparking of the brushes, and the commutator was in excellent condition and apparently the machine was giving very satisfactory results.

The General Electric Company has constructed a revolving-field type of alternating-current generator of good mechanical construction. The generator problem of Curtis turbines is simplified on account of the slower speeds of the turbine. In the direct-current generator (see Fig. 5) the same difficulty is present in the commutator, and it has designed a commutator with an insulated-wire binding around the center of the bars. It would appear that there is difficulty in obtaining direct-current generators except in the smaller sizes to operate on lower voltages than 220 volts, on account of the difficulty of commutation of a greater output of current, with a reduction in voltage with the small practical length of bar. For 500 volts and over, the commutator construction can be made satisfactory.

Tests.—A test was conducted on a 400-kilowatt Parsons turbine at the works of the Westinghouse Machine Company at Pittsburg. The unit consisted of a Parsons parallel-flow turbine directly connected to a two-phase, revolving-field, 60-cycle, alternating-current generator made by the Westinghouse Electric and Manufacturing Company. This was a commercial set and the machine was delayed in shipment in order to allow the test to be made. Steam was taken from a separate superheater, regularly used to supply superheated steam to the steam piping in the testing room. The set was tested under its usual running conditions and at loads varying from 25 per cent. overload, or 500 kilowatts, to 100 kilowatts and no load, viz., 500, 400, 300, 200 and 100 kilowatts. The period of each test was one hour and the load maintained as nearly uniform as practicable for that time. Readings were taken at five-minute intervals, so as to obtain the corrected load for one hour. This load was obtained by means of water rheostats, and intervals of 20 minutes were allowed between each test, so as to adjust the rheostats and other apparatus prior to the starting of the next test. The first test was made at 500 kilowatts. A surface condenser was used with independent air and circulating pumps. Excitation was obtained from a small turbine directly connected to a direct-current generator. Water from the condenser was weighed in tanks, mounted on platform scales, and a three-way valve arranged so that the water could be discharged into either tank, allowing continuous readings to be taken during the operation of the turbine; the hot well was provided with a gauge glass and calibrated so as to check any errors due to water in the system of piping and condenser.

The condenser was tested for leakage at the end of the test. The electrical instruments, thermometers and gauges were calibrated before the test was started. After these tests were completed full load was thrown off and on instantaneously, to test the governor. Its behavior was all that could be desired. The variation in speed of the turbine shaft was within two per cent. and the rise in voltage of the generator was within five per cent. The turbine was in continuous operation over 10 hours, and during that time did not require any attention from the operator, demonstrating the automatic feature of the machine.

It was the intention of the committee to make tests on two or three different sizes of turbines of the Parsons and Curtis type at the works of the manufacturers. This was found to be impracticable, on account of the fact that the only machines available were machines on order, and the shipment could not be delayed to permit of these tests. A test was made at Schenectady on a 2,000-kilowatt four-stage Curtis vertical turbine directly connected to an alternating-current revolving-field generator. This test was conducted by experts appointed by the General Electric Company, one of whom was appointed as a representative of your committee. A number of engineers was also invited to be present and witness the test. The object of the test was to determine the efficiency at various loads. Two of the tests were interrupted on account of failures of the auxiliaries. A surface condenser was used and the water from the surface condenser was weighed in a tank mounted on a platform scale, the air and water pumps being independent and driven by motors. Causes for interruptions were due in one case to failure of the air pump and in the other case to interruptions in service supply to electric motors. The load was applied by means of a water rheostat and was kept as nearly uniform as practicable during the time of the test. Five-minute readings were taken, so as to check the load. All of the instruments, gauges and thermometers were checked, previous to the test, in the company's laboratory. Various officials of the company expressed the opinion that the results were not so good as they had obtained in previous tests. The results of this test are given in the table.

SUMMARY OF TESTS ON 400-KILOWATT STEAM TURBINE.

Test No	7. ¼ Over-load	8. Full Load.	9. ¼ Load	10. ½ Load	11. ¼ Load	12. No Load.
Steam pressure at throttle, gauge	147.7	148.2	147.7	155.5	156.6	154.2
H. P. inlet pressure lbs. gauge	120.9	92.8	71.0	49.5	30.8	
Vacuum in L. P. outlet by mercury column	27.35	27.47	27.4	27.4	27.35	27.4
Vacuum referred to 30" barometer	28.14	28.16	28.4	28.04	28.00	28.05
Barometer	29.21	29.31	29.31	29.31	29.31	29.31
Temperature at superheater outlet	666.6	696.6	698.6	697.3	696.3	642.6
Superheat at superheater	300.9	330.8	333.0	328.7	327.0	274.1
Temperature at throttle	540.6	547.5	527.6	502.2	466.9	425.6
Superheat at throttle	176.1	127.0	163.1	133.9	98.1	57.9
Speed	3307.	3376.4	3547.0	3567.9	3586.8	3612
Load in K. W.	504.6	408.0	300.6	199.6	99.8	0
Load in Elec. H. P.	676.4	547.0	402.	267.6	134.0	0
Total net lbs. steam condensed	8624.0	7032.0	5538.0	4036.0	2670.0	916
Lbs. steam per Elec. H. P. hour	12.7	12.8	13.7	15.1	19.9	
Lbs. steam per K. W. hour	17.09	17.24	18.42	20.22	26.70	

The very widespread interest which has lately been aroused in steam turbines appears to be general throughout the country. Engineers in the East, in the West and in the South are showing a keen interest in this subject. It would appear that this type of engine used by the ancients and experimented with by most of the prominent engineers will soon supplant its rival, the reciprocating engine. A number of large engine builders are now devoting their attention to the construction of steam turbines, notably the Allis-Chalmers Company, which is preparing to manufacture turbines of the Parsons type.

In the operation of turbines the class of attendant materially changes. The machine being practically automatic, it requires the minimum of attendants, and necessitates a man who is constantly watchful, but does not become fretful with the easy position. The engineer usually employed on reciprocating engines frequently becomes disgusted with the operation of the steam turbine unless he has an opportunity to give some attention to the auxiliaries. It seems to be constitutional with him that he wants to use a wrench and have a number of bearings to watch and handle.

The advantages of the turbines can be summed up as follows:

Higher efficiency.
Lower first cost.
Minimum amount of labor.
Lower depreciation and maintenance.
Small amount of oil required.
Freedom from vibration.
Lower cost of buildings and foundations.
Uniform rotation, which is especially desirable for operating alternating-current generators in parallel.
The machine can be started as quickly as the reciprocating engine.
Can be governed as closely as the steam engine.
Full load can be thrown on or off instantaneously without in any way endangering the turbine.
Condensed steam is free from oil, so that the water can be returned to the boilers, this being especially valuable where bad feed water is used.
Simplicity of packing.
Small number of bearings.
All parts can be made to gauges.
Minimum amount of fittings and easy to renew the parts.
Operates equally well condensing or non-condensing.
Freedom from breakdowns, owing to water in the steam.
Relatively small size of all parts, insuring more perfect material.
High economies at light loads.
Good regulation of generator.

The depreciation of the turbine has not so far been fully determined. We feel confident, however, it will be less than that of the reciprocating engine.

Those who have had the turbine in use for some time strongly indorse its operation and efficiency, and the interruptions which they state they have had were due to mechanical defects, which were easily remedied.

The time given for erecting turbines in sizes varying from 400 to 1,500 kilowatts is from two to four weeks, depending upon the facilities for handling the heavy parts in each case during erection.

In regard to the operation of the step bearing of the Curtis turbine, there has been no objection from the users, and we have been unable to locate a case in which it has given trouble. We did not receive any unfavorable replies from the users regarding the operation of the turbine or any of its parts.

Mr. Fred. Sargent has made a very exhaustive investigation of the steam turbine and of the manufacture of the various types in Europe.

Navy May Control Space Telegraphy.

According to recent Washington advices, the Navy Department, as an initial step to the acquisition and control by the government of a space-telegraph systems in operation on the seacoast of the United States, may shortly place its coast wireless-telegraph stations at the disposal of the general public, newspapers, maritime exchanges and telegraph companies for the transmission of commercial and news messages. No charge will probably be made for the transmission of these messages, but the government will not assume any responsibility in handling them. When Congress convenes it is said the president's message will recommend government control of all stations now owned by individuals.

Twenty-three space-telegraph stations have been or are being established under the control of the Navy Department, and negotiations are in progress for obtaining sites for about as many more. Of the stations completed or practically so, 16 are on the Atlantic and Gulf Coasts, two on the Pacific Coast, two in the West Indian possessions of the United States, and three in the Pacific Ocean possessions of the United States.

The control of coast wireless-telegraph apparatus by the government, to the exclusion of private concerns, is deemed necessary to the proper defense of the coast, and unless exclusive control is given to the government there would be constant interference with the naval wireless stations by instruments of private companies. Already complaints have been received that there has been much interference, thus making the transmission of space-telegraph messages difficult and embarrassing to all concerned. Owing to a lack of trained operators, some time may elapse before the Navy Department's scheme can be carried out in its entirety, but there will probably be little delay in starting operations at most of the stations. Enlisted men of the navy will operate the instruments. Some of them, rated as electricians, are now competent to do the work, and others are being instructed.

The Marconi station on the Nantucket lightship is to be replaced by the German system now in use by the Navy Department. Naval officials say they will publish to the world the length of their sound wave, so that messages may be received from all passing vessels. The Marconi people, it is said, stated that their instruments could not record the messages sent by the German operators, and rather than put in new instruments [illegible] take out the service.

Underground Construction.[1]

By W. P. Hancock.

Part I.

The call of the secretary of the association for a paper on "Underground Construction," as per Mr. Doherty's previous request, that is to say, a paper "so complete and detailed, that any central-station man who is forced to put his wires underground can do so by the guidance of such a paper," will no doubt be heeded to a large degree, and a great many men associated with underground construction will place the methods they choose to employ on record at this meeting; but the writer wishes to suggest that a "complete and detailed paper" as called for cannot be regarded as a short story, and therefore if there seems to be too much detail in this paper, I ask you to be lenient, for I have only intended to meet the requirements of the call.

Preliminary Survey.—Assuming that the central-station man has been forced to put his lines underground, or that he is to install a new system for either alternating or direct currents, the first thing he needs is a map of the district he wishes to cover. By a map I mean a survey, such as one can generally find by applying to the city or town authorities. He will next consider what streets he can best use, after considering the load his system has or will have, the shortest distance available over which to transmit the load, his probable heavy points or centers of distribution, not for a moment losing sight of needs for future business, when considering the number of ducts which will form his conduit and the number and size of manholes he will need. If the district is located in a large city, he must, previous to deciding on any location, consult the street-service plans of the city, and also those of other corporations, and find whether it is possible, at a reasonable cost, to sink his trenches and locate his manholes, without interfering with the service of others, and he must especially keep in mind that increasing distance, with a stated number of volts, means increasing loss in kilowatts, which reflects itself on the coal pile, and, therefore, adds expense.

Actual Survey.—Having settled in his own mind what he wants in the nature of lines, the central-station man, needs next an experienced and competent engineer—one to whom he can tell his needs and rely on for sound advice, and as soon as such assistance is secured an actual survey should be promptly made on the proposed locations by the usual method of measuring and field-book notes, and if, when the notes are complete, the conditions seem to indicate a reasonably good line without an excessive cost, the engineer should get his men at work on his notes, and produce therefrom the necessary plans, from which a prospective bidder on the work can see at a glance the location of the line, the distance between manholes, the cross-section of the conduit, showing the number and size of ducts, the location, size inside, and probable depth of manholes, indicating also the thickness of walls and depth of concrete base, and whether walls are plain or shelved for cable supports, and also show the type of manhole cover.

Having completed his plans, traced them, and then secured the requisite number of blue-prints to submit to the city authorities, and also to prospective bidders, he needs a set of specifications to give out with plans to the bidders, and if his engineer has had sufficient experience in this line of work, they can be furnished forthwith, and a set could be easily included with this paper, but are not, for the reason that I do not think the association would appreciate them at this time, as it is well known that the specifications for this class of work are accessible if applied for at the office of almost any large company.

Right-of-way.—The central-station man, having provided himself with the necessary data, may now make his formal application for right-of-way on the one hand, while, on the other, he can send out his invitations to contractors for bids on his work. In the first instance I hope he is in good standing with "the powers that be," and in the second instance I hope he will send his invitations to bid to several contractors who have had experience in and are competent to construct conduit lines for electrical service, and not assume that a few laborers and a brick mason are all that is needed.

Placing Contract.—Assuming that right-of-way has been secured, and that bids have arrived in the meantime, you are now ready to place a contract for your work, and your engineer should then be called on for advice in this important matter. He should, with you, look over the bids, for while the specifications and plans submitted are alike, it does not necessarily follow that the lowest bidder should do the work. His responsibility, financial and moral, should be considered. The question of his experience and ability to carry on work of this type in crowded streets without excessive complaint from abuttors, and especially your own customers' interests, should be looked after thoroughly. Additional to this, he should give you a bond to indemnify your company for accidents which may occur on his work, another bond to guarantee his workmanship and material for a period not to exceed five years, and another one, if required, to keep the surface of the streets through which he has operated in such a condition as is required by your city officials, for a period not to exceed one year.

One more point as to the contractor and the specifications. Make the latter ironclad, if you choose; make them, if you will, so that they stand practically for the interest of your company alone; but after you do that, use discretion, for if you do a great deal of this type of work, you will find that to be reasonable and fair with a contractor who is doing your work, and who encounters difficulties in its progress that either he or you did not even imagine existed, will in the end be an advantage to you rather than otherwise; and bear in mind, that he is open to criticism from all the people who are on the streets and all of the companies or individuals who have property under them, and, of course, being a central-station man, you will at least sympathize more or less by reason of having had troubles of your own.

Material and Labor.—Whether you intend to build your lines yourself or have them built by contract, there will be material and labor used, and it should be of the best of its kind in either case, and for the reason that a first-class conduit installed is good for all time, so far as wear is concerned, and if the material has been of the best and the workmanship all that it should be, the repair and renewal charges will be low enough to please you at the end of every month in the year.

In taking up the matter of material and labor, I shall use some figures which will closely approximate the correct, but I am using them for illustrative purposes only, and I will ask you to kindly consider that they are given for that end.

Then the material you will need follows:

First, a clay duct that is suited to your conditions. If your streets are congested under the surface, use a short-length single duct; if the work is in a suburban district, use a clay duct constructed in multiple, and in either case make a careful selection and provide yourself with goods made from the right kind of clay, and by that I mean a clay that when it is in its finished state and ready for use is as nearly non-absorbent as possible. For the concrete you will need a grade which is not of excessive cost, but it should be made sufficiently strong, so that four inches of it will form a suitable foundation for your conduit, and you will with the same grade surround the two sides and the top of the conduit with a thickness of three inches. The concrete should be composed of a five-part mixture as follows: One part good quality Rosendale cement, two parts crushed stone, two parts sand; and with the conduit protected on all sides with this mixture, well set, there will be little danger of its ever being disturbed or injured in any way by other underground work which may be installed in the future in close proximity to your lines.

You need mortar to lay your ducts and to build the manholes, and Rosendale cement one part, and two parts sand, will make a strong mortar for these purposes; in fact, there are many who would make this mortar of one part cement and three parts sand, but, from actual experience, I prefer the former mixture.

You will need a good quality of spruce boards, one inch thick for the side boards on either side of the trench, in order to form the concrete to the conduit, and not waste the concrete material, and you will also need the lumber to cover the top of your conduit, after the three inches of concrete has been placed over the ducts, but this top layer of spruce should be two inches thick. Many prefer to use creosoted plank, or so-called kyanized lumber, but in my opinion the extra cost of this material over that of plain two-inch spruce plank is money wasted, for, as a matter of fact, this protection is for two purposes only; first, to protect the top concrete until it is set solid, and after that its only function is to serve as a signal to future excavators that they are sinking over some sort of construction, the location of which they have failed to note in their plans.

Your bricks for the manholes, or perhaps handholes, or both, should be a good quality of hard burned sewer brick, so called. The framework for the top of the manhole, which will support the roof and manhole frame and cover, should, in all ordinary manholes, consist of steel rails; second-hand 80-pound rails will answer the purpose, unless the traffic is of an unusually heavy nature in the district. In a manhole five by five feet inside you will need eight pieces of the above material. Manhole castings may be of the heavy sewer type, or of the double-cover type, depending on the type of lines which will operate through the manholes, and also whether transformers are to be placed therein. Additional material, in the form of tools, lanterns, barriers, flags and lumber for crossings and sheeting the trench when necessary, will be needed if you do the work with stock and labor from your own company; but I will suggest that you will have less difficulty, less bookkeeping, and have just as good lines, if you employ the right kind of a contractor.

Assuming you wish to furnish your own labor, you already have secured the services of a good engineer, who, having assisted you to lay out your lines, will in general oversee the work, providing himself with such assistants as he may consider necessary, which will be dependent on how much ground you want to open at one time, whether or not the total work is in one locality or scattered, whether the season is early and you have reasonable time ahead, previous to cold weather, to complete the work, and whether or not the locations of the lines are in streets difficult to open on account of traffic. Your engineer will give his instructions to such assistants, and these instructions will be based on the terms and conditions of the plans, specifications and contract; and he will deputize them and vest them with proper authority to represent him on their several locations and see that the work is carried on in strict accordance with the lines, grades and locations, as shown by the plans. The contractor should be officially notified by the engineer that such assistants will take charge of certain sections and that their orders are to be followed as fully as if they were given by the engineer himself. The assistants in each case should not only perform the duties as heretofore laid down but should carefully watch the progress of excavation, and in case of obstructions being encountered should use their best efforts to overcome them, and if possible keep the route as originally laid down intact; as, for instance, it may happen that service pipes of some corporation may interfere with the sinking of the trench, or the location of a manhole, and if, for instance, it be a water or gas main, and it becomes necessary to offset the original

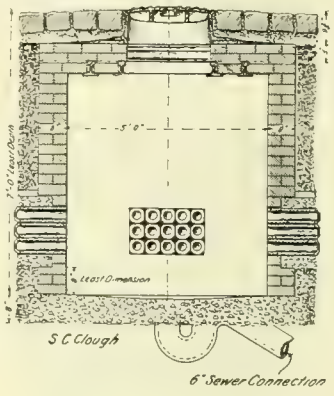


FIG. 1. UNDERGROUND CONSTRUCTION.—SECTION OF SQUARE MANHOLE.

line, the assistant must look into the feasibility of such a matter, take his measurements carefully and find out whether there is the requisite space without fouling another service, and if it is a case where the trench must sink deeper, then care should be exercised on the matter of grades, so that the section will pitch both ways to the manholes on its terminals, and thereby drain itself to the sewer connection which is in the manholes. If obstructions appear in the manhole location and are not far below the surface, then in most cases these can be avoided by setting the manhole frame on one side, or perhaps on one corner of the manhole, and if the pipes occur on both sides of the location, roof the manhole partially, on each side, and under the obstructions, and build what we term a chimney up to a point of proper height, and between the pipes, and then set the frames on the chimney.

If pipes of any kind appear in the manhole location deep enough to interfere with working on cables, or within the enclosure occupied by ducts and cables, they should be removed, for a gas or water main in an electric-service manhole in these days is a menace to life and property. I am aware, by actual observation, that they do occur in a great many manholes in the largest cities, but that fact does not warrant such practice nor lessen the danger. It should be the duty of the assistant engineer at once to take steps to rid the location of the pipe or pipes, and if, after diligence and patience have been exercised in that direction, it has been found to be impossible to have them removed, then the location of the manhole should be changed, even if the duct line is to be deviated from its original route thereby, and in case this is done and the line offset, make sure that the curve is easy and that no reverse curves appear. It will be well to remember at this point that the contractor will claim extras for relocating manholes or offset lines, but it is the business of the assistant engineer at that time to follow the specifications, for it must be remembered that the plans of the line have been laid down after having exhausted all obtainable means of information and that they were submitted in good faith to the contractor; also, that specifications have been written which contain an obstruction clause, and it is assumed that the bidder had read them before he sent his figures to the company; but, as I have said previously in this paper with reference to writing specifications, this is one of the occasions when the engineer for the company should be discreet and consult higher authority than he is vested with on the question of an extra if in his own mind such a thing is fairly due the contractor.

One more point with reference to the duties of the assistant engineer: It should be his most imperative duty to take notes as his section of work progresses in such volume and with such accuracy by actual measurement to enable him absolutely to correct the original plans as laid down, provided relocations have been made to avoid obstructions, lines offset, or if anything of that nature has occurred. It is all to the advantage of the company that this matter is carried out in that manner and the writer understands that fact from actual experience. A record also of the manholes should be accurately

[1] A paper presented to the National Electric Light Association at Boston, May 26, 1904. It was awarded the gold medal offered by Mr. H. L. Doherty, past president, for the best paper on the subject. Mr. Hancock is superintendent of generating department for the Edison Electric Illuminating Company of Boston. This valuable paper will be given in full in the Western Electrician in three instalments.

kept and the record should give the number of the manhole, the street and the street number nearest to its location, and this, with a correction once in six months in case the names of streets or street numbers change, will suffice for a record that will become invaluable in case of fire troubles or troubles on lines, and for various other purposes.

Additional to your assistants to your engineer you need a general foreman, and you cannot afford to have a man in that position that is not acquainted with this line of work. Under this man, for every 35 men you have on the trench at work, you will need a sub-foreman, provided the streets to be opened are in a city of much traffic.

Upon this general foreman you will need to place a great deal of dependence, for he is the man who can make your payroll appear heavy for the amount of work performed if he has not had experience in this line of work, and if he has had experience and has not the "steam" in his make-up, the payroll will then reflect the fault. He must instruct his sub-foreman as to what he expects to do in a day in

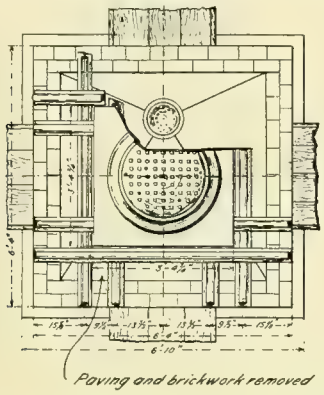


FIG 2. UNDERGROUND CONSTRUCTION.—PLAN OF SQUARE MANHOLE.

certain kinds of ground, and furthermore he must see that he gets it. He must not run behind for material, but order it in time to keep the work moving, and when his excavated material appears on the street in too great quantity he must have his teams there in time to get it away and not wait until the city officials drop in on him or your company with an ultimatum with reference to obstructing the street. He must be able to watch his work and the men who do it from the beginning of the day until its end, and be able to observe the laggards and cut them out. He must watch the weather and not let a rainstorm overtake him to the detriment of the abuttors' interests, and especially so if they are customers or prospective customers. He must observe the rule of cities that bridges over all openings necessarily crossed by foot passengers must be maintained at all times during the progress of the work, and that such bridges must have hand rails. The same applies for openings nearer the center of the street, where the crossing of heavy teams and fire apparatus is concerned. He must see that necessary barriers are in place in case he has been given permission to close an opening to a street, and see that the total openings made by his men are flagged at all times by day and lighted with lanterns from sunset to sunrise.

Base of Estimates.—Having seen what you need in the nature of material and labor, we will now look into the matter of how much you need of each and its approximate cost, and in order better to illustrate we will assume that we wish to install a conduit of 15 ducts cross-section, with four manholes five feet square inside, plain, seven feet deep under the cover. Then—

Total length of line, 1,500 feet.
Number of manholes, four.
Size of manholes, five feet by five feet by seven feet by eight-inch walls, plain.
Width of trench, 32¼ inches.
Depth of trench, 64¼ inches.
Depth of cover plank to surface, 42 inches.
Paving, figured at an average cost of all granite block paving, including four types, average, per yard, $1.44.
Cubic feet of excavation, per linear foot, $14.39.
Cubic feet concrete, per linear foot, $1.93.
Length of line less manhole space, 1,480 feet.

Figs. 1 and 2 will show a manhole diagram in plan and section, and Fig. 3 will show a cross-section of the lines.

Excavation and Backfilling.—Cost is based on the actual measurements of the cross-section drawing of the conduit for dimensions, and $0.0278 per cubic foot, and this figure is based on labor at $1.50 per day of 10 hours and excavating and backfilling two cubic yards per day per man, and therefore, as the trench in question contains 14.39 cubic feet per linear foot the cost per foot in length for this item will be $0.0266 per duct foot, or $0.3990 per conduit foot.

Lumber.—Cost of lumber, which is needed next, is based on a price of $15 per 1,000 feet one inch in thickness for a fair grade of spruce. The dimensions are taken from the cross-section drawing. Then the cost of the lumber per square foot would be $0.015, and 20 per cent. has been added for cleats and waste. We also know by experience that one man in one day of 10 hours at a cost of $2 will cut and place the lumber for 500 feet of three-duct conduit, or at a cost of $0.00061 per square foot, or $0.0004 per duct foot; and therefore, on that basis, the lumber for one linear foot of the trench in question would cost $0.1575, and labor for cutting and placing the same would cost $0.0060.

Mix and Place the Concrete.—Cost of concrete is based on actual dimensions shown on cross-section drawing, and then five per cent. is added to our estimate for wasted material, and this percentage is ample for the purpose. Now, to illustrate, we will find the material needed, the proportions of each we need, and what it costs, basing the cost of material on Rosendale cement at $1.15 per barrel, crushed stone at $0.086 per cubic foot, sand at $0.05 per cubic foot. We need, however, something to measure the material that is convenient. I have used a cement barrel on most work for that purpose, but of course if you wish you can have a standard receptacle made for that purpose. If you try the experiment on a dozen barrels you will find that each will contain very near 3.5 cubic feet of dry material, and in this section of the country the tip carts, so called, which we use for hauling sand, earth and stone, will contain 35.1 cubic feet, or about 1.3 cubic yards. Now, with these two items, we have a means of measurement which laborers can understand and use, and the means is always at hand. Then if we decided to use the barrel, we would say 0.13 of a yard or 3.51 cubic feet of dry material is what it will contain, and our concrete is to be a five-part mixture, and if the laborers were mixing they would simply turn down on the mixing ground or concrete board two barrels of sand, and over this material they would spread two barrels of crushed stone, and last spread one barrel of cement over the sand and stone, and then settle the material together dry, and then, when wet and thoroughly mixed, they would have what is called on the work a batch of concrete; but what we want to get at is the cost of a yard of concrete. As a matter of fact, we know by actual measurement with the material on the ground that the shrinkage of the material when wet is 30 per cent. In other words, if there were no shrinkage, we should need for a yard of concrete 5.4 cubic feet of cement, 10.8 cubic feet of stone, 10.8 cubic feet of sand. Now, we know that

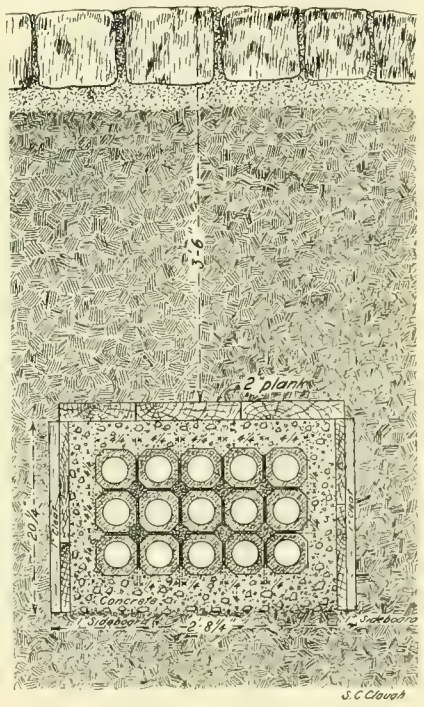


FIG. 3. UNDERGROUND CONSTRUCTION.—SECTION OF A 15-DUCT CONDUIT.

the above is only 70 per cent. of the stock needed to give us one cubic yard of finished concrete on account of the shrinkage. Therefore, we must add enough of the dry material to make up the remaining 30 per cent.

Then for the cement we shall need $\frac{5.4}{0.7} = 7.7$ cubic feet; for the sand, $\frac{10.8}{0.7} = 15.4$ cubic feet; for the stone, $\frac{10.8}{0.7} = 15.4$, or a total 38.5 cubic feet of dry material, which divided by 3.5 cubic feet, which is the contents of our measure, gives us 11 barrels, and the same result will obtain if we use yards instead of cubic feet, or use the barrel absolutely, as follows:

We know the measure has a cubic contents of 0.13 of a yard when filled with dry material, and as it shrinks 30 per cent. when wet the contents would be $0.13 \times 0.70 = 0.001$ of a cubic yard; then $\frac{1.000}{0.091} = 11$ is the number of barrels of dry stock we shall require to obtain a yard of concrete ready for use; then

$\frac{11}{5} = 2.2$ barrels Rosendale = one part cement at
$1.15 ..... $2.52
$\frac{11}{5} = 2.2 \times 2 = 4.4$ barrels = two parts stone at
0.086 cubic feet..... 1.39
$\frac{11}{5} = 2.2 \times 2 = 4.4$ barrels = two parts sand at
$0.05 cubic feet..... .77
Total five parts.....$4.62
Add five per cent. for wasted material..... .23
Total cost stock for one yard concrete....$4.85
or 18 cents per cubic foot.

As we know that our 15-duct conduit will require 1.93 cubic feet per conduit foot, then $1.93 \times 18 =$ cost of concrete per conduit foot = $0.3465 and per duct foot $0.0231. By actual test, and several of them, we know that six laborers will mix the stock for one yard of concrete in 20 minutes, and the same men will in 20 minutes more place the concrete in the trench, and with labor at $1.50 per day of 10 hours the cost would amount to 60 cents for placing one yard of concrete in the trench, or a total cost of $0.0029 per duct foot, and the labor to mix and place the concrete per conduit foot would cost $0.0435.

Mix and Place the Mortar.—Cost of mortar is based on same prices for cement and sand as in the concrete, and since .13 of a yard is the contents of a barrel, we shall need eight barrels of material for a yard of mortar.

$\frac{8}{3} = 2.66 \times 2 = 5.34$ sand = two parts at $0.05
cubic foot $0.93
$\frac{8}{3} = 2.66$ barrels cement = one part at $1.15.... 3.05
Total cost material, three parts.....$3.98

[*To be continued.*]

Joint Meeting of the British and American Mechanical Engineers.

As the Western Electrician goes to press the joint convention of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers of Great Britain is in session in Chicago, following the programme published last week. At the opening meeting, held on Tuesday evening, May 31st, in the Fine Arts Building, there were nearly 600 delegates present, the members of the British society numbering about 100. Many of the wives and daughters of the visiting delegates were also present. The president of the British society is J. Hartley Wicksteed of Leeds and the secretary is Edgar Worthington of London. Other prominent English members at the opening meeting were Prof. D. A. Low of the Batterson Polytechnic Institute, London; George A. Ryder, Bolton; William G. Kirklady, James Dronsfield, Oldham; George Chaffey, who first reclaimed lands in Australia by the irrigating process; James Barningham of Manchester and Walter Jones, Holly Mount, Stourbridge. Sidney Smith and William Blane of Johannesburg, S. A., were also present.

City Controller McGann delivered an address of welcome on behalf of the city.

President Ambrose Swasey of Cleveland responded on behalf of the American society, and President J. Hartley Wicksteed of Leeds, on behalf of the British society. Mr. Wicksteed said it was his first visit to America, and he had found much to interest him. "Chicago seems to me to be the place of all others where an engineer should go," said Mr. Wicksteed. "Chicago is only the age of most of us who have gray hairs. It comes within the limits of the average span of life. Nature did not make Chicago 14 feet higher than the lake. The city was raised by the energy of the citizens."

Following the meeting the delegates were given a reception in the parlors of the Auditorium Hotel.

The foreign engineers are making a tour of the United States and Canada and after the Chicago convention will proceed to St. Louis and from there to Cincinnati and Montreal. A condensed report of the convention will be given in the Western Electrician next week.

Preparations are being made by the Oconee Electric Light and Power Company of Milledgeville, Ga., for beginning work on the proposed development of the waterpower on Oconee River. The company will erect a dam 32 feet high and 900 feet crest, construct a canal [illegible] a power house and install machinery to accommodate eight units of 1,000 kilowatts each and transmit power to Milledgeville and to Macon, 33 miles distant. A double pole line will be constructed between the two cities, and it is estimated that about 10,000 horsepower will be obtained [illegible] from $500,000 to $[illegible] company's consulting engineer.

Ohio Telephone Notes.

An ordinance has been passed at Cleveland making an appropriation of $2,000 for expenses in placing a portion of the fire-alarm telegraph system underground. It is planned to do some of this work each year, until all the wires in the business district are underground.

The steamers of the Detroit and Cleveland Navigation Company have been equipped with telephone instruments, and wires have been arranged at the Cleveland docks, so that they can be connected up with the city exchanges when they come in. Both local and long-distance service may thus be had.

The new long-distance switchboard that has been arranged by the Cleveland Telephone Company occupies about two-thirds of the fifth floor of the building, and in all 60 operators will be employed. The board, when completed, will cost about $40,000, but the management feels fully justified in making the expenditure, in view of the amount of business that is transacted over the wires daily.

A meeting of the Independent telephone men of Ohio was held in Columbus, Thursday of this week, to discuss various matters of common interest. For some time there has been a plan to consolidate the Independent Telephone Traffic Association and the Ohio Telephone Exchange Association. The plan to secure long-distance service over the country by means of a traffic arrangement among the large companies was also to be one of the matters under consideration.

April statements of the United States Telephone and other subsidiary companies of the Federal Telephone Company show a satisfactory increase. The surplus of the United States company will be about $7,000, and the total surplus for all will be a little more than twice that amount.

The Pleasant City Telephone Company of Pleasant City has been incorporated with a capital stock of $10,000 by C. L. Stranahan, J. H. B. Danford and others. A line from Pleasant City to Ada will be built.

The Gilbert Telephone Company, incorporated last week, will build a system of lines through Muskingum County, with a central exchange at Gilbert.

C.

Telephone News From The Northwest.

The Twin City Telephone Company is seeking a franchise for a long-distance line through Willmar, Minn., en route to Grand Forks and Fargo, N. D.

The Great Northern Railroad Company is extending telephone lines at various points between stations on its lines.

The North Star Telephone Company of Mountain Lake, Minn., has been granted a franchise at Butterfield, Minn., for a local exchange.

The Farmers' Co-operative Telephone Company of Traverse, Minn., has been incorporated with $12,000 capital.

W. L. Van Camp, manager of the Northwestern Telephone Company at Austin, Minn., was married last week to Miss Kathryn D. Mayer.

The Young America-Norwood Telephone Company has been granted a franchise for a toll line to Glencoe, Minn., and will build at once.

The construction work on the new Independent telephone line at Sioux City, Iowa, has been commenced.

The Farmers' Connective Telephone Company has been incorporated at Bonaparte, Iowa, with a capital of $10,000. J. W. Batchelor is president and D. R. Hornbaker secretary.

R.

Indiana Telephone Items.

The Greenfield Telephone Company suffered severe loss by fire on May 26th. Two cables, containing 100 wires each, were melted by the intense heat. A valuable fuse board was also destroyed. The company will now install modern apparatus.

A new telephone exchange is being installed at Harmony, which will be connected with the Citizens' exchange at Brazil.

J. F. Slinkard has resigned as manager of the Green County Telephone Company and Earl Talbott of Linton has been selected to succeed him.

The bitter war between the city of Portland and the Central Union Telephone Company, which has been waged for some time, culminated in a clash during the last week. The council passed a resolution ordering the arrest of any employe of the company found at work on the streets. The contention is that the company has no franchise. The company claims that a franchise was granted it in 1882. Two workmen were put to work and were promptly arrested.

F.

Southeastern Telephone Developments.

The Central Mississippi is the name of a new telephone company, backed by Kentucky capital, that is to build a line from Grenada to Meridian, Miss.

The commissioners of the District of Columbia have declined a petition to furnish telephone service for the offices of justices of the peace, on the grounds that the offices are not under the control of the commissioners.

The Southern Bell Telephone Company is connecting the system at Mocksville, N. C., with the long-distance copper wires.

The Rural Telephone Company of Hopkins, Miss., has been chartered, with $500 capital stock. W. N. Bailey and others are the stockholders.

Both the Mutual and Cumberland telephone exchanges were destroyed by the recent fire at Yazoo City, Miss. The loss is about $2,500 to each company.

L.

Michigan Telephone Matters.

The Benzie County Telephone Company has decided to put in an automatic switchboard, which will do away with the girl operators.

Warren W. Hill of Schoolcraft has invented a new metallic pole and post anchor for use on telephone and telegraph poles which prevents them from falling, even if decayed at the butt.

The Valley Telephone Company, with headquarters at Saginaw, proposes to start a telephone exchange at Caro, Mich., and, not being able to secure many subscribers, it proposes to install an exchange, placing free telephones in offices and residences, thus compelling the business men to put in their telephones. The W. J. Moore telephone system is pretty well established in Caro, and is entirely rebuilding its system and has solicitors out trying to increase the list of rural subscribers.

W.

Independents May Enter Cincinnati.

Judge Nippert of the Hamilton County (Ohio) Probate Court has rendered a decision giving the Queen City Telephone Company the right to operate in Cincinnati and defining the manner in which the lines shall be constructed and the streets and alleys used.

In the business and thickly populated districts the court has decided that all lines must be placed in conduits, with poles only for house connection and distribution of wires and cables. In the remainder of the territory pole lines may be used, but the right of abutting property owners must be observed. Plans must be filed with the Board of Public Service and such changes may be required in them as will better preserve the streets and property already in the streets, without unreasonably inconveniencing the company. The company is required to file a surety company bond of $100,000 as a guaranty that the streets and alleys will be left in as good condition as found. One duct in the conduits and one cross-arm on the poles shall be reserved for police and fire-alarm service wires. The franchise thus granted must be accepted within 20 days.

City Solicitor Hunt says that the case will at once be taken to the Supreme Court. The Bell Telephone Company contends that the power to fix the use of the streets has been used once, and is, therefore, exhausted; that the Probate Court has, in fact, no authority to again grant the use to any other company. This is one of the questions that the Supreme Court will be asked to consider.

Judge Nippert stated that he would not decide the cases of the other three Independent companies until the Supreme Court had decided upon this one.

J. G. Splane on Independent Long-distance Movement.

According to an interview credited to President J. G. Splane of the Pittsburg and Allegheny Telephone Company, considerable progress is being made by the several Independent telephone companies mentioned last week which plan to establish a comprehensive long-distance service. Mr. Splane is quoted as saying that the companies that are working together to perfect the system are to be supplemented by another Illinois concern. "A representative from each of these corporations comprises a committee which will formulate plans of operation. These have not been completed. The local business will be handled by each local company as it is at present. The long-distance system will be controlled by one comprehensive company. The tendency will be toward cheapening the long-distance rates, and toward improving the service. The companies referred to are figuring on a great deal of building, and much of the extension is under way."

United States Telephone Statistics.

More than 5,000,000,000 telephone messages were exchanged in the United States in 1902, according to a preliminary report on telephones issued by the Census Bureau last week. The report covers all commercial and mutual companies. There is a total of 4,151 systems, with 4,850,486 miles of wire and 2,315,297 telephones. The subscribers number 2,137,256. The total revenues of all the companies is $86,825,536; total expenses, $61,152,853; dividends paid, $14,982,719. There are 14,124 officials and clerks, who receive salaries amounting to $9,885,886, while $26,369,735 is paid as wages to 64,628 workmen. The total assets of the companies are placed at $452,172,546, and the net surplus at $52,364,858.

The United States Circuit Court of Appeals, on May 28th, denied the petition for a rehearing in the case of the Western Telephone Manufacturing Company versus the American Electric Telephone Company, for infringement of the self-restoring drop patent, owned by the former. An order for an injunction and an accounting was entered, and this is said to close the case.

GENERAL TELEPHONE NEWS.

The Farmers' Mutual Telephone Company of Concordia, Kan., has been chartered for $10,000 to build rural lines out of Concordia.

The Pacific States Telephone and Telegraph Company has completed surveys for the construction of a rural telephone line in West Salem, Ore.

The Assumption (Ill.) Mutual Telephone Company has been incorporated. Allen Peabody, Seth Benepe and J. A. Lambdin are interested. The capital is $5,000.

The residents of Reed Creek and Paskenta, near Red Bluff, Cal., are considering the matter of constructing a telephone line from Reed Creek to the foothill towns.

The Sunset Telephone Company of Santa Rosa, Cal., has leased a portion of the Trembley Building and will install a sub-station which will cost between $18,000 and $20,000.

A charter has been granted the Independence Telephone Company of Wilson County, Tenn. The capital stock is $1,000. W. C. Arrington, J. P. Belsher and others are the incorporators.

Articles of incorporation of the Grangeville and Salmon River Telephone Company have been filed with the secretary of state at Boise, Idaho. The amount of capital stock is $12,000.

The Dexter (Tex.) and Gainesville Telephone Company has been chartered and proposes to construct exchanges in the towns named. J. F. Morris of Gainesville and B. H. Humphreys of Sandusky, Texas, are interested in the company.

Two companies which will operate telephone systems in Eastern Montana and Billings, Mont., were organized recently in the latter city. They are the Billings Mutual Telephone Company, with a capital stock of $40,000, and the Montana Telephone Company, with a capitalization of $10,000.

A combination on Independent telephone companies is reported as being formed for the purpose of fighting competition throughout the West. The report comes from Seattle, Wash., where the Independent Telephone Company is preparing an extensive war without waiting for the combination to be perfected.

The New England Telephone and Telegraph Company will open an exchange in Rockport, Mass., shortly, contracts for service sufficient to warrant the establishment of one in that town which has been under the Gloucester exchange neretofore, having been obtained.

The Rocky Mountain Bell Telephone Company will shortly commence the construction of its line between Emmett and Roosevelt, Thunder Mountain, Idaho, a distance of 160 miles. On account of the rugged and mountainous nature of the country, the cost of the line is estimated at $100,000.

The North Adams telephone exchange of the New England Telephone and Telegraph Company is one of the old-fashioned type, destined very soon to be superseded by an entirely new outfit. The lamp system of the common-battery type is to be installed and the changes planned involve an expense of about $30,000.

Stockholders of the Stromberg-Carlson Telephone Manufacturing Company have adopted a proposition to increase the common stock from $1,500,000 to $3,000,000. There is also outstanding $1,500,000 of preferred stock. A special dividend of 10 per cent. has been declared on the common stock, to be paid in cash or in new stock.

F. Lubberger of Chicago has recently opened an evening class for instruction in automatic telephony. The course will last approximately three months, and lectures will be given Tuesday and Thursday evenings and Saturday afternoon at Silver's Business College on Wabash Avenue. Mr. Lubberger may be addressed in care of the Automatic Electric Company, Chicago.

The Kinloch Telephone Company of St. Louis is about to erect a modern fireproof building at the corner of Tenth and Locust Streets. Several floors will be occupied by the company and the remainder of the building, which will probably be 12 stories high, will be rented. It is understood that a part of the space will be occupied by the proposed Independent long-distance telephone service, which comprises various Independent systems.

The Bell Telephone Company has begun estimates for a long-distance telephone line between Kansas City and Joplin, Mo., to connect with a new line that is being built from St. Louis to Joplin and thence through the Indian Territory into Central Texas. Over $1,000,000 has been appropriated for these extensions, it is said, which, with the Bell connections east of St. Louis, will make one of the longest telephone lines in the world.

The Supreme Court of Montana has reversed the District Court in the suit of the Rocky Mountain Bell Telephone Company against the city of Red Lodge. The latter refused to permit the telephone company to string wires or set poles when petitioned by the company to designate a route for a pole line, but offered to designate a conduit route. The District Court held for the city, but the Supreme Court holds that the demand that the wires be placed underground is unconstitutional.

Electric Locomotives for the New York Central.

The new electric locomotives which are being built for the New York Central and Hudson River Railroad Company at Schenectady by the General Electric Company and the American Locomotive Company differ radically in their electrical features from any electric locomotive hitherto constructed.

The motors are bipolar gearless, the magnetic circuit, the field windings and the motor poles being integral with the locomotive frame and spring supported. The pole faces, which are laminated, are vertically tangential to the armature, thus providing for vertical movement of the locomotive frame with attached poles without affecting the armature air gap. The armature is assembled on a quill which is pressed solidly on the axle. The dual weight of the assembled rotating part, including the armature, axle and wheels, is less than on many steam locomotives, and there being no uncompensated reciprocating parts there is a perfect rotative balance.

This design was submitted in accordance with specifications prepared by the electric-traction commission appointed by the railroad company, the members of which are Messrs. William J. Wilgus, fifth vice-president of the New York Central and Hudson River railroad; John F. Deems, general superintendent of motive power of the railroad company; Bion J. Arnold, of Chicago; Frank J. Sprague, of New York, and George Gibbs, of New York. The secretary to this commission is Edwin B. Katté, electrical engineer of the railroad company.

This commission after careful deliberation, had prescribed the conditions which must be fulfilled by electric locomotives taking the place of steam locomotives as far as Croton on the Hudson River line and as far as North White Plains on the Harlem River division, a distance of 34 miles and 24 miles respectively.

The conditions prescribed by the commission, briefly stated, were that the successful bidder should furnish an electric locomotive capable of making two regular successive trips of one hour each between the Grand Central Station and Croton with a total train weight of 550 tons, a single stop in each direction and a lay-over not to exceed 20 minutes. In addition to this it was provided that a similar schedule should be maintained with somewhat lighter trains making more frequent stops. Finally, it was provided that with a total train weight of 435 tons, the electric locomotive should be able to run from the Grand Central Station to Croton without stop in 44 minutes, and, with one hour lay-over, be able to keep up this service continuously. This last schedule is the equivalent of the present timing of the Empire State Express, though the latter has a somewhat lighter train.

Specifications embodying these conditions were prepared by the commission and sent to all the principal electrical manufacturing companies both in the United States and abroad. It will be observed that no restriction was placed on bidders as to whether direct or alternating current was to be used. The successful bidders were the General Electric Company in conjunction with the American Locomotive Company. The choice of a direct-current type of locomotive was dictated largely by its known reliability of service, owing to the amount of experience which had been accumulated with the direct-current motor.

The new electric locomotive will be 37 feet in length over all. The wheel base will consist of four pairs of motor wheels and two pairs of pony truck wheels, the length of the total wheel base being 27 feet, and of the rigid wheel base, consisting of the four pairs of motor wheels, 13 feet. The diameter of the driving wheels will be 44 inches and of the truck wheels 36 inches. The driving axles will be 8½ inches in diameter. What is known as a double-ender type will be employed and the locomotive will weigh approximately 190,000 pounds. The frame will be of cast steel, the side and end frames being bolted together at machined surfaces and stiffened by cast-steel cross transoms. The journal boxes and axles will be designed to permit sufficient lateral play to enable the locomotive easily to pass around curves of 230-foot radius.

The superstructure of the locomotive is to be of steeple form, so designed as to offer the least practicable wind resistance consistent with the adequate housing of the apparatus and its convenient operation. The cab is designed so as to afford a clear view of the track. The whole of the superstructure is to be of sheet steel with angle-iron framing, and the doors and windows of the cab are to be fireproof.

Motive power will be furnished by four 600-volt direct-current gearless motors, each of 550 horsepower. This will make the normal rating of the locomotive 2,200 horsepower, with a maximum rating of about 2,800 horsepower, or about 50 per cent. greater than that of the largest steam passenger locomtives now in service.

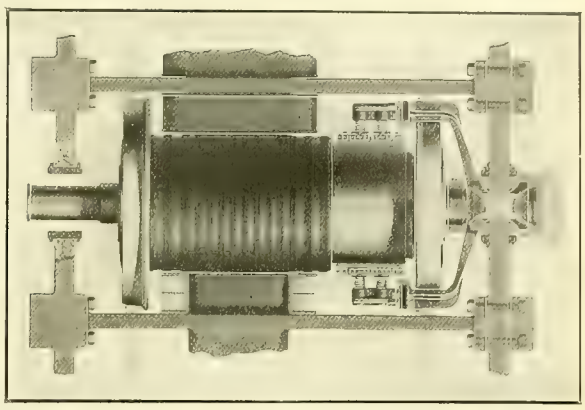
The armatures will be mounted directly on the axles and will be centered between the poles by the journal boxes, sliding within finished ways in the side frames. The armature core will be of the iron-clad type, the laminations being assembled on a quill which will be pressed on the axle. The winding will be of the series drum-barrel type. The conductors will be designed so as to avoid eddy currents and will be soldered directly into the commutator segments.

Commutator segments will be made of the best hard-drawn copper. They will be supported on a quill and will have the ears integral with themselves. The brush-holders will be made of cast bronze and mounted on insulated supports attached to the spring saddle over the journal, maintaining a fixed position of the brush-holder in relation to the commutator.

Unlike the ordinary four-pole motor, where the magnetic circuit is made through a separate box casting, the magnetic circuits in this type of electric locomotive are completed through the side and end frames. The pole pieces are cast in the end frames and there are also double pole pieces between the armatures carried by bars which act as part of the magnetic circuit.

The pole pieces will be shaped so that the armature is free to move between them with ample clearance on the sides. As the poles move up and down with the riding of the frame on the springs, they will always clear the armature, and provision is made so that the armature will not strike the pole pieces even if the springs are broken. The field coils will be wound on metal spools bolted to the pole pieces and will consist of flat copper ribbon.

The Sprague-General Electric multiple unit control will be used on this type of electric locomotive. There will be two master controllers in the cab, so placed that the operating engineer looking ahead will always have one of these under his hand. The control system will permit two or three locomotives to be coupled together in any order in which they happen to come and to be operated as one unit by the engineer in the leading cab. The control system will also be semi-automatic in its action, as it will provide a check on the rate of acceleration of the train, which the engineer cannot exceed, while he may accelerate at any slower rate if he so desires. Should two locomotives break apart the control current will be automatically and instantly cut off from the second locomotive without affecting the ability of the engineer in charge to control the front locomotive under his charge. The control system is designed for a minimum of 300 volts and a maximum of 750 volts.

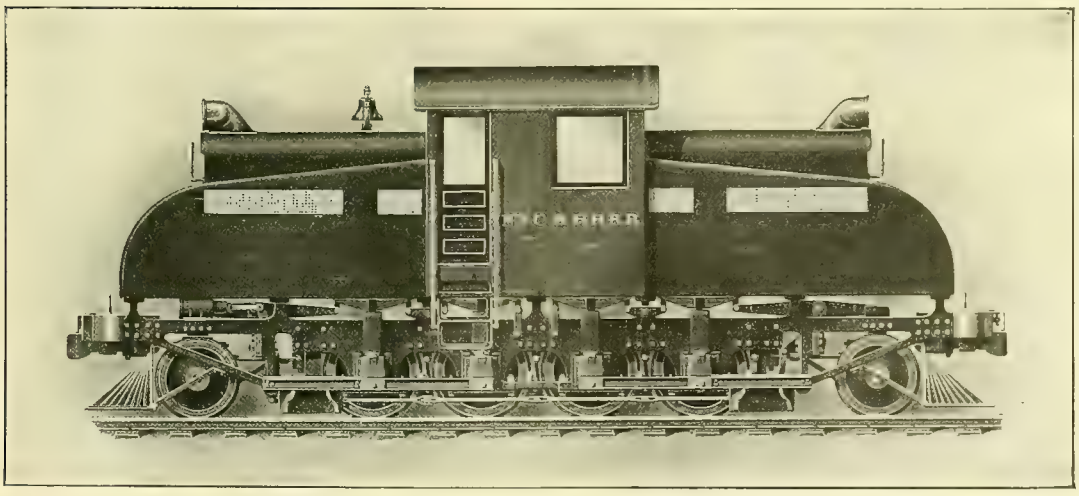


ELECTRIC LOCOMOTIVE FOR NEW YORK CENTRAL.—PLAN OF ARMATURE.

That part of the weight which will rest upon each of the driving wheels will be about 17,000 pounds. Proper distribution and division of the weight among axles will be accomplished by swinging the main frames from a system of elliptical springs and equalizing levers of forged steel, the whole being so arranged as to cross-equalize the load and furnish three points of support.

All the usual accessories of a steam locomotive will be provided, including an electric air compressor to furnish air for the brakes. It will have whistles, a bell and an electropneumatic sanding device and electric headlights at each end. The interior of the cab will also be heated by electric coils.

In actual performance this locomotive is expected to give better results than any engine hitherto placed upon rails. With a light train the locomotive is expected to give speeds up to 75 miles an hour and with heavier trains similar speeds can be attained by coupling two locomotives together and working them as a single unit. Its tractive force will be greater than that of any passenger locomotive now in existence, and it is believed that in the simplicity and accessibility of its parts and in the provision made in its design to insure continuous operation with the minimum chances of failure it marks an entirely new and successful type of electric locomotive. The accomplishment is of great interest not only to electrical men but to railroad managers in all parts of the country.



ELECTRIC LOCOMOTIVE FOR THE NEW YORK CENTRAL.—SIDE ELEVATION.

The Paxtang Company Exalteth Itself.

A Harrisburg (Pa.) paper recently printed the following interesting advertisement: "Paxtang Electric Company paid the city $10,000 for its franchise; put by $5,000 as a guarantee that it would build and operate its plant; spent $100,000 installing a conduit system; gave the city 200 lights free, saving the city $75,000 on its lighting for five years; saved the county $2,000 on one year's lighting; cut the price of lighting to our business men from 15 cents per 1,000 watts to less than half that price, saving them at least $50,000 per annum. These are facts, not "rumor foundry" vaporings. If you can think of any public utility other than the Paxtang Electric Company with a record like this, trot the critter out; we would like to gaze on it."

An ordinance has been passed by the supervisors of Santa Rosa, Cal., granting Louis Breitenbach a franchise to construct and operate a telephone system in Sonoma County. Work on the installation of the system will commence shortly.

Ohio Interurban Railway Association.

At the last meeting of the Ohio Interurban Railway Association, held in Chicago on May 26th, negotiations were perfected through which, it is believed, most of the electric roads of the state will adopt the coupon books which have been under discussion for some time. In reality no contracts were signed up at that meeting; however, an agreement was presented which provides that each road shall take as many of the books as it will probably sell and give a bond to the others, guaranteeing settlement in full for coupons from its books for redemption. The arrangement will probably include some 40 roads when they are all in.

A number of important subjects were discussed at the meeting, among them the question of advertising in the daily newspapers. Some of the managers contended that the papers had taken advantage of their courteous treatment and were using free transportation to advance their own interests in any way they desired. However, there was a strong sentiment toward giving the newspapers whatever they desire on the grounds that they are doing much toward molding public opinion in favor of electric roads.

The question of how to take care of extra employes from a transportation standpoint was discussed from almost every point of view. The opinion of an able attorney was cited, showing that a road employing men must furnish some means for taking them back and forth to their work, in which case there is still the same liability as would exist in having them travel on paid transportation.

Benefit associations among employes and social relations between employes and employers was a subject that elicited considerable attention, as it directly concerns the managers and superintendents. Mr. Bicknell of the Lake Shore stated that the maintenance of kindly relations between the men and the management is a great advantage to both the company and the men, and Mr. Clegg described the "Get Together Club" that is being formed among the office force and heads of departments of the Dayton and Troy. They will have a place to take lunch together and there will discuss all manner of subjects.

The discussion of "The Most Economical Arrangement for Keeping Cars Clean" brought out the fact that several of the roads were employing women for cleaning the interior of the cars. Mr. Rounds of the Canton-Akron and Mr. Harrigan of the Columbus, Buckeye Lake and Newark both had found women the best car cleaners they can secure. The Western Ohio road uses compressed air for cleaning and dusting cars to good effect. The motors and equipment may also be blown out and all the copper and carbon dust removed. This eliminates much trouble in the operation. Some other roads use air on a less extensive scale and have found it a success.

The plan advocated by F. J. J. Sloat for estimating charges for allowing cars of one company to pass over another's lines was discussed. It was finally decided that the system was so complex that it would be better to make a flat charge of 20 cents per mile, but the transportation committee will investigate further and if this figure is found wrong, will suggest another. It is said that the actual cost is from 12 to 14 cents per mile.

The next meeting will be held in Springfield some time in October, when officers will be elected. The executive committee will continue to meet monthly.

Jewell Direct-current Instruments.

The Jewell Electrical Instrument Company of Chicago announces that it has perfected an entirely new type of direct-current instrument. The new instrument differs from the old one, inasmuch as it has no core and there is only one air gap in the magnetic

JEWELL D. C. PORTABLE CURRENT PORTABLE VOLTMETER

circuit instead of two as in the old type. This produces a much more dense magnetic field so that the movement is very dead-beat. The ammeters work on the same shunt as the old instrument. The voltmeters have a resistance of about 100 ohms per volt of scale but can be furnished up to 2,000 ohms per volt of scale if necessary. The scale is somewhat longer and more open, making it more easily read. The accompanying cut shows the type of portable voltmeters that the company is now prepared to furnish. In addition the Jewell people have a complete line of ammeters, ohmmeters and millivoltmeters of the portable and station type.

Street-railway Properties Absorbed by Steam Road in New England.

Boston, May 28.—Disposition of the Worcester and Southbridge, the Worcester, Rochdale and Charlton depot and the Southbridge and Sturbridge street-railway properties in Massachusetts has been made, the New York, New Haven and Hartford Steam Railroad corporation being the purchaser. Coming upon the heels of the information regarding various consolidations and other absorptions by the big steam railroad company, it adds much of interest to the conjectures regarding its plans. Further speculation has been aroused by the statement that the Park Square railroad station in Boston, which has remained idle since the terminal station of the New York, New Haven and Hartford and New York Central railroads was built and occupied, had been purchased from the Boston and Providence Railroad Company, whose railroad property heretofore has been leased to the New York, New Haven and Hartford. The various properties in Park Square and vicinity taken over by the steam railroad company have an assessed value of upward of $5,000,000.

This raises anew the interesting question as to the future of the Boston and Worcester Street Railway Company, owned by the Shaw syndicate of Massachusetts. This line is one of the most modern in the country, equipped with fine passenger coaches and running over private land in many sections of its route, where an average speed of 30 to 40 miles an hour is attained. It has valuable charter privileges both for passenger and freight transportation and would be an exceedingly desirable acquisition for the steam road, enabling it to control the through passenger service in territory through which its steam lines run, and wherein the stress of competition is felt. The Boston and Worcester line runs into Park Square in Boston. The connection between the steam railroad company's latest moves and the possibility of its desire to obtain control of the Boston and Worcester railway eventually is obvious.

Announcement has also been made of the projecting of a new line to Providence from Boston by the Boston and Worcester Street Railway Company. It is proposed to utilize the present Park Square and suburban route out as far as Needham, and thence branch off to the southward, via Dover, Walpole, Norfolk, Wrentham, the Attleboros and Pawtucket to Providence. The cost is estimated at $2,500,000 for this line, which would be double-tracked throughout and enable the trip to be made in about two hours. The distance is a little over 45 miles, and the express trains of the steam road now do the trip in about an hour. B.

Technical Society of the Pacific Coast.

The Technical Society of the Pacific Coast held its annual session in San Francisco on May 26th, 27th and 28th. The society numbers 250 members, including electrical engineers, civil engineers and mechanical engineers. George W. Dickie, manager of the Union Iron Works, San Francisco, is president. During the first day's session the principal event was the reading and discussion of a paper entitled, "The Laying of the Pacific Commercial Cable," written by Frank P. Medina, an electrical engineer with the San Francisco office of the Commercial Cable and Telegraph Company. His paper was a progressive history of the laying of the cable between San Francisco and Manila, the materials used, the methods pursued, tests applied and difficulties overcome.

On Friday morning the society took an excursion on the bay to the Union Iron Works, and in the afternoon the following-named papers were read and discussed: "Steam Turbines," by John Richards; "Jet Pumps," by Prof. F. G. Hesse of the University of California. "The Reclamation of a Mountain Swamp," by Marsden Manson. "Pipes and Joints for High Pressures," by Franklin Little. In the evening additional papers were read as follows: "Vertical Railway Curves," by H. I. Randall; "Armored Concrete Construction," by M. C. Couchor; "Skeleton Steel and Hollow Concrete Block Construction," by S. Gilleti; "Experiments in Driving Pipes for a Foundation with a Steam Hammer," by J. J. Welch.

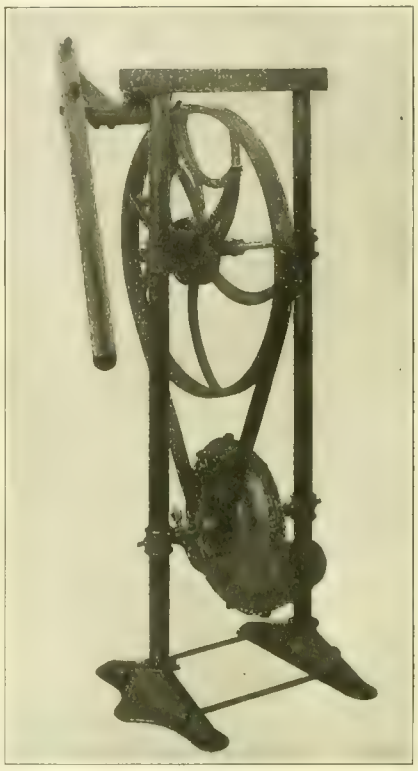
On Saturday afternoon the members of the society took a trolley car tour through the city and later held an additional session at which the following papers were read: "Construction of an Uplift as Effecting the Design of Masonry Dams," by Professor Chard D. Marz of Leland Stanford University; "Portland Cement Manufacture," by C. J. Wheeler, and "Collection and Discussion of Materials in County Highway Bridges," by Prof. C. Wing of Leland Stanford University. On Saturday evening the session ended with a banquet at the Palace Hotel. A.

The Aurora, DeKalb and Rockford Traction Company, the new company which proposes to build an electric railway from Aurora to Rockford, Ill., via DeKalb and Kaneville, will begin construction at once. V. A. Watkins and William George of Rockford and G. B. Shaw and R. S. Vivian of Chicago are interested in the new road.

Improved Hand Blowers.

In these modern times men are always seeking devices by which they may accomplish the greatest results with the least exertion. To this fact, doubtless, more than any other, was due the rapid introduction of the hand blower as a substitute for the old-time bellows. During the years which have elapsed since this change the B. F. Sturtevant Company of Boston, Mass., pioneer in the manufacture of blowers, has been perfecting its design and construction until its hand blower, known as style A, has shaped itself into a new design known as style B, illustrated herewith.

These hand blowers have been extensively introduced in connection with new forges of all kinds and have likewise been applied to old-style brick and iron forges as simple, efficient and economical substitutes for the bellows. Not only are they



IMPROVED HAND BLOWER.

adapted to forge blowing but can readily be applied as portable ventilating apparatus. They are simple in design, strong, rigid and compact, easy and economical in operation and readily portable. The running gear is simple.

The blower is adjustable on the shaft and its outlet may thus be set to discharge in any direction and be readily connected to the forge tuyere by means of galvanized iron piping. The blower is of cast iron, strongly constructed in every particular, has a steel shaft running in babbitted boxes and a fan-wheel of galvanized steel solidly riveted to a composition hub with extending arms. Careful design has been followed in the frame, which is well braced, and is so arranged that the slackness of the belt driving the blower may be taken up by lowering the blower shaft, which is supported by collars sliding on the frame. The feet are provided with holes so that the hand blower may be readily screwed to the floor.

These hand blowers are made in two sizes. The total length on the floor of style B-1 is 18 inches, while the total height of the frame, not including the handle, is 48 inches. The driving wheel is 24 inches in diameter, the lower outlet is 3½ inches in diameter, and the complete outfit weighs but 135 pounds.

Style B-2 is of slightly larger dimensions and has proportionately greater capacity for delivering air. The driving wheel is 24 inches in diameter, the blower outlet is 4¾ inches in diameter and the complete outfit weighs 155 pounds.

New Members of the Institute.

Among those elected to associate membership in the American Institute of Electrical Engineers at the directors' meeting in New York city last month were the following named:

Adam, Fred B., Frank Adam Electric Company, St. Louis, Mo.
Bates, F. R., Bogart-Bates Company.....Seattle, Wash.
Bramhall, C. A., Diehl Manufacturing Company.....New York city
Byllesby, H. M., H. M. Byllesby & Co.....Chicago, Ill.
Curtis, L. E., Guanajauto Power and Electric Company.....Colorado Springs, Colo.
Dunwoody, H. H. C., Signal Corps Post....Fort Myer, Va.
Gale, F. H., General Electric Company...Shenectady, N. Y.
Goehst, J. H., Chicago Edison Company.....Chicago, Ill.
Goldsmith, Leon, Westinghouse Electric and Manufacturing Company.....Columbus, Ohio
Howell, C. A., Wagner Electric Manufacturing Company.....St. Louis, Mo.

Lamme, W. F., Westinghouse Electric and Manufacturing Company ..... San Francisco, Cal.
Lea, E. S., De Laval Steam Turbine Company..New York city
Lee, W. S., Jr., Catawba Power Company..Rock Hill, S. C.
Lombard, P. H., General Electric Company.....
..... San Francisco, Cal.
Mountain, J. T., Chicago Edison Company....Chicago, Ill.
Muller, H. N., Allegheny County Light Company.....
..... Pittsburg, Pa.
Nicholson, L. C., University of Missouri.....Columbia, Mo.
Nurian, Kerson, World's Fair.....St. Louis, Mo.
Osthoff, O. F., H. M. Byllesby & Co.....Chicago, Ill.
Pettit, J. E., Postal Telegraph-cable Company..Chicago, Ill.
Schuler, L., Wagner Electric Manufacturing Company...
..... St. Louis, Mo.
Skog, G. E., Westinghouse Electric and Manufacturing Company .....Wilkinsburg, Pa.
Slemin, H. C., Stromberg-Carlson Telephone Manufacturing Company .....Rochester, N. Y.
Smith, R. J., Canadian Electric and Water Power Company .....Perth, Ont., Can.
Stratton, Samuel W., National Bureau of Standards....
..... Washington, D. C.
Weber, F. C., General Electric Company..Schenectady, N. Y.
Wiswell, O. N., Snoqualmie Falls and White River Power Company .....Snoqualmie Falls, Wash.
Woodmansee, F., Sargent & Lundy.....Chicago, Ill.

Programmes for International Electrical Congress.

The preliminary programmes of section B (general applications) and section C (electrochemistry) of the International Electrical Congress have been submitted and contain a good array of interesting papers. The programmes are as follows:

Section B.—"Direct-current Commutation," by Professor E. Arnold; "Compensated Alternators," by Dr. O. S. Bragstad; "Standardization of Dynamo-electric Machinery and Apparatus," by Colonel R. E. Crompton; "Calcul des Alternateurs," by M. Andre Blondel; "Uber die Natürliche Radioactivität der Atmosphere und des Erdbodens," by Professors Elster and Geitel; "The Distribution of Voltage and Current in Closed Conducting Networks," by C. Feldmann; "Self-regulating and Compounded Synchronous Machines," by M. A. Heyland; to be announced, W. M. Mordey; "Rectifiers," by A. Nodon; "Electricity in Ancient Egypt," by Sir W. Preece; "Magnetic Leakage in Alternating-current Machinery," by Professor C. A. Adams; "Electric Motors in Shop Service," by C. Day; "Carrying Capacity of Cables and Conductors," by J. W. Esterline; "Sparking Distances Corresponding to Different Voltages," by H. W. Fisher; "The Design of Insulators," by Professor H. J. Ryan; "The Regulation of Alternators," by D. B. Rushmore; "The Influence of Wave Shape Upon Alternating-current Meter Indications," by Professor E. B. Rosa; "The Equipment of a Commercial Testing Laboratory," by Dr. Clayton H. Sharp; "Very High-voltage Transformers," by Professor H. B. Smith.

Section C.—"Methods of Determining the Degree of Dissociation," by Professor S. Arrhenius; "Electrometallurgy of Nickel," by Professor W. Borchers; "Electrolytic Methods for the Rapid Production of Copper Sheets and Tubes," by Sherard O. Cowper-Coles; subject to be announced, Dr. F. Dolezalek; "Electrical Extraction of Nitrogen from the Air," by J. Sigfried Edstron; "Alumino-thermics," by Dr. H. Goldschmidt; "Electrolytische Zerstörungen in der Erde," by Professor F. Haber; "Electrometallurgy of Iron and Steel," by Dr. P. C. L. Heroult; "Chlorine Smelting," by J. Swinburne; "The Chemistry of Electroplating," by Professor W. D. Bancroft; "The Lead Voltameter," by A. G. Betts and Dr. Edward Kern; "The Preparation of Materials for Standard Cells," by Professor H. S. Carhart and Dr. C. A. Hulett; "Alkaline Batteries," by Thomas A. Edison; "The Silver Voltameter," by Dr. K. E. Guthe; "The Units Employed in Electrochemistry," by Carl Hering; "Notes on Electrolytic Copper Refining," by J. T. Morrow; "The Energy Absorbed in Electrolysis," by Professor J. W. Richards; "The Relation of the Theory of Compressible Atoms to Electrochemistry," by Professor T. W. Richards.

BOOK TABLE.

A Textbook on Static Electricity. By Hobart Mason. New York: McGraw Publishing Company. 1904. Pp. (5¾ by 8¼ inches), 155, with 63 illustrations. Price, $2.

The apparent lack of a textbook devoted to the subject of static electricity led the author to undertake this work. What has been written on the subject has mostly been confined to a few chapters in textbooks of physics or general electricity, or else to books on static or influence machines. The author does not assert that the subject matter of the work is original with him, but hopes that, as a result of his study, he has been enabled to place before the student interested in this particular phase of the science, in a lucid and orderly fashion, the wisdom of others, so that the book will be of real value. The work has been made simple in phraseology and there are no abstruse mathematics embodied. The author starts out by giving a few chapters on the theory and phenomena of static electricity and then takes up the matter of its measurement and the instruments used for the purpose, ending up, finally, with static generators. In an appendix are given two tables and a few paragraphs not pertaining strictly to the subject. They are the physical dimensions of units and the relation of the units of the electrostatic series to those of electromagnetism.

Data and Tests on a 10,000-cycle Alternator.[1]

By B. G. Lamme.

In the early part of 1902 Mr. Leblanc, the eminent French engineer, was in this country and spent considerable time at the Westinghouse Electric and Manufacturing Company's works at East Pittsburg. Mr. Leblanc was very much interested in certain special telephone work, and in connection with such work he desired for experimentation a current of very high frequency. He took up with the writer the question of building a successful alternator for generating current at frequencies between 5,000 and 10,000 cycles per second. He was informed that the machine would necessarily be of very special construction, but that it was not an impossible machine. Later he took up the matter with Mr. Westinghouse, who, upon receiving satisfactory assurance that such a machine was possible, advised that the generator be built. A preliminary description of the general design was given Mr. Leblanc before he returned to Paris. He was somewhat surprised at certain of the features proposed, especially at the fact that an iron-cored armature was considered feasible for a frequency of 10,000 cycles per second.

The machine was designed and built on practically the lines of the preliminary description furnished Mr. Leblanc. The frequency being so abnormal, the writer believes that many features in the machine, with the results obtained, will be of scientific interest, and therefore the data of the machine and the tests obtained are presented herewith.

The starting point in this machine was the sheet-steel to be used in the armature. No direct data were at hand showing loses in sheet-steel at such high frequencies, nor was there at hand any suitable apparatus for determining such losses. As preliminary data, tests at frequencies up to about 140 cycles per second were used, and results plotted in the form of curves; these results were plotted for different thicknesses of sheet-steel. Also, tests were obtained showing the relative losses due to eddy currents and hysteresis, and these were plotted, taking into account the thickness of the sheets. These data were not consistent throughout; but the general shape of the curves was indicated, and in this way the probable loss at the frequency of 10,000 cycles per second was estimated for the thinnest sheet-steel which could be obtained. The steel finally obtained for this machine was in the form of a ribbon about two inches wide and about 0.003 inch thick, which was very much thinner than any steel used in commercial dynamos or transformers which varies from 0.125 to 0.0280 inch. Therefore the machine had to be designed with the intention of using this narrow ribbon of steel for the armature segments.

A second consideration of great importance in the construction of such a machine is the number of poles permissible for good mechanical construction. For instance, at 3,000 revolutions—which was adopted as normal speed—the number of poles required is 400 for 10,000 cycles per second. The frequency, expressed in terms of alternations per minute, multiplied by the pole-pitch in inches, gives the peripheral speed in inches. At 1,200,000 alternations per minute (or 10,000 cycles per second) and a pole-pitch of 0.25 inch, for example, the peripheral speed of the field will be 25,000 feet per minute. It was therefore evident that either a pole construction should be adopted which would stand this high peripheral speed, or the pole-pitch should be less than 0.25 inch. It was finally decided that an inductor type of alternator would be the most convenient construction for this high frequency; with the inductor type alternate poles could be omitted, thus allowing 200 pole projections instead of 400. The field winding could also be made stationary instead of rotating, which is important for such a high speed. This construction required a somewhat larger machine for a given output than if the usual rotating type of machine were adopted; but in a machine of this type where everything was special the weight of material was of comparatively little importance, and no attempts were made to cut the weight or cost of the machine down to the lowest possible limits.

The following covers a general description of the electrical and magnetic features of the machine:

Armature.—The armature was built up in two laminated rings dovetailed into a cast-iron yoke. The laminations were made in the form of segments dovetailed to the cast-iron yoke. Special care was taken that the laminations made good contact with the cast-iron yoke, as the magnetic circuit is completed through the yoke.

The armature sheet-steel consisted of plates of 0.003 inch thickness. The sheet-steel was not annealed after being received from the manufacturer; it was so thin that to attempt annealing was considered inadvisable. To avoid eddy currents between plates each segment was coated with a thin paint of good insulating quality. This painting was a feature requiring considerable care and investigation, as it was necessary to obtain a paint or varnish which was very thin, and which would adhere properly to the unannealed laminations. These laminations had a bright polished appearance quite different from that of ordinary steel. They were so thin that the ordinary paint or varnish used on sheet-steel made a relatively thick coating, possibly almost as thick as the plates themselves. A very thin varnish was finally obtained which gave a much thinner coating than the plate itself, so that a relatively small part of the armature space was taken up by the insulation between plates.

Each armature ring or crown has 400 slots. Each slot is circular and 0.0625 inch diameter. There is 0.03125 inch opening at the top of the slot into the air gap, and the thickness of the overhanging tip at the thinnest point is 0.03125 inch.

The armature winding consists of No. 22 wire, B. & S. gauge, and there is one wire per slot. The entire winding is connected in series. The measured resistance of the winding is 1.84 ohms at 25° C.

After the sheet-steel was built up in the frame it was ground out carefully. The laminations were then removed, all burred edges taken off and the laminations again built up in the frame. The object of this was to remove all chances of eddy currents between the plates due to any filing or grinding. The finished bore of the armature is 25.0625 inches.

Field or Inductor.—This was made of a forged-steel disc 25-inch diameter, turned into the proper shape, and the poles were formed on the outside by slotting the periphery of the ring. The poles were 0.125 inch wide and about 0.75 inch long radially and were round at the pole-face.

The field winding consisted of No. 21 wire, B. & S. gauge. There were 600 turns total arranged in 30 layers of 20 turns per layer. The field coil after being wound was attached to a light brass supporting ring. The measured resistance of the field winding is 53.8 ohms at 25° C.

Tests.—The machine was designed primarily for only a small output, but was operated on temporary test up to two kilowatts. On account of the high frequency the machine was worked at a very low induction; consequently there is an extremely wide range in pressure, the normal operating pressure being taken at approximately 150 volts. It was considered possible that at 3,000 revolutions the air-gap might be slightly lessened, due to the expansion of the rotor under centrifugal action; and it was also thought that eddy-current loss due to the high frequency might affect the distribution of magnetism at the armature face; but the armature iron losses were comparatively small, and there appeared to be no such effect. Also there appears to be no effect due to expansion at high speed. The air-gap specified for this machine is 0.03125 inch on each side, or 0.0625 inch total gap. A very small variation in the diameter of the inductor or the bore of the armature would make a relatively large per cent. in the effective air-gap. Therefore no reliable calculations can be made on the saturation curves of this machine based upon the specified air-gap.

According to the original data showing the relative losses due to eddy currents and hysteresis, the eddy-current loss even with these thin plates should have been much higher than the hysteresis loss, but these losses with a given field charge were almost proportional to the frequency, which is the ratio that the hysteresis loss alone should show. As the eddy-current loss varies as the square of the frequency, the writer expected this to be a larger element in the total iron loss, especially at the higher inductions. In determining the iron losses the machine was driven by a small motor and the losses measured with different field charges. Under most conditions of test the iron loss was a small element of the total loss, and therefore slight variations in the friction loss would apparently show large variations in the iron losses. Also the flywheel capacity of the rotating part of the alternator was comparatively high. Therefore, if there are any variations in the circuits supplying the driving motor, there would tend to be considerable fluctuations in the power supplied.

In first undertaking tests on this machine there was considerable difficulty in measuring the pressures. It was found that at a frequency of 10,000 cycles per second the Weston voltmeter did not work satisfactorily. Practically the same deflection was obtained on the high and low scales of a 60-120-volt Weston alternating-current direct-current voltmeter with the same pressure.

Very good results were obtained by the use of a form of static voltmeter devised by Mr. Miles Walker. This voltmeter is of the same form as the static wattmeter described by Mr. Walker before the American Institute of Electrical Engineers, May, 1902.[1] Tests were also made with the Cardew hot-wire voltmeter with the high frequencies, and the results checked very satisfactorily with the static voltmeter.

For measuring the current a current dynamometer was used which had wood upright supports and a celluloid dial. The only metal parts outside of the copper coils were brass screws. It was found that the current dynamometer is not affected by frequency, unless there are adjacent metal parts in which eddy currents can be generated which react upon the moving element. The dynamometer used had but a few turns in order to reduce the pressure drop across it. This dynamometer was checked very carefully at different frequencies and apparently gave similar results for any frequency between 25 and 10,000 cycles.

Several temperature tests were made on this machine. The heaviest load on any test was 13.3 amperes at 150 volts, or two-kilowatt output. This test was of two hours' duration, and at the end the armature iron showed a rise of 16° C.; the armature copper 21° C. by resistance, and the field copper 17.3° C.;

1. Abstract of a paper presented before the American Institute of Electrical Engineers in New York on May 17, 1904.

1. Transactions of the A. I. E. E., vol. XIX., p. 1035.

air temperature, 19° C. The machine showed a relatively small increase in temperature at this load over the temperature rise with one-third this load. This was probably due to the fact that the windage loss was so much higher than the other losses of the machine that the temperature was but little affected by the small additional loss with increase in load.

Attempts were made to utilize the current from this machine for various experiments, but difficulty was at once found in transforming it. At this high frequency no suitable iron-cored transformer was available. Transformers with open magnetic circuits were tried and operated better than those with iron cores, but were still rather unsatisfactory. It was decided that nothing could be done in this line without building special transformers.

Among the few experiments made was that of forming an arc with current at this high frequency. This arc appeared to be like an ordinary arc so far as the light was concerned, but had a very high-pitched note corresponding to the high frequency. This note was very distressing to the ears.

This machine is in reality of the nature of a piece of laboratory apparatus; and at present it has no commercial value. It was designed primarily for scientific investigation, and appears to be a very good machine for that purpose.

Patents and Inventions.[1]

By Samuel G. McMeen.

A patent issued by our government is a memorandum of a bargain between the inventor as one individual and the people of the country as another. This bargain is to the effect that because the inventor furnishes to the people a more or less useful product of his brain, they in their turn guarantee to pay him for his effort. The payment is not made in a definite sum of money, but in an arrangement whereby he may enjoy for 17 years all the profits coming from the use of the thing he has produced. Rights to these profits he may sell or rent to others, or make such disposition as he likes, but from the time of the making of the bargain the thing belongs to the people. At the end of the 17 years the inventor has no further claim on his production, and it belongs thereafter wholly to the people, having been bought and paid for.

In a sense the price paid by the people is set by the inventor. It may be very large or very small, depending on the excellence of the invention or on the caprice of the people. Examples will come to mind of inventions almost trivial, so far as real usefulness is concerned, but which gave the inventor large financial return. There are other examples of inventions which were epoch-making, but, because they were too soon for the minds of the people, they brought no financial return. It may be that if they had been invented later, so that the period of monopoly had coincided with the period of welcome, the reward might have been proportionate to the excellence of the conception.

The industrial greatness of this nation is in large measure due to the existence of good patent law and to the encouragement which has been given to inventors by its operation. The inventive ability of a people lies not alone in its facility in finding ingenious ways of setting things together to achieve results, but also in its wisdom to see clearly industrial and social needs. In the instance of the inventor who produced the cranberry sorter, everyone in the cranberry industry knew the need of sorting so that cranberries for market would contain no soft ones; it required a mental aptitude to see an immediate possibility of invention in the circumstance that when cranberries were spilled down the back steps only the sound ones hopped from step to step, the soft ones stopping early.

It is not true that a patent granted by the United States may be renewed. A reissue is not an arrangement by which an expiring patent may be given new life, but only an arangement whereby a necessary correction may be accomplished. In other countries there are periods of patent life, which, by proper action, may be extended somewhat as in the case of a copyright in this country, but in each case there is an ultimate time beyond which the term of the patent cannot be extended.

An applicant may not secure a patent in this country if his invention has been in actual public use for two years or more before he makes his application. Interesting questions sometimes arise as to whether the use has been really public or might not have been wholly for the purpose of testing the efficiency of the invention by a continued test. A form of sidewalk which had been in use for two years was held not to vitiate the rights of the applicant because, although distinctly in public use, the excellence of its form could only be proved to the inventor by actual trial and could not be considered to be a final test unless continued for a considerable time. In another instance of an article of wearing apparel distinctly not public in its use, a period of two years was held wholly to vitiate the rights of the applicant because very much less than two years should have sufficed to enable him to decide whether the invention was or was not in a proper form for filing his application.

1. Abstract of an address to the engineering student body of Lewis Institute, Chicago, May 16, 1904.

CORRESPONDENCE.

Great Britain.

London, May 21.—Since the postmaster-general made the announcement in the House of Commons a short while back that negotiations were in progress between the government and the National Telephone Company for the acquisition of the undertaking of the latter the municipal authorities within the London telephone area have shown great interest and activity in the matter. A largely attended conference took place on Tuesday, at which all the local authorities in question were represented, as well as the city of London corporation and the London County Council, and although some variety of opinions were expressed there was a general unanimity with regard to the final resolutions that were passed. These resolutions expressed the opinion that it would be inexpedient for the government to acquire the undertaking of the National Telephone Company on other terms than those set out in the agreement between the postmaster-general and the company, dated November 18, 1901, and strongly deprecated the increased cost that would be entailed by the proposed acquisition of the undertaking before the expiration of the existing license in 1911. It was also asked that any agreement between the two parties should be submitted to the inspection of the local authorities. A further resolution called for a material reduction of the telephone charges, a scale nearly 50 per cent. lower than the existing one being mentioned. A final resolution expressed dissatisfaction with the trunk telephone service of the country. All these resolutions will be submitted to the authorities, and when a reply from the government has been received a further conference will be held.

The London and Northwestern railway, following the example set by several of the other large steam-railway companies in Great Britain is to experiment with electric traction. A branch line in Buckinghamshire, about four miles long, is to be equipped upon the third and fourth-rail continuous-current system.

The efforts of numerous provincial local authorities, which possess electric-lighting powers, to extend their boundaries for the supply of electrical energy, has, as was expected, produced several fights in Parliament with the large electric power companies, inasmuch as the local authorities, by the extensions sought, have encroached upon the statutory areas of the companies. In the large majority of cases the corporations have been unsuccessful, the parliamentary committees holding the view that the functions of a local authority are to look after the needs of its own district and not to constitute itself a trading authority and to set up competition with commercial concerns. Up to the present it has been held that an electric power company which has been granted a large area by Parliament has a monopoly in that area for the purposes of supplying electrical energy "in bulk."

The London County Council last week had a proposal before Parliament to link up the tramway systems on the north and south sides of the River Thames, by running cars through the famous Blackwall tunnel. It failed to convince the committee, however, and the line was rejected. One of the biggest needs of the London traveling public is a means of direct communication by tramway across the Thames. At present there is none, and although the London County Council recognizes the need full well, yet it systematically opposes any proposals which come from outside bodies. During this session a private company proposed to construct a tube railway under the river to serve the populous districts of North and South Woolwich, but the council's opposition was sufficiently strong to secure its rejection. Otherwise there was no opposition.

The telephone committee of the Portsmouth corporation has reported that there is a profit upon the first year's working.

The Northeastern Railway Company has opened a further section of line for electric traction. The work has been pushed forward, owing to the success of the first portion of electric railway, which was put into service at Easter.

G.

New York.

New York, May 28.—This evening saw the completion of the electric-lighting system of the Williamsburgh Bridge, subsequent upon the opening of the portion reserved for foot passengers. There are now stretched across the bridge at regular intervals 131 arc lamps and 214 incandescents.

Ashley T. Cole and Charles T. Lark, both of this city, are among the directors of the newly incorporated Kings County Lighting Company. This corporation has a capital of $2,000,000 and will manufacture and supply gas and electricity in the boroughs of Brooklyn and Queens. Another new local incorporation is that of the Electrical and Chemical Gas Company with a capital of $50,000 and headquarters in Jersey City.

Morris Moskowitz, a young Brooklyn electrician, has been responsible for the installation of a new system of electric lighting, used for the first time this week on the cars of the Empire State Express. The Moskowitz invention is fully patented and is controlled by the United States Light and Heating Company. The inventor says that he has overcome successfully the problem of accommodating a dynamo to various speeds and the mechanism does not operate until the train is traveling at a speed of 15 miles an hour. A feature of the invention is a controller in each car which automatically turns the surplus electricity into storage batteries and switches off the storage batteries altogether when they are fully charged.

Samuel Rea, fourth vice-president of the Pennsylvania railroad, has been invested with the general charge of the pending construction work of the Pennsylvania Company in New York city. This will give Mr. Rea entire control of the construction of the North and East River tunnels and of the terminus at Thirty-fourth Street. This railroad has just filed a supplementary map of its tunnel route at the Long Island City end, showing an extension of the East River tunnel to a total length of 6,800 feet. Work at the Long Island end of the tunnel will commence next week.

Police raids this week on local pool rooms resulted in the capture of 152 telephones and 15 telegraph instruments. It is said that the pool-room managers will bring suit against the Western Union Telegraph Company for breach of contract, and should this be done Police Commissioner McAdoo says that it will be most interesting to have legal evidence that the instruments found in these pool rooms were the actual property of the telegraph company.

The New York Edison Company is installing in the new sub-station at Twenty-seventh Street, rotary converters, each of 2,000 horsepower. These are the largest rotary converters that the New York Edison Company has ever erected. A new sub-station is also being erected at One-hundred-and-seventh Street.

A charter of incorporation has been granted at Albany for an important consolidation of traction interests in the Bronx. The corporation will be known as the Bronx Traction Company, with a capital of $585,000. The president will be Edward A. Maher, and the treasurer of the company is Thomas Olcott of New York city. The properties that are consolidated are known as the Suburban Traction Company, the Van Nest, Westfarms and Westchester Traction Company, the Westfarms and Westchester Traction Company, and the William's Bridge and Westchester Traction Company. The franchises of these five companies are for about 20 miles of track, mostly in the eastern section of the Bronx. About 10 years ago these franchises were bought by the Union Railway Company and the present consolidation is for the purpose of developing the capacity of the various lines.

The Board of Estimate and Apportionment has tentatively enacted terms for granting permission to the New York, Westchester and Boston railroad to cross certain streets in the Bronx by their proposed electric roads. Among the amendment suggestions is the provision of a five-cent fare within the city limits.

As soon as the electrical equipment is complete, cars will be running over the Williamsburgh Bridge as the result of an agreement signed this week by Bridge Commissioner Best and the presidents of the Brooklyn Rapid Transit, the Metropolitan Street Railway Company and the Brooklyn and Coney Island Railroad Company. In spite of Mayor McClellan's intimation that he would insist on a five-cent fare from the very first, only one of the Brooklyn lines will grant a continuous ride for five cents, and it is agreed that all the other lines shall charge an eight-cent fare until such time as through cars can run over all the connecting tracks.

The twenty-first birthday of the opening of the Brooklyn Bridge occurred this week. It was not, however, until 1897 that electric traction was first used over the bridge for surface cars, and it was not until 1903 that the electrification of the elevated lines was accomplished, these lines having been run by cables previously. It is curious to reflect that at the Park Row end of the bridge horse cars are still to be seen in daily operation.

D. W. W.

Dominion of Canada.

Winnipeg, Man., May 28.—W. N. Dietrich, who has been appointed chief electrical engineer for the Canadian Pacific railway, has been superintending the installation of the electrical machinery at the new shops now building in Winnipeg. This work will take about six weeks to complete. From the power plant in Winnipeg electricity will be transmitted to the shops, where it will drive all the machinery. The larger machines will have individual motors, while the smaller ones will be driven in groups by single motors. This arrangement is being adopted all over the company's system.

The Winnipeg Electric Street Railway Company has received three big new double-truck cars during the last week as part of the new equipment that the officials are installing, to assist in handling the heavy increase in traffic expected this year, from the Dominion exhibition, which will be held in Winnipeg and from the natural growth of local trade and population.

The Grand Valley Railway Company commenced operating cars last Sunday between Brantford and Paris, a distance of seven miles. The company has a fine park and theater midway between the two towns. The cars were well patronized.

The shareholders of the London (Ont.) Street Railway Company, at a special general meeting, held a few days ago, authorized the directors to issue $50,000 of additional stock and to increase the bond

issue the same amount, thus making a total stock and bond issue of $500,000 each.

The Toronto and Niagara Power Company is negotiating with the Cataract Power Company of Hamilton for the purchase of its plant and rights. William McKenzie is one of the principal backers of the Toronto and Niagara company.

The taxpayers of St. Catharines, Ont., are to vote on June 22d, on a by-law to approve the subscription of $20,000 worth of stock in the Niagara, Queenston and St. Catharines Railway Company, which will build an electric railway from St. Catharines to Niagara-on-the-Lake, and thence along the banks of the Niagara River to Queenston. W. A. Mittleberger is secretary and treasurer. H.

New England.

Boston, May 28.—New rates of fare have gone into effect on the Lexington and Boston Street Railway Company's lines, and the change has stirred up the residents in the various towns along the route from Boston to Lowell, which are served by the road. Talk of appeal to the railroad commissioners is rife, but a recent Supreme Court decision on a similar case, it is believed, precludes action by the state board. The new schedule raises fares between some of the points from five cents to 10. Directors of the New Bedford and Onset Street Railway Company have taken like action relative to that road's rates, with resultant protests.

General electric rights on the new stock issue are quoted at $4.50 a share. Each stockholder of record June 15th will be entitled to subscribe one new share for each 10 shares held.

The Edison Electric Illuminating Company of Brockton and the Whitman Light and Power Company have jointly petitioned the state board of electric-light commissioners for approval of the sale of the Whitman company to the Brockton concern. The Edison company also seeks authority to increase its capital stock to finance the consolidation. B.

Southeastern States.

Charlotte, N. C., May 28.—The grading of the Nashville, McMinnville and Woodbury (Tenn.) railway, one of the projected interurban electric roads that have awakened so much interest in Nashville and neighboring points for the last year, will begin at once. The road as surveyed will be about 70 miles in length from Nashville to McMinnville and will pass through a territory that has never been developed for lack of transportation facilities. C. M. Henley of Columbus, Ohio, is president of the company. Electricity will be used both for passenger and freight traffic and the estimated cost is $1,500,000. The company is capitalized at $1,000,000.

The Charlestown (W. Va.) city authorities will take steps to annul the franchise of the Kanawha Water and Light Company on the alleged grounds that the company has failed to comply with the terms of the franchise.

The Lily Mill and Power Company of Lawndale, N. C., is authorized to increase its capital stock from $50,000 to $100,000. L.

Indiana.

Indianapolis, May 30.—F. C. Chappell, secretary of the Vincennes and Jasper Traction Company, announces that the right-of-way has all been secured except a small strip, for which condemnation proceedings will be instituted. This new line will connect Vincennes, Petersburg, Jasper and a number of intervening towns.

Car No. 102 of the Richmond Street and Interurban Company broke all records in its trial trip to Indianapolis on May 20th. The distance of 75 miles was covered in two hours, while 52 miles of select track was made in one hour and 12 minutes. At some points the car attained a speed of 70 miles an hour. The run was made to test the new motor with which the Richmond cars are being equipped.

The Indianapolis and Eastern Traction Company announces that through-train connections on Sundays will be run between Indianapolis and Columbus, Ohio, during the summer, and the service will be hourly.

A survey is being made through Park County for an electric line to connect Veedersburg and Rockville. Business men and farmers are encouraging the enterprise.

A party of Philadelphia traction capitalists, composed of Randall Morgan, J. Levering Jones and others, in company with G. F. McCulloch, inspected the Indiana Union Traction lines during the week. They also inspected the Wabash Valley trolley system. According to the visitors, the traction lines in which they are interested, were found to be in splendid condition.

The Portland, Montpelier, Warren and Huntington Electric Railway Company filed articles of incorporation during the week. The preliminary capital stock is $15,000. The company proposes to build a line connecting the cities named in its title and numerous intermediate towns. The company will maintain offices in Montpelier. The incorporators are Scott Mills, D. A. Bryson, James West and T. H. Bradstreet.

The Elkhart City Electric Company of Elkhart has filed articles of incorporation. The capital stock is $5,000. Charles G. Conn heads the board of directors.

The Tritt Electrical Manufacturing Company of South Bend, capitalized at $15,000, has filed articles of incorporation. The company will manufacture all kinds of electrical appliances and machinery. B. S. Tritt, A. H. Calvert and C. H. Kregbaum are the incorporators. F.

Michigan.

Detroit, May 28.—The contract for the Ionia and Grand Rapids electric road has been filed with the Farnham Construction Company of Chicago. Work is to be commenced before July 1st. The power house is to be located at Saranac.

A company has been organized to carry into operation a new automobile line in Detroit, the starting point to be on Jefferson Avenue near Belle Isle Bridge. A round trip constitutes transfer across the bridge, around the island and return in 40 minutes for 25 cents. The capital stock is $10,000.

Menominee citizens have incorporated an automobile company, capitalized at $100,000, for the purpose of operating an automobile livery in Yellowstone Park.

The people of Manton have decided to issue bonds in the sum of $8,000 for the extension and enlargement of the electric-light and waterworks system.

It is understood that James Helm, ex-senator, is promoting a project for an electric railway to connect Adrian with Jackson, via Devil's Lake. It is stated that it will be completed this season.

The Detroit, Flint and Saginaw electric railway which has completed its line for seven miles out of Saginaw has asked for a receiver. T. E. Tarsney and T. G. Sullivan are interested in the road.

A new electric railway will be built between Detroit and Adrian. It is proposed to have the cars leave over the Detroit United railway and run through Taylor Center to Romulus, from there parallel with the Wabash railroad to Belleville, also to Milan, passing through Tecumseh to Adrian. G. W. Moore of Detroit, who is interested, states that the third-rail system will be used except when passing through towns.

The work on the new electric railway between Marquette and Ishpeming has come to a standstill owing to a strike of the men.

The Detroit, Plymouth and Northville electric railway has succeeded in getting franchises from the villages through which it runs allowing an increase in rates of fare. The company shows that it has been losing money for the last three years. C. G. W.

Ohio.

Cleveland, May 28.—E. E. Mandeville of Philadelphia has been awarded a contract for an electric-light plant at Newton Falls, Trumbull County. A 10-year franchise for street lighting and 20-year franchise for commercial lighting goes with the contract.

Plans are being consummated for inaugurating a through trolley passenger service from Erie, Pa., to Cleveland, Toledo and Detroit, and it is believed that this result will be accomplished within the next few months.

Councilman Walker has introduced an ordinance in the council at Cleveland, providing for a 20-year extension of the franchises of the lines of the Cleveland Electric Railway Company, with the provision that seven tickets be sold for 25 cents. One transfer is to be allowed on all lines and two on Wilson Avenue or any cross-town line.

The Geneva Electric Company has been granted a franchise to build an electric railway from the corporate limits of Jefferson to the lake road, near Chestnut Grove. The original franchise was given to Frank P. Hood, who has turned his interests over to others. O. M. C.

Rocky Mountain States.

Salt Lake City, May 26.—Major Bonta, chief promotor of the big project for an electric railway from Baker City, Ore., through the southern portion of the state, states that a sufficient amount of the bond issue has been negotiated to insure that construction work will be commenced at once on a portion of the proposed line, the scope of which contemplates an ultimate junction with some transcontinental system in California or Nevada. The cost of construction and equipment of the proposed line from Baker City to Prairie City alone, a distance of 80 miles, is estimated at $750,000, exclusive of the amount which will be expended on power plants. Surveys have already been made and rights-of-way secured. The present plans contemplate the building of branch lines from the main system to various towns in the southern portion of the state. The bonds of the company were underwritten by the North American Trust Company of New York.

The Boise Traction Company of Boise, Idaho, has decided to make numerous extensions of its system in the immediate future.

Numerous criticisms of the service of the Utah Light and Railway Company on account of alleged inferior lighting service at Salt Lake City, have been temporarily set at rest by the report of an expert employed by the council to make a thorough investigation of the matter. The report states that the company is delivering all the electricity called for under its contract with the city.

Work will be commenced in the immediate future on the construction of a power plant to be erected at the mouth of Cherry Creek, Phoenix, Ariz., by the Globe Power Company. Three large reservoirs will be constructed and the plant will have a generating capacity of 8,000 horsepower. G.

Northwestern States.

Minneapolis, May 28.—Fred Zollner of Courtney, N. D., has purchased the electric-light plant at Wimbledon, N. D.

The Central Construction Company of Oshkosh, Wis., has secured the contract for the construction of an electric-lighting plant at Wittenberg, Wis.

Bonds have been issued for the purpose of extending the electric-light plant at Redfield, S. D.

The Cannon River Electric Power Company will begin work on a dam at Cannon Falls, Minn., where a power plant will be established.

The contracts have been let for the machinery for the new electric-light plant at Fennimore, Wis.

The La Crosse (Wis.) Gas and Electric Company is putting in a conduit system.

The Vought-Berger Company, manufacturer of telephone and electrical supplies, has decided not to move from La Crosse, Wis., to Minneapolis.

The new Sioux City (Iowa) Homer and Southern Railway line will be completed from Sioux City to Dakota City, Neb., within six weeks.

The contract for building the Fourth Street line of the Davenport and Suburban electric railway was let to the Calnan Construction Company of Clinton, Iowa, and the Burlington Construction Company. R.

Pacific Slope.

San Francisco, May 25.—O. A. Hale, president of the Interurban electric railway leading out of San Jose, has returned from an eastern trip, where he has completed arrangements for the immediate construction of the short line from Los Gatos to San Jose by the way of Campbell.

S. W. Griffith, building an electric road from Reno, Nev., to Tonopah, is in San Francisco arranging with Eccles & Smith for a large amount of electrical apparatus.

It is understood that President Bourn of the San Francisco Gas and Electric Company is to resign soon to go abroad.

Deeds have been filed transferring to the Los Angeles Interurban Railway the property of the California Pacific Railroad Company, the Los Angeles and Glendale Electric Railroad Company and the Los Angeles Traction Company. The amount involved is placed at $2,038,808, of which $1,646,548 is for traction holdings.

The Central California Electric Company has been incorporated at Sonora, Cal., with a capital stock of $500,000. The incorporators are B. F. Eastman, M. J. Gardner, G. G. Grant and others.

The City Council of Seattle, Wash., has authorized the Board of Public Works to purchase an electric street sprinkler to cost $4,500.

A proposition is under way for the construction of an electric road to connect Marysville and Downieville, Cal. George F. Taylor, George B. Mores and John B. Irish are the prime movers in the enterprise. It is proposed to generate power 4½ miles below Downieville on the Yalu River. The road will be 68 miles long.

Work will be commenced next week on the erection of the Mutual Electric Light Company's new power station at the corner of Folsom and Spear streets, San Francisco.

Construction work has been commenced on the extension of the Fortieth Street electric railway in Oakland from Oakland Avenue across Linda Vista to Vernon Heights.

The Watsonville Light and Power Company has filed its articles of incorporation at Santa Cruz, Cal., with an authorized capital stock of $250,000. The incorporators are Fish M. Ray, Joseph C. Love and David H. Foote.

The Eureka Lighting Company of Eureka, Cal., is planning for the erection of a power plant on the south fork of Trinity River. The company expects to expend about $2,000,000 in construction work.

The Arrowhead Reservoir Company of San Bernardino, Cal., has let the contract for the construction of the cement concrete core wall of the dam to be thrown across the outlet of Little Bear Valley. It will make a lake over four miles long, of varying width, and 150 feet deep at its greatest depth. The water stored will irrigate thousands of acres in the valley and will be the basis of a great electric-power system.

The Pacific Electric Railway Company of Sawtelle, Cal., is contemplating the erection of a substation in that place.

More than half of the 500,000 shares of the North Mountain Power Company, which was recently incorporated for the purpose of developing an electrical power plant on the Smith River, to supply Eureka and the adjacent towns, has been subscribed and work begun. J. Ralston and J. B. Rogers are engineering the work and have crews in the field. Machinery and the necessary wires and insulators have been ordered. Immediately upon the completion of the initial line into Eureka work will begin upon the company's water rights on the south fork of the Trinity River in Trinity County and upon all the branches of the Smith in Del Norte County.

There promises to be a lively contest over the proposed San Jose-Pacific Railway, which will run along Main Street in Los Gatos, between F. S.

Granger and the Interurban Company. Both interests have applied to the Los Gatos trustees for a franchise. The franchise is desired for the Los Gatos end of a proposed electric line from San Jose by way of Campbell.

Henley & Bursell of Globe, Cal., have received word from Washington stating that their application for the right-of-way through the reserve east of Springfield had been granted and that the contest placed upon their right-of-way by A. G. Wishon had been dismissed. This means two large power plants for Middle Tule.

The Pacific Coast Company will substitute a third-rail system for the existing mule trains in the Black Diamond and Gem mines at Seattle, Wash.

Messrs. Rogers and Lilburn, vice-president and treasurer of the Watsonville Transportation Company, have been visiting in Hollister, Cal., with a view to extending the electric line from Watsonville to Hollister. A.

PERSONAL.

Elihu Thomson was elected president of the Commercial Club of Boston at the recent annual election held in that city.

Wallace Franklin, manager for Westinghouse, Church, Kerr & Co. in Detroit, has gone to St. Louis to look after the affairs of the company in connection with the World's Fair.

C. O. Baker, president of Baker & Co., of Newark, N. J., and New York city, refiners and artisans in platinum, gold and silver, sailed on Wednesday, May 18th, on the White Star steamship Cedric for his annual trip abroad.

T. F. Manville, president of the H. W. Johns-Manville Company of New York; E. B. Hatch, president of the Johns-Pratt Company of Hartford, and J. W. Perry, manager of the electrical department of the former company, are in England and will return about June 10th.

Gordon M. Arnold has passed his examination for entrance to the United States Military Academy at West Point, and is now ready to enter that institution, which he expects to do on June 16th. Mr. Arnold, who is a brother of Bion J. Arnold, is a graduate of Armour Academy in Chicago.

Edward B. Ellicott has returned to Chicago from St. Louis, where he has been in charge of the electrical construction at the exposition. He will resume his work as city electrician, having completed the exposition work with the exception of a few details, which will require him to return for several days.

David R. Fraser died at his home in Chicago, on May 31st, from a stroke of apoplexy. He was 80 years old. Mr. Fraser was identified with the invention and manufacture of mining machinery. He came to Chicago in 1848 and was first connected with the firm of Gates & McKnight, which afterward became Gates, Warner, Chalmers & Fraser, and later was reorganized as Fraser & Chalmers. In 1891 he started a large plant in Great Britain to take care of the company's foreign business. Mr. Fraser retired in 1893 and after his retirement the concern was merged into the present Allis-Chalmers Company. Mr. Fraser was born in Berwick-on-the-Tweed, Scotland. A widow and three children survive him.

ELECTRIC LIGHTING.

The proposition to bond the village of Manton, Mich., for $8,000 to increase and extend the electric-light plant and waterworks was carried at a recent election.

The Missouri, Kansas and Oklahoma Railroad Company contemplates improving its electric-lighting plant at Fayetteville, Ark., by the installation of a 120-kilowatt unit to be operated by a steam turbine.

The City Council of Ottawa, Ill., has renewed the lighting contract with the electric-light company. Some of the citizens and a number of the aldermen had expressed themselves in favor of a municipal plant.

An electric-light plant and system of waterworks will be installed at Johnston City, Ill., by J. A. Hamilton, T. C. Reed and O. B. Bagshaw, who have incorporated as the Johnston City Electric Light and Water Works, with a capital of $10,000.

The finance committee of the city of Reading, Pa., has reported favorably on the proposition for the holding of a special election to secure the assent of the voters to a loan of $200,000 for the erection and maintenance of a municipal electric plant.

The Baltimore Refrigerating and Heating Company has applied to the City Council of Baltimore for the use of the city subways and for permission to erect poles and string wires for furnishing electricity for light and power purposes in the business district of Baltimore.

In the United States Circuit Court for the district of New Jersey, in the case of the General Electric Company against McKeon et al., Judge Archibald recently ordered that a preliminary injunction be issued and directed to the defendants, William F. McKeon and Joseph Conning, restraining them and their agents from directly or indirectly selling or otherwise disposing of any old or second-hand "Edison" incandescent electric lamps without plainly and unmistakably marking them with the words "used and second-hand," until the further order of the court. Two other preliminary injunctions of substantially similar character have been issued against other dealers.

The city of Harrisonburg, Va., will issue bonds to the amount of $60,000 for the purpose of establishing an electric plant. It proposes to build a dam on the Shenandoah River at a point 16 miles distant and generate electricity to be transmitted for lighting the streets and municipal buildings and furnishing power to manufacturing plants. The cost of the entire plant is estimated at $53,000.

ELECTRIC RAILWAYS.

What is said to be the first electric railroad in Denmark is to be built on the island of Seeland. The road will extend across the island and will be 56.51 miles in length.

The Rockford (Ill.) and Interurban Electric Railway Company is improving its city system. New rails are being laid and a number of new summer cars have been put on.

The Iowa and Illinois Railway Company, which is building an electric railway between Clinton and Davenport, Iowa, has decided to locate its shops, power house and offices in Clinton.

The new Sterling and Dixon (Ill.) interurban electric railway, which was recently completed, has been opened for traffic. Regular hourly service will be established between the two terminals.

The Nashville, Columbia and Gallatin Interurban Electric Railway Company is about to build a fine new power house in Nashville, Tenn. It is stated that $500,000 will be expended. J. H. Connor is president of the company.

The entire issue of $650,000 bonds by the Union Electric Company of Dubuque, Iowa, to pay for improvements in track and property has been taken by the stockholders of the company. Local capitalists have considerable faith in the Dubuque enterprise.

The Pioneer Electric Railway Company of Minneapolis, Minn., has been incorporated in the office of the secretary of state with a capital stock of $100,000. The company will construct an electric line from White Rock to Minneapolis and St. Paul. The incorporators are P. W. McAllester, H. F. Johnson, F. D. Woodbury and B. F. Cooper of Minneapolis and A. W. Holmes of St. Paul.

The United States Supreme Court has affirmed the decision of the United States Circuit Court for the Northern District of Ohio in the Cleveland (Ohio) street-railway-fare cases, and the opinion is favorable to the railway. The cases involved the validity of the ordinance passed by the City Council of Cleveland in 1898, fixing the rate of fare at four cents cash or seven tickets for 25 cents. The court held that the consolidation ordinance of 1885, fixing fares at five cents, constituted a contract binding both on the city and the railway companies.

POWER TRANSMISSION.

A waterpower-electrical plant is to be built for transmitting power to operate a new cotton factory at Francis, Ga. The plans are said to contemplate the erection of a dam to develop several thousand horsepower. It is rumored that J. F. Little is interested.

The Albany Power and Manufacturing Company of Albany, Ga., will develop its proposed waterpower on the Muckafoonee Creek if the contract made between the city and the company is ratified by the voters on June 9th. The contract is for 10 years and calls for 300 horsepower of electrical energy anuually for operating the city light and water plant for a consideration of $8,000 a year.

SOCIETIES AND SCHOOLS.

Invitations are extended by the trustees and faculty of the Worcester Polytechnic Institute to its annual commencement. Commencement-week exercises will extend from June 5th to 9th. The commencement address will be given by Dr. Ira Remsen, president of Johns Hopkins University, on June 9th.

The annual convention of the National Electrical Contractors' Association will be held in St. Louis on September 14th to 16th. A special convention train will leave Grand Central Station, New York city, Saturday, September 10th, at 1 p. m., for St. Louis, where it is due to arrive on Sunday, September 11th, at 6:45 p. m. Headquarters of the eastern delegates will be at the Washington Hotel. Alex. Henderson, 527 West Thirty-fourth Street, New York city, is master of transportation.

Professor A. Marston, who for 12 years has been in charge of the civil-engineering department of the Iowa State College at Ames, has recently been elected dean of the engineering division. The present enrollment of the engineering division is 670 students. A new engineering building has also recently been erected at a cost of $220,000. The new dean is a graduate of Cornell University, and prior to taking up educational work was engaged in railroad and bridge engineering.

PUBLICATIONS.

The R. Thomas & Sons Company of East Liverpool, Ohio, is sending out a price list of its wiring cleats and wire holders. High-potential insulators, telegraph insulators and floor tubes are also manufactured by the company.

Gyrofans, a product of the Jandus Electric Company of Cleveland, are described in a pamphlet from that company. The gyrofan is mounted on a support which rotates in a horizontal plane, through the reaction of the fans, and disturbs the air in all directions. It is also made with a hanger in the form of an electrolier, with a light attachment.

The Nernst Lamp Company of Pittsburg has issued a small catalogue, describing 44 and 55-watt Nernst lamps. This small-size lamp has special advantages which are set forth in the catalogue. The lamp is described in all its parts, a radical change being made in the heater and holder, the latter designed so that a complete new holder may be replaced when the glower or heater fails.

"The Shawinigan Water and Power Company, Its Property and Plant," is the title of a very interesting publication issued by the company and descriptive of the organization and equipment of this great power-development undertaking. Many pictures are contained, showing the plant, its machinery and the interesting points about the river and the town of Shawinigan Falls, Quebec. Maps are also given and profiles which aid in making clear the excellent description of the plant. Transmission lines constructed out in various directions from Shawinigan Falls are described. In short, the pamphlet is intended to furnish accurate information regarding the plant of this company and also to set forth some of the reasons why Shawinigan Falls is a desirable location for manufacturing industries.

The new publication just issued by the Westinghouse Electric and Manufacturing Company entitled the "Works of the Westinghouse Electric and Manufacturing Company" is certainly a creditable piece of work, especially in the matter of illustrations and cover design. The descriptions which it contains are of an interesting and instructive nature. Among them are the "Interborough Rapid Transit Company's Installations," the "Installation for the Louisiana Purchase Exposition," the "South Side Elevated Railroad Company, Chicago," and "Niagara Falls Installations." Many interesting views are shown about the factory, with descriptions of the processes by which the products of the company are turned out. The sociological aspects of the company's organization are also taken up, such as its clubs and forms of amusement for the employes. On the next to the last page is a map showing the location of the Westinghouse interests.

SPACE TELEGRAPHY.

The Navy Department has been given permission to establish a space-telegraph station on the lightship at Nantucket shoals. It is proposed to utilize the lightship station in connection with the ships of the navy for the collection of meteorological information to be transmitted to the hydrographic offices at New York, Boston and elsewhere; to report passing vessels and as an accommodation to all ships equipped with space-telegraph apparatus.

MISCELLANEOUS.

The Ohio Electric Advertising Company of Cincinnati, organized by G. R. Harms, William Moore, G. W. Carr, M. M. Harms, Harry C. Busch and Charles E. McCarthy, has been incorporated with a capital of $10,000.

The first death due to electricity in the New York rapid transit subway is said to have occurred last week. While light circuits were being tested Foreman John Southwayd received a current of high voltage and died instantly. The body was badly burned.

The Dominion of Canada Exhibition, otherwise known as the Winnipeg Fair, will be opened on July 24th and continue till August 6th next. The Dominion government has granted the sum of $50,000 to assist in making the fair a success. All applications or requests for information must be directed to Exhibition Department of the Canadian Manufacturers' Association, Toronto, Ontario. Foreign exhibits are invited and foreign exhibitors will be accorded the same benefits, power for processes of manufacturing, exhibiting, etc., as are granted to Canadian manufacturers.

A feed wire on the Lowell division of the Boston and Northern street railway line in Hudson dropped across the railroad track recently and proved strong enough to stop a freight train, which was going at the rate of 12 miles an hour on an up grade. The wire had sagged sufficiently to catch the locomotive just below the headlight. Poles for almost half a mile were ripped up and a house which stood near the track was lifted on one side several feet in the air by the cable, drawn taut in front of the train.

The train was brought to a standstill with the locomotive wheels revolving on the rails. Steam was shut off and the train backed up to release the wire, but the trainmen dared not touch it for fear that the power was on. The Lowell and Nashua lines were interrupted while repairs were being made.

TRADE NEWS.

The Electrical Equipment and Inspection Company of New York city, capitalized at $25,000, has received a charter in Illinois, with a capital of $2,500.

Sealed proposals are being invited until June 7th for supplying electric fittings and materials and electric-light wires and cables to United States buildings under control of the Treasury Department east of the Rocky Mountains. Specifications and blank forms will be furnished upon application to the secretary of the treasury, Washington, D. C.

Sealed proposals will be received at Kilbourn City, Wis., until June 9th for furnishing all labor, material and apparatus necessary for the construction of a complete electric-lighting plant for the village of Kilbourn City in accordance with the plans and specifications on file with the village clerk. Copies of the specifications may be seen at the office of L. W. Burch, engineer, at 323 East Wilson Street, Madison, Wis.

Sealed proposals will be received by the supervising architect, Washington, D. C., until June 28th for the installation of an electric passenger elevator in the postoffice and court house at Montgomery, Ala. Drawing and specification are on file at the Treasury Department. Also until June 21st for the plumbing, heating and ventilating apparatus and electric wiring and conduits in workrooms under terrace at the Mint at Philadelphia.

The trustees of the Stilwell-Bierce & Smith-Vaile Company of Dayton, Ohio, are about to offer the properties of the company for sale at public auction in three ways, the best aggregate result to be accepted. The old plant, machinery and appliances, covered by a $300,000 mortgage-bond issue, is to be first offered in bulk; all the rest of the property will be offered in bulk next, and finally the property as an entirety, with the good will, is to be offered. A deposit of $10,000 is to be made with each partial offering and $25,000 on the entirety. The trustees are H. E. Talbott, W. S. Rowe and N. H. Davis, with offices at Dayton.

The supervising architect at the Treasury Department, Washington, D. C., will receive sealed proposals until June 30th for the construction, including plumbing, heating apparatus, electric wiring and conduits of the postoffice at Gainesville, Texas, in accordance with drawings and specifications on file at the office of the postmaster at Gainesville.

Sealed proposals will be received by the supervising architect, Treasury Department, Washington, D. C., for the construction, including heating apparatus, plumbing, electric wiring and conduits of the postoffices at Sterling, Ill., and Elkhart, Ind., in accordance with the drawings and specifications, copies of which may be had of the supervising architect or of the postmaster of the cities named. Bids on the former will be opened on July 7th and the latter on July 11th.

BUSINESS.

The Electric Appliance Company, Chicago, is advertising itself as headquarters for heating apparatus and asserts that central stations may make business grow where none grew before by advertising and pushing the company's appliances.

Having recently perfected his new "differential" waterwheel governor, Mark A. Replogle of Akron, Ohio, has been retained by the Replogle Governor Works as chief engineer, and the manufacture and sale of this new machine will be begun in earnest.

The A. Nelson Manufacturing Company of Chicago wishes to announce to users of electrical apparatus that it is prepared to manufacture tools, dies and metal specialties and do screw-machine work, etc., guaranteeing satisfaction in all particulars.

The Western Salvage Wrecking Agency, of which Samuel Gans is manager, will sell at public auction, Tuesday, June 7, 1904, at its temporary salesrooms. 117-123 Market Street, Chicago, a large quantity of bare and insulated-copper wire, galvanized-iron wire cables, cordage, etc. These goods are salvage from the recent fire at the Chicago store of the American Electrical Works, and the sale is for the account of the fire underwriters. Goods will be sold in lots, and catalogues may be had on request.

The Automatic Electric Company extends to all a hearty invitation to visit its headquarters at the St. Louis Exposition for the purpose of inspecting its large working exhibit in section 24, Palace of Electricity. Visitors will be courteously received and given an opportunity to acquaint themselves with the system.

W. S. Seaman & Co., Milwaukee, Wis., have for many years manufactured sound-proof telephone booths which are extensively used in various parts of the country. The company has issued a new catalogue and states that it has a special proposition of exceptional interest. Those interested in telephone booths are requested to communicate with the Seaman company.

The Ohio Valley Glass Company, manufacturer of glass insulators, is calling the attention of the trade to its products in this line. It is maintained that these insulators are especially noted for their strength and toughness and are guaranteed to be standard in every respect. Particulars concerning the product may be had on application to the company's office at 1501 Monadnock Building, Chicago.

The Monarch Electric and Wire Company of Chicago has secured the exclusive agency for a useful and practical telephone attachment. It is a pneumatic receiver cushion, which may be adjusted or attached to any receiver by simply slipping over the end. It makes a soft cushion for the ear, which is desirable, especially when one has to wait for lengthy information or data. It excludes all surrounding noises and prevents any shock or concussion to the ear.

Westinghouse-Parsons steam turbines are to be installed in the new power station of the Union Metallic Cartridge Company at Bridgeport, Conn. The initial installation will consist of two turbo-generator units, each of 500-kilowatt capacity. The two units will operate in parallel, and will furnish 440-volt, three-phase current at 7,200 alternations a minute for general power and lighting purposes. The turbines will operate under 150 pounds steam, 28-inch vacuum, and possibly superheat. The installation is in charge of Samuel M. Green, consulting engineer, Holyoke, Mass.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) May 24, 1904.

760,426. Alternating-current Wattmeter. Frank Conrad, Edgewood Park, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed February 20, 1903.

Two quadrature-adjusting coils connected together in parallel circuit are connected with a fixed resistance common to the circuits of the coils. A second resistance and means for transferring any desired portion of the latter from the circuit of either coil to that of the other are supplied.

760,463. Wireless-signaling System. Guglielmo Marconi, London, England, assignor to Marconi's Wireless Telegraph Company. Application filed September 10, 1903.

An elevated conductor comprising an upright wire or rod and a number of wires extending outwardly in elevated positions augment the distance to which intelligible signals may be transmitted with a given amount of energy.

760,480. System of Electrical Distribution. John S. Peck, Pittsburg, and Joseph W. Farley, East Pittsburg, Pa., assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed July 3, 1903.

Transformers connected to a two-phase circuit supply three-phase energy. Regulating transformers having their secondary windings connected in series with secondary windings of the main transformers have primary windings, the active lengths of which have the ratio of 0.867 to 1. Two auxiliary transformer windings may be connected with variable lengths in series with the respective primary windings of the regulating transformers. (See cut.)

760,483. Gas or Vapor Electric Apparatus. Max von Recklinghausen, New York, N. Y., assignor to the Cooper Hewitt Electric Company. Application filed February 14, 1903. Renewed September 29, 1903.

A gas or vapor electric apparatus comprises a container of metal, a conducting gas or vapor within suitable electrodes and means for insulating the negative electrode from the metal of the container.

760,565. Electrical Switching Apparatus. Walter J. Richards, Milwaukee, Wis. Application filed April 29, 1903.

The disposition of the pole pieces of two electromagnets and of their armatures is such that the energization of one of the electromagnets causes a rotation of the shaft to cause an electrical connection between the movable and the stationary contact pieces, while an energization of the other electromagnet causes a rotation of the shaft to cause a break in the connection between the contact pieces.

760,567. Electrochemical Gas Lighter. Ignatz Rothstein, Berlin, Germany. Application filed May 12, 1903.

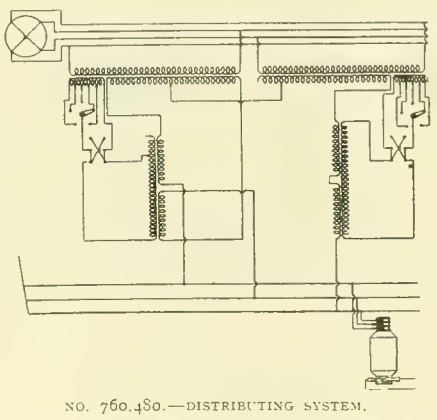
A gas lighter comprises a source of electricity, conductors extending from it, a short wire connecting the conductors, platinum wires extending from the short wire and an arm supported by the conductors having its outer end adapted to support the outer ends of the platinum wires beyond the ends of the conductors.

760,568. Electric Indicator. Edward Sadler, Upper Tooting, England. Application filed May 16, 1903.

Indicating coils severally connected electrically to the points whence signals are to be transmissible are associated with a corresponding series of resetting coils collectively connected in series and common to all the signal circuits, the indicating and resetting coils being located in pairs with their similar poles adjacent to one another. A series of vibratory pole pieces located to be magnetized by one of the coils to be respectively repelled from the other coil when current is flowing in both coils of a pair and to be attracted when one of the coils is idle co-operate with a series of corresponding signal disks movable with pole pieces.

760,573. Telephone Exchange System. Charles E. Scribner, Jericho, Vt., assignor to the Western Electric Company, Chicago, Ill. Application filed September 15, 1902.

A winding of a repeating coil is included in the circuit of the line at the central office. A local telephone circuit, a second winding of the repeating coil, a source of current, and a signal device included therein are associated with means controlled by the relay adapted to vary the resistance of the local circuit to actuate the signal device.



NO. 760,480.—DISTRIBUTING SYSTEM.

760,574. Electric Pole Changer. Charles E. Scribner, Jericho, Vt., assignor to the Western Electric Company, Chicago, Ill. Application filed September 15, 1902.

A switch operating to intermittently make and break the circuit, causes impulses of current to actuate the signal device. A conductor is adapted to shunt the switch, a spark-preventing device is included therein, and a key controls the shunt conductor and co-operates with the switch to close the shunt momentarily while the switch operates to break circuit, whereby the spark at break is suppressed. (See cut on next page.)

760,577. Clutch Mechanism. Severn D. Sprong, New York, N. Y., assignor of one-half to James H. Harnden, New York, N. Y. Application filed October 29, 1903.

Combined with a driven shaft having disks secured thereon is a sleeve loose on the shaft between the disks. A gear wheel on each end of the sleeve carries a clutch rim in juxtaposition to the adjacent disk. Magnetizing coils are provided for both clutch rims, with provision for reversely rotating the gear wheels for alternately energizing the coils.

760,591. Fan-motor Support. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed September 8, 1902.

A supporting base for an electric fan is described.

760,601. High-tension Oil Switch. Henry P. Ball, New York, N. Y., assignor to the General Incandescent Arc Light Company, New York, N. Y. Application filed February 25, 1902.

An electric switch, comprising an insulated chamber, a pivoted platform in the chamber, and an oil well mounted on the platform is described.

760,602. Oil Switch. Henry P. Ball, New York, N. Y., assignor to the General Incandescent Arc Light Company, New York, N. Y. Application filed March 10, 1902.

Combined with the conductors of a distribution system and the interposed connecting means between the switches are a pair of switches in each leg of the system, each switch comprising a removable oil well, a pair of oppositely disposed suspended contacts, and a pivoted knife blade.

760,603. Electric Switch. Henry P. Ball, New York, N. Y., assignor to the General Incandescent Arc Light Company, New York, N. Y. Application filed July 5, 1902.

Fixed contacts, movable bridging devices, a pair of solenoidal magnets, a band wheel, a band connecting the magnet cores, a connecting rod interposed between the band wheel and the bridging devices, and means for alternately energizing the magnets are the essential parts.

760,611. Printing-telegraph Receiver. George A. Cardwell, New York, N. Y., assignor to Frederic J. Swift, trustee, New York, N. Y. Application filed April 11, 1903.

An arm extends from the shaft of a rotary type wheel. A series of stops movable into and out of the path of rotation of the arm are actuated by electromagnets. Means are supplied for [illegible] operation, including the one actuated after one has been actuated.

760,641. Trolley Pole. Alfred W. Morgan, Longbeach, Cal., assignor of one-fourth to Lewis M. Wood, Longbeach, Cal. Application filed November 16, 1903.

A lever mechanism holds the pole suspended and comprises two levers, one of which is connected to the pole and the other lever [illegible] the first-named lever.

760,643. Third-rail Guard for Electric Railways. Vincent M. [illegible] tion filed February 16, 1904.

A third-[illegible] rel with [illegible] attaching two of the timbers to the cross ties, devices attaching [illegible] away from [illegible] fasteners [illegible]

760,656. Electric Track Switch-operating Mechanism. Charles W. Squires and James B. Squires, Springfield, Mass. Application filed January 20, 1903.

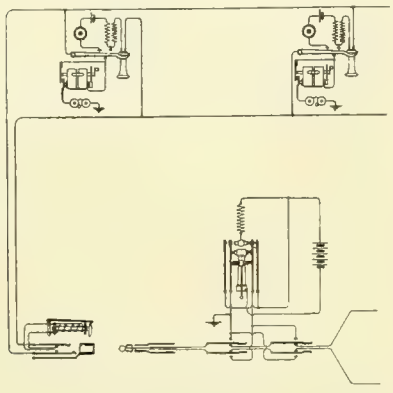
In a track-switch operating mechanism are a primary member, and a secondary solenoid controlled by the movement of the primary member. The track switch is movably controlled by successive similar movements of the secondary solenoid core.

760,657. Portable Electric Hand Lamp. George Stein, New York, N. Y. Application filed July 18, 1903.

A battery and incandescent lamp are contained in a rotatable casing having a lens for projecting the light.

760,658. Circuit-breaker. Charles F. Stoddard, Boston, Mass., assignor to the American Pneumatic Service Company, Dover, Del. Application filed June 8, 1903.

A pivoted swinging member is normally held in a position near the limit of oscillation when the circuit is open, and released when the circuit is closed.



NO. 760,574.—ELECTRIC POLE CHANGER.

760,679. Circuit-breaker. John Burry, Ridgefield Park, N. J. Application filed August 30, 1902.

In a transmitter is a line circuit-breaker consisting of two springs tensioned to press normally against each other. An electromagnet operates one spring to open the circuit.

760,711. Automatic Telephone System. James C. Slater, St. Louis, Mo. Application filed March 10, 1902.

The subscriber's telephone comprises a receiver support, an alarm circuit, an alarm therein, a circuit-closer disposed for operation by the receiver support and a second circuit-closer serving when in position to close the alarm circuit and to perform the additional function of maintaining the telephone in electrical connection with a second telephone at a remote point.

760,712. Storage-battery Plate. Edward W. Smith, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed September 10, 1903.

Means for connecting the grid and perforated cover plate comprise grooves in the cover plate and projections cast from the grid and engaging perforations of the plate and occupying the grooves.

760,713. Automatic Regulator for Electric Generators. William A. Turbayne, Lancaster, N. Y., assignor to Charles M. Gould, New York, N. Y. Application filed September 8, 1903.

Details are described.

760,714. System of Electrical Distribution. William A. Turbane, Lancaster, N. Y., assignor to Charles M. Gould, New York, N. Y. Application filed November 2, 1903.

In an electrical system are a dynamo and external circuit, of translating devices, and a storage battery in the circuit. Means for regulating the dynamo-field strength are provided, also a magnetic controlling device for the regulator having differentially acting windings respectively connected with the supply and work portions of the circuit. A third winding is connected in shunt across the storage battery.

760,736. Trolley-pole Head. John E. Greenwood, Utica, N. Y. Application filed September 25, 1903.

Combined with a trolley pole having a harp mounted thereon is a head bolt mounted on the pole to have a limited movement in a vertical plane. Wheel harps are mounted on the head bolt to have a horizontal movement and trolley wheels are journaled in the harps.

760,740. Means for Safely Conducting Electric Currents. Edward A. Jarvis, Port Richmond, N. Y. Application filed December 16, 1903.

Co-operating with a primary conductor and a secondary conductor insulated therefrom are means adapted to close the circuit between the two conductors. Magnetic means act to operate the circuit-closing means, the magnetic means consisting of a permanent magnet having attached both poles of an electro-horseshoe magnet, whereby the permanent magnet is strengthened during the period of excitement of the electromagnet.

760,756. Leading-in Device for Vapor Conductors. Max von Recklinghausen, New York, N. Y., assignor to the Copper Hewitt Electric Company, New York, N. Y. Application filed February 20, 1903.

One or both of the electrodes is composed in part of a conducting fluid and a conducting rod inside the fluid is so arranged that a partial cooling is effected and better

760,789. Vapor Electric-lamp Manufacture. Peter C. Hewitt, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed December 4, 1903.

the lead wire to the positive electrode in a vapor electric apparatus having a negative electrode of mercury and a positive electrode of solid material, a mass or puddle of mercury is located around the seal during the process of manufacture.

760,794. Electrical Bathing Apparatus. Robert S. Lawrence, Boston, Mass., assignor to the Consolidated Inventors' Corporation, Boston, Mass. Application filed August 3, 1903.

Vibratory current is sent through the water of the bath between electrodes at the ends of the tub.

760,798. Circuit-breaker. Andrew C. Miller, Corona, Cal., assignor of one-half to Frank Chase, Corona, Cal. Application filed May 19, 1902.

A circuit-breaker comprises a fixed contact, a movable contact, a vertical bar pivoted at its lower end out of balance, a normally slack connection between the bar and the movable contact, means for normally preventing the bar from drawing the connection taut, means for automatically releasing the bar and a switch lying in the path of movement of the bar.

760,801. Automatic Trolley-controlling Device. Horace W. Nichols, Philadelphia, Pa. Application filed September 9, 1903.

A spring-controlled drum takes up the slack of the trolley rope.

760,813. Electric Printing Machine. David G. Smyth, Hartford, Conn. Application filed February 16, 1903.

An electromagnetic device actuates the striker which does the printing.

760,815. Electric Switch. Frank Stevens, Philadelphia, Pa. Application filed December 30, 1903.

An operating frame consists of two T-shaped frames combined with push parts connected to the opposite horizontal arms. An insulating block interposed between the free ends of the other legs or arms of the T-shaped frame carry pins. An arch-shaped supporting frame is arranged between the two T-shaped frames.

760,822. Clutch. Walter S. Timmis, Brooklyn, N. Y. Original application filed March 10, 1902. Divided and this application filed December 9, 1902.

An electromagnet operates the clutch of a pattern-feeding machine.

760,828. Trolley. John S. Weckman and Robert J. Millard, Carnegie, Pa. Application filed October 17, 1903.

Details are described.

760,846. Electric-railway Switch. Rupert L. Border, Pittsburg, Pa. Application filed October 15, 1903.

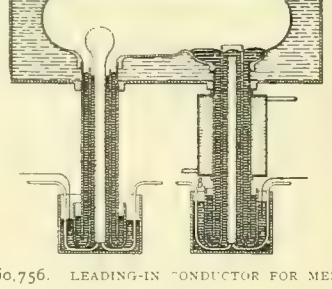
A contact is associated from the trolley wire a commutator is mounted on a suitable shaft and electrically and mechanically controlled means move the commutator. Brushes are set alternately to engage the insulated and contact surfaces of the commutator, while a conductor simultaneously energizes the commutator. A double solenoid is electrically connected to the brushes and to the contact of the trolley wire.

760,849. Electric Incandescing Lamp. Francis M. F. Cazin, Hoboken, N. J. Application filed September 1, 1903.

A dielectric heat-conducting support, a heat-producing primary conductor wound thereon and a light-producing normally non-conducting filament carried by the support are embodied in the invention. The support and conductor are adapted to heat the filament, whereby it becomes conductive and short-circuits the heat-producing conductor.

760,895. Electric Clock-striking Mechanism. Emil Meyer, Swissvale, Pa. Application filed September 24, 1903.

A circuit-breaker wheel is engaged by a brush. A solenoid, a lever connected to the core of the solenoid, a trip lever, a circuit-breaker, and a contact carried by the trip lever for engagement with the circuit-breaker are the other features.



NO. 760,756. LEADING-IN CONDUCTOR FOR MERCURY-VAPOR LAMPS.

760,897. Storage-battery Plate. Achille Meygret, Paris, France, assignor to Edward T. Magoffin, New York, N. Y. Application filed June 29, 1903.

A grid for a storage-battery plate consists of an end piece and a number of strips or bars united with the end piece and definitely separated one from the other a small distance apart, each strip having on each outer face a receiving surface for the active material, the receiving surfaces running parallel with the outer side faces of the end piece of the plate.

760,947. Electric Bond for Railway Rails or Other Conductors. John S. Alexander, New York, N. Y. Application filed February 25, 1903.

Adjoining ends of a pair of electric conductors are connected by an electric bond consisting of a body of conducting material confined in a chamber formed by a segmental end recess having its outer end or mouth shallower than the inner portion.

760,955. Electric Signaling System and Apparatus Employed Therein. Robert G. Callum, Washington, D. C. Application filed October 11, 1902.

Combined with a spring-operated signaling instrument is an auxiliary signaling mechanism having an independent motive power and adapted to be set in motion by an expansion beyond a predetermined point of the spring controlling the operation of the instrument.

760,970. Means for Controlling Electric Currents. Isidor Deutsch, Montreal, Canada, assignor to the Electric and Train Lighting Syndicate, Montreal, Canada. Application filed April 30, 1902. Renewed June 25, 1903.

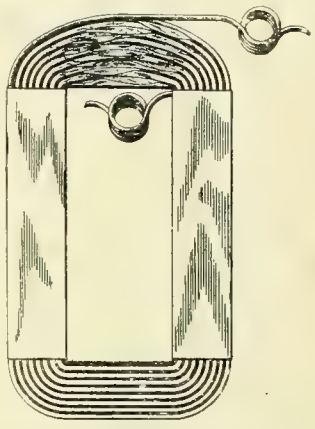
Details are described.

760,976. Electric Signal System. Otto Ernst, Larchmont, N. Y. Application filed September 22, 1903.

A single feed wire of one polarity and a pair of wires of another polarity contain alarm mechanisms connected in multiple with the last-mentioned wires. A source of electricity is connected with the single feed wires.

760,988. Electrically Controlled Switch. William H. Hillyer, Atlanta, Ga. Application filed January 21, 1903.

Solenoids control the movable part of the switch.



NO. 761,039. TRANSFORMER COIL INSULATION

761,000. Trolley. James A. Lavery, New York, N. Y., assignor of one-half to George F. Allen, Brooklyn, N. Y. Application filed November 7, 1903.

Jaws are mounted to swing on opposite sides of the trolley and adapted to meet at their upper ends above.

761,012. Automatic Regulator for Electric Generators. Marcellus R. Shedd, Lancaster, N. Y., assignor to Charles M. Gould, New York, N. Y. Application filed September 8, 1903.

The generator is movable relative to the driving element to vary the speed of the generator. A normally open circuit is supplied by the generator and a normally inoperative electric motor causes the relative movement of the generator.

761,017. Turnstile Apparatus. Edwin H. Spear, New York, N. Y., assignor to the F. S. M. Syndicate, London, England. Original application filed January 3, 1903. Divided and this application filed September 2, 1903.

Electrical means are provided to actuate the latch of the turnstile.

761,029. Apparatus for Therapeutical Purposes. Fred. H. Brown, Los Angeles, Cal. Application filed March 28, 1904.

Vibrators attached to a belt are caused to vibrate by an electric current.

761,039. Insulation for Transformer Coils. Charles Le G. Fortescue, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 30, 1903.

A coil for electrical apparatus comprises a number of layers wound in the same direction, the first and last turns of each layer being provided with sleeves which extend across the coil between the layers. (See cut.)

REISSUE.

12,223. Alternating-current Transformation. Maurice Hutin and Maurice Leblanc, Paris, France, assignors to George Westinghouse, Pittsburg, Pa. Application filed April 20, 1904. Original No. 754,371, dated March 8, 1904.

A method of producing two separate alternating magnetic fluxes in quadrature by a greater number of dephased alternating currents consists in passing each of the initial currents around one of two separate magnetic cores in a number of turns proportionate to the sine of the current lag and around the other core in a number of turns proportionate to the cosine of the same current lag.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on May 31, 1904:

363,880. Device for Preventing the Escape of Noxious Fumes from Batteries. Mark Bailey and John Warner, London, England.

363,886. Electric Belt. Wilson W. Dunlap, Oskaloosa, Iowa.

363,909. Process for Repairing Incandescent Electric Lamp Filaments. Casimir Pauthonier, 17 Rue Danton, Levallois-Perret (Seine), France.

364,031. Method of Carbonizing Incandescents. William Maxwell, Claybrook Road, Fulham, County of Middlesex, England.

364,086. Electric Motor. George F. Card, Covington, Ky.

364,177. Machine for Making Seamless Lead-covered Electrical Conductors. George L. Kitson, Philadelphia, Pa.

364,178. Lead-covered Electrical Conductor or Cable. George L. Kitson, Philadelphia, Pa.

10,838 (reissue). Electrical Safety Device for Elevators. Egbert M. Curtis, Brooklyn, N. Y.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, JUNE 11, 1904

Chèvres Hydro-electric Plant on the Rhone, Near Geneva.

By A. De Courcy.

The hydro-electric plant which has been installed on the Rhone just below Geneva is no doubt the largest in Switzerland. This plant was laid out in 1893 and the first part completed in 1896. It is designed to furnish current for the city of Geneva for the lighting and power circuits and also for the extensive electric-railway lines in the city and suburbs. Current is also taken by motors in the surrounding district. The power house, known as the Chèvres plant, lies on the bank of the Rhone, not far from where it leaves Lake Leman. The river here has a considerable depth and a strong current and is capable of furnishing an abundant supply of energy. The Chèvres plant takes about 18,000 horsepower at its maximum capacity.

Fig. 2 shows the appearance of the long station building, which lies near one bank of the river. The dam, which has been erected across the river and joining on to the station, is a handsome piece of engineering work. The station building is separated from the bank by the main canal, which leads from the dam. The turbines are disposed in a single row along the length of the building. They occupy the lower floor, while the generators are above them in the second story, as shown in Fig. 1. The intakes of all the turbines lie along the main canal, and the water thus passes through the turbines and comes out at the front of the station. A pier, which is built in front of the station, carries the water to a point further down stream.

The station is laid out with 15 vertical turbine and dynamo groups in a single line. The foundation was put in complete at the beginning, with a house for the first five groups above it. At present the building is entirely completed for the 15 groups, the 10 remaining sets having been added a few years ago.

In the Chèvres plant the turbines are of the well-known Escher-Wyss pattern. The first five are of a slow-speed type and run at 80 revolutions per minute. On increasing the station it was desired to run at a higher speed, and the remaining 10 turbines work at 120 revolutions per minute. To provide for variations in the fall of water (the maximum fall is 28 feet and the minimum 15 feet) a double turbine has been adopted. It consists of two turbine wheels mounted one above the other on the main shaft, and the water supply is regulated by a set of gates so that the lower turbine can work alone, or the two turbines can be made to act together and give double the power. The turbines are kept at constant speed by a governing device which has proved quite successful. The outer part of the wheel has its vanes mounted on pivots in order to vary the water supply to the revolving part. A set of levers works the movable vanes and these levers are connected by transmission shafting with the hydraulic governors, which will be observed in front of each alternator (Fig. 1). There are pumps which are designed to operate the vanes by hydraulic pressure, and as the pumps are driven from the turbine shaft, any variation of speed will cause a corresponding variation in the water feed to the turbines.

Dating from 1896, the first part of the Chèvres plant was completed with five alternator groups running. The alternators were supplied by the Compagnie de l'Industrie Electrique, on the Thury system, and are built for 1,200 horsepower. They work at a speed of 80 revolutions per minute and furnish two-phase current at 45 cycles. The voltage is 2,750, or by different coupling the machines will give 5,500 volts single-phase current. These alternators are built in the usual vertical design, but differ somewhat from the usual practice, as they are of the inductor type. This was thought preferable at the time the machines were constructed, but the new Thury machines use the internal-field pattern.

In the first five machines the outer fixed part, which is a large ring, contains both the field and armature windings. These are laid on the periphery, one above the other. The revolving part, lying inside, is mounted on the top of the turbine shaft. It is a bell-shaped piece which carries a set of poles disposed in a double row around the periphery, corresponding with a similar set of pole projections on the outer ring. The magnetic circuit is thus completed by the two sets of poles on the inductor and fixed ring. There are 34 poles in each row, or 68 around the circumference of each part. The fixed ring has a field winding of copper strips placed on the polar projections, and below it lies the armature winding, which also occupies 34 poles. An exciting current of 45 amperes is required for the field when running at full load. The external diameter of the alternator is 14 feet nine inches and the height above the floor seven feet three inches. The complete machine weighs about 75 tons. The inductor or revolving part weighs 13 tons. Seeing that these alternators were built nearly 10 years ago, their good performance, which still keeps up, reflects great credit on the makers.

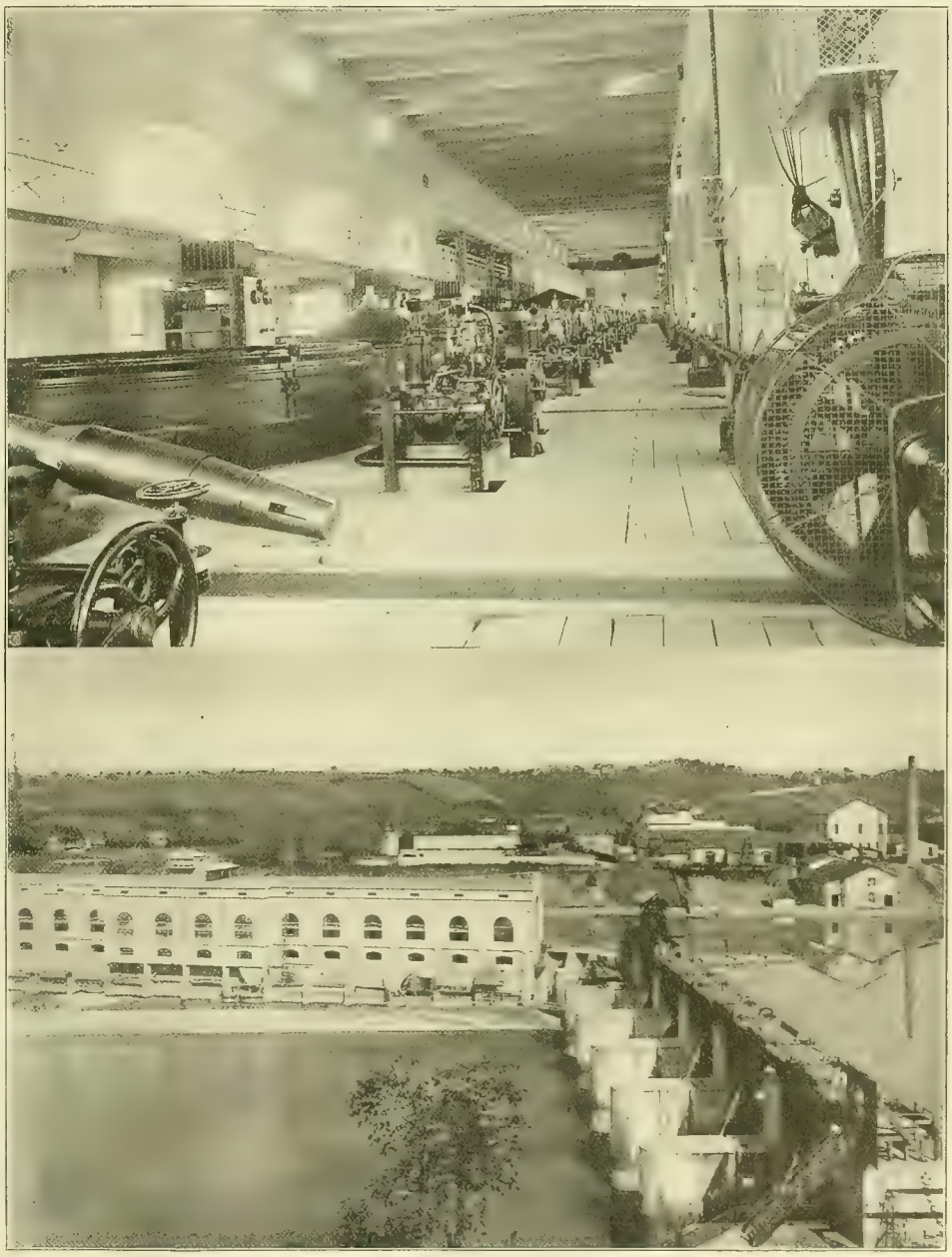


Fig. 1. Interior of the Generator Room in Power House
Fig. 2. Power House and Dam.
CHÈVRES HYDRO-ELECTRIC PLANT ON THE RHONE, NEAR GENEVA.

When it was decided to increase the Chèvres plant in 1899 and install 10 new machines the Compagnie de l'Industrie Electrique was called upon to furnish part of these, and the design of the new alternators has been carried out on somewhat different principles. The former speed of 80 revolutions per minute was found to have some disadvantages, and it was decided to run the new series at 120 revolutions.

In these machines, which were designed by Mr. Thury, the field is mounted on the turbine shaft and consists of a mushroom or bell-shaped piece provided with a set of 46 field poles around the exterior. Outside of it is a fixed armature ring, with the winding laid in grooves in the inner part. The first machines, shown in the foreground of Fig. 1, are of this pattern. The second machine is complete, while the one in the foreground has had the internal field removed (its shaft is also visible), leaving the cylindrical armature as shown.

About the same capacity —1,200 horsepower—is obtained from the new alternators. They deliver two-phase current at 5,000 volts and 4[illegible] [illegible]. Lathe-wound coils are used for the armature winding and these laid around the inner periphery, which is of laminated iron, slotted in the usual way. A specially high insulation of shellac and mica is used for the armature coils, and these are forced into the slots by a form of press which has been designed for the purpose. The 46 field coils are placed on laminated pole projections, which are fastened around the bell-shaped piece of cast steel. Designed to run at a high speed, these machines are of lighter build than the former set. The revolving field weighs 17.5 tons [illegible] inches), and the complete alternator weighs 40 tons.

The remaining alternators of the Chèvres station were installed in 1898-99 by the Brown-Boveri Company. Like the former [illegible] horsepower and are mounted directly on the vertical

shafts of the turbines. They are two-phase alternators working at 45 cycles and delivering 2,700 or 5,500 volts, according to the method of coupling the armature. The winding of the latter is laid on in two distinct sets, one for each phase, and they can be coupled either in series or parallel. The general disposition of these machines is about the same as those last described, but the armature winding is somewhat different, as it is laid in tubes instead of slots. The inner periphery of the ring contains a set of holes which receive the armature winding, protected by tubes of a high-quality insulating material tested at 30,000 volts.

The last of the main groups in the station consists of a vertical turbine upon which is mounted a large direct-current generator having the same capacity as the alternators, or 1,200 horsepower. It furnishes current for an electrochemical works, which lies opposite the station. This generator, which was also designed by Mr. Thury, is of a somewhat original type. It is placed vertically and its armature is

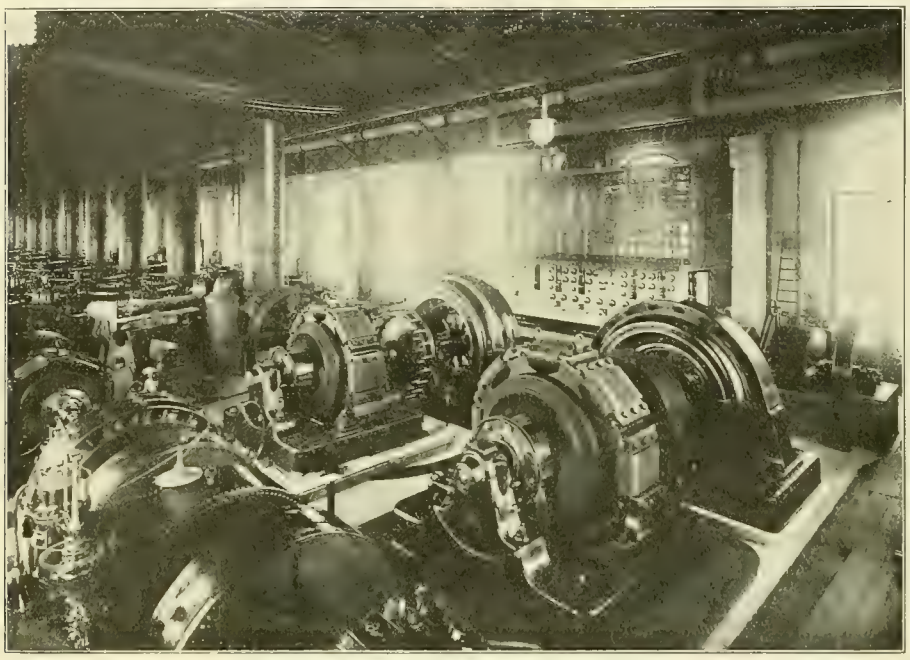


FIG. 3. CHÈVRES HYDRO-ELECTRIC PLANT ON THE RHONE, NEAR GENEVA.—INTERIOR OF SUB-STATION IN PUMPING PLANT AT GENEVA.

mounted upon the turbine shaft with the commutator upward. The lower part, containing the usual drum winding, is surrounded by a ring, which forms the field. It is made up of 12 flat cores placed end to end. Each core carries a field coil. This disposition forms 12 consequent poles around the inner periphery of the ring. The generator gives a heavy current of 4,000 amperes for electrolytical work, with a voltage of 210 volts. The armature measures nine feet 10 inches in diameter. The whole machine weighs about 60 tons, counting the armature at 27 tons. The commutator lying above the armature is especially long and heavy and is about three feet in diameter. It contains 12 sets of carbon brushes.

To furnish the exciting current for the fields of the different alternators three smaller turbine groups have been installed in one end of the station. Current from these machines is sent to the exciter panels of the main switchboard, whence it is distributed to the different field circuits. The Oerlikon Company installed the exciters. These are six-pole machines, with the armature mounted directly on the turbine shaft. Each of the dynamos is built for 120 volts and 750 amperes, using a speed of 150 revolutions per minute.

The two-phase current is sent over a 5,000-volt overhead line to Geneva, where it is lowered in the different transformer posts. To supply direct current for the railways a sub-station has been installed in the Coulouvrenière pumping plant, as shown in Fig. 3. It contains synchronous motors, which receive the main voltage. These motors are coupled to Thury direct-current generators of 800 horsepower, which deliver 560 volts.

Heavy rainstorms in St. Louis last week flooded the conduits leading from the main power house of the St. Louis Transit Company. The water seeped through the insulation of the feed wires at the power house causing short-circuits which burned out the wires and as a consequence practically all the company's lines to the World's Fair grounds were closed down. Captain McCulloch got his men to work and by the next morning had restored traffic on three of the lines.

Types of Large Waterpower Installations.[1]

By Dr. F. A. C. Perrine.

The development and use of the waterfall is a subject not only of vital industrial importance, but also one of fascinating interest. Whatever charm the subject may have generally, it is much more worthy of attention and more picturesque when viewed from the standpoint of electrical development, which goes hand in hand with a preservation of the scenic effects, while affecting important social and industrial improvements. During the last 10 years you have been intimately concerned in this work, and it is fitting that you should know more of what has been accomplished by your fellow workers. Young men have been the pioneers in this industry, and are yet today among its foremost workers. There has been no region too remote and no problem too difficult for their energies and ambition.

But before attempting to present to you the picturesque view of this work that is so intensely interesting from every side, it is well to stop and consider why we should be especially proud of the work that has been done, beyond the pride that we feel in winning success for ourselves and taking part in making nature do our work for us. Without thought, it is often the custom of some to consider and arraign the development for power purposes of the streams of our country as but a form of industrial vandalism. Such a belief or feeling can now be held only by the thoughtless and unobserving. John Ruskin during many years of his life bitterly arraigned the commercialism of his day, blaming mechanical inventiveness and progress for what he saw about him worthy of blame. He undoubtedly placed his finger on many sore spots in our day of progress, and about his teachings a school has developed which has accomplished much in spite of the fact that many of his fears and forebodings were groundless. The hideous characteristic of commercial growth about which he complained was but one of the accompaniments of new growth, for today we cannot call modern commercial, industrial and mechanical progress old.

One hundred years is surely a short period in the world's history, and yet the birthday of the steam engine as applied to manufacture dates back only to the spring of 1786. The first 50 years of the nineteenth century marked the introduction of all we know as manufacturing, while the last 50 years of that century developed practically all of the machinery we use today. Is it strange, then, that accompanying the birth of so many new ideas, and being engaged in their rapid development and introduction, those concerned with this work should use the machinery first in the crudest and most temporary manner, hesitating to build and plan as though in the belief that what they were doing was other than experimental?

With much of the crude mechanical application completed, we are now during the present century devoting our time and talents and using our opportunities for the development of the comfortable and artistic. Surely, no one who has for any period of time considered the products of manufacture can fail to notice and acknowledge this advance.

What I claim, then, is that the introduction of machinery and the use of new industrial ideas produce results not necessarily hideous, nor are they accompanied by a retrogression in taste or culture, but rather, in spite of what we have seen to condemn the development of the world's resources as we have seen them developed mechanically, are naturally devoted first to obtaining for all the comforts of life, and only after this object has been accomplished, to the attainment of culture, beauty and artistic surroundings.

In this the world differs in no one age from another. The primitive man—and we are never far from him—first supplies his needs, then his taste, and as often as possible indulges in a revel, but out of it all, and because of all he does, develops character. Applying this view to the subject in hand causes us to see that if only we look about us we shall find in the first development of the waterfall our scenery destroyed, our streams polluted, and, in place of the blessings of clear water and cozy nooks on the banks of flowing streams, the factory arising in unsanitary and unsafe conditions to supply our crying need for clothing to bear the winter's blasts.

But now, with all that accomplished, the electrician has come forward with his inventions in hand to remove the factory from the bank of the stream to a location where the health and comfort of the operative can be considered, and he has established the factory where there is a possibility of lifelong occupation, with less of dirt and danger than ever could have been accomplished in any other manner. Beyond the factory, too, the influence reaches far, for in the development of every horsepower of water energy made available by such means, there is at least 12 tons of coal less per year that it is necessary to mine for doing the world's work; by reason of each of the 1,000-horsepower generators that the electrical companies are sending out every year in numbers there are 12,000 tons of coal less to be mined per year, and not for one year only, but for every year the machine continues in operation. The waterfall has been called the white-coal mine, the miners, the stokers and the coal passers being the sun, the winds and the rain which continually replenish the river's source. Not only in its generation, but in its application, is the electrical development of the waterpower important. It surely must be evident to all how important an element in the disintegration of the crowded and squalid portions of cities is the extension of electrical traction, and, further, the use of electrical power that may be distributed to great distances and applied in small quantities is rendering the small manufacturer more independent of the large one; an effect which in our country is only just becoming apparent and important, but which in some localities (as notably at Geneva, Switzerland) has had a marked effect on the character of trade, and has enabled the home-worker to continue in competition with the factory. Do not think that what has been said is an apology for electrical waterpower development. On the contrary, it has been said in the hope of calling to your attention neglected facts that are about you and the importance of work that has been done in your midst.

The development, transmission and distribution of the power of the waterfall has resulted from the continuous study and work of the electrical dis-

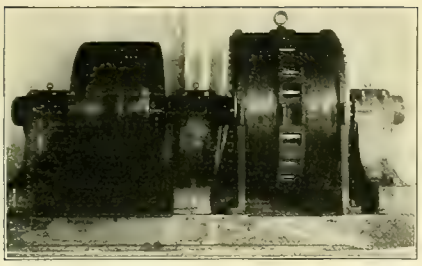
MAP OF 218-MILE TRANSMISSION IN CALIFORNIA.

coverers, inventors, and engineers during a period of about 70 years, every year of which has been important to the result attained, though the last 10 years have produced the most striking of the practical results. During this period the advance has been so rapid as to astonish even the most sanguine and enthusiastic prophets of advancement.

The art of the electrician as we know it today began in 1832, when Faraday, working in his laboratory at Cambridge, England, discovered the principle of the production of electricity from magnetism and laid the foundation for the invention of the dynamo-electric machine. In the year following, at Albany, N. Y., Joseph Henry discovered the principles that are now embodied in the transformer, and with the foundations for the art thus laid, the inventions began.

Gradually the machinery was developed until suddenly and accidentally the reversibility of the dynamo was discovered at the Vienna Exposition of 1873, and the whole field of electric-motor working was opened up, for the reversed dynamo is the motor.

1. A lecture delivered before the National Electric Light Association at Boston on May 26, 1904. Dr. Perrine, who is first vice-president and general manager of the Stanley Electric Manufacturing Company, is a well known authority on power transmission. The illustrations given herewith are selections from about 100 pictures used in connection with the lecture.



POWER GENERATOR INSTALLED AT HOUSATONIC, MASS., IN 1893.

Then began the study of the application of electricity as a motive power. In the early days attention was being given almost exclusively to lighting problems, and it was not until in the early eighties that the motor became a really important machine. About that time in California, in Switzerland, and in Northern Italy beginnings were made in the electrical use of the waterfall, but the present solution of the long-distance problem has been based upon the discoveries of Ferraris in the later eighties. The work of this Italian pointed out the manner in which the alternating motor could best be made, and how that beautifully simple generator, the alternator, which has no sparking commutator, and, if necessary, no moving wire, could be utilized for power purposes.

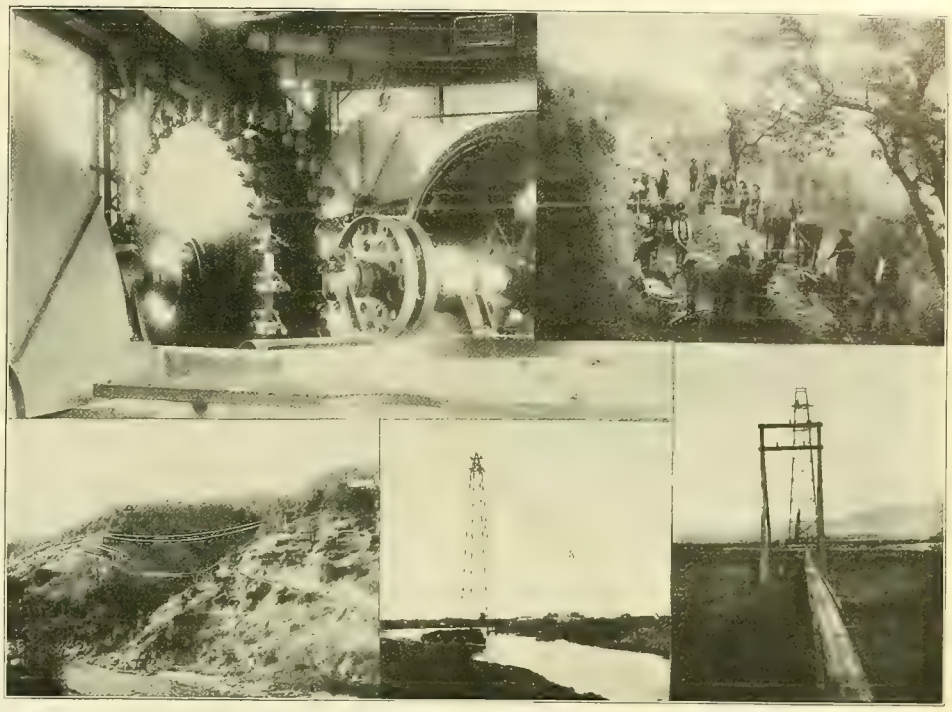
Furthermore, the experiments of Henry and his successors had shown how the pressure of the alternating current could be raised or lowered without moving apparatus, and this resulted finally in the development of the simple transformer.

The first American plant utilizing all of these elements was installed by the Stanley Company at Housatonic, the current being transmitted to the Monument Mills and Great Barrington. This was in 1893. From these small beginnings the art has rapidly advanced, the engineers and inventors working together and vieing with each other, till now there seems no problem too difficult or startling for them to attempt together.

The most startling and picturesque work has been carried out on the Pacific Coast, a land of no coal and little water, but in which the rivers flowing to the sea descend with most startling rapidity, permitting the development of great powers from insignificant streams. Over and through the central part of the state there runs a network of transmission lines fed by machinery designed and manufactured in Pittsfield. In this region many falls have been utilized, and the current is transmitted to great distances for the operation of lighting plants, railroads and mills.

Here the season of practically no rain is long and must be guarded against by the storage of water in the mountain lakes of the high Sierras at elevations of from 6,000 to 9,000 feet. From these lakes the water falls into the bed of the rivers, where it flows among the high mountains and through the deep canyons, until it is caught and carried along the mountain sides through ditches and along the face of high precipices in timber flumes, until a point is reached where the difference of level between the ditch and the river is sufficient, and the site favorable, for the location of the power house, when, with a bold leap, the water is carried in iron pipes down the mountain side to the power house, where, with immense force, it plays on the buckets of the wheels in a stream of great power. These jets of water, spouting under pressures of from 300 to 700 pounds per square inch, seem now to have almost lost the character of ordinary water and to have become a different substance. Nothing built will resist the terrible tearing force they develop. The moving of mountains and the filling of rivers and harbors is a tale familiar to all from the stories of mining days, but even a knowledge of this does not enable one to realize the force so much as does the fact that these jets will wear away and tear apart riveted shells of boiler iron; a stream no larger than your smallest finger will pierce and kill a man as quickly almost as a shot from a gun; the skin will be stripped from the hand if laid for an instant along the side of the stream, and a stone or board thrown into it will rebound as from a surface of rubber, it being thrown many feet away. The scenes about these power houses are of great beauty and are filled with many spectacular features. As one approaches one hears coming up the canyon a continuous humming sound as of many bees, for the machines that one sees here in the power house once in operation are running continuously for weeks and months at a time. One can hardly realize that in this bright power house, with no confusion or dirt, and little of the evidence of what one ordinarily associates with machinery, current is being generated for the operation of lights and cars and mills in cities many miles away, where annually the use of many thousands of tons of coal is being displaced.

In some ways the transmission of the current presents more startling feats of engineering than the generation of the current itself; poles, wires and insulators must be brought many miles into the mountains, distributed at inaccessible spots over a hostile country, and then after a right-of-way has been cleared through the forests the task of erection requires great skill and the ability to overcome obstacles of startling variety. At times the poles must be set in river beds by cementing to mounds of rock so that they will not be carried away during the spring floods; at other points the line must be swung across canyons, at times in spans exceeding one-quarter of a mile in length, and always stretching away over hills and valleys to the far-distant city in a course as straight as possible. This is no haphazard work such as is often seen in the construction of the telegraph and telephone lines about us here, for the success of a transmission plant depends upon the permanence and continuity of its service, for the attainment of which the greatest precautions are taken in the clearing of the right-of-way and providing for a continuous patrol, inspecting and guarding the lines.

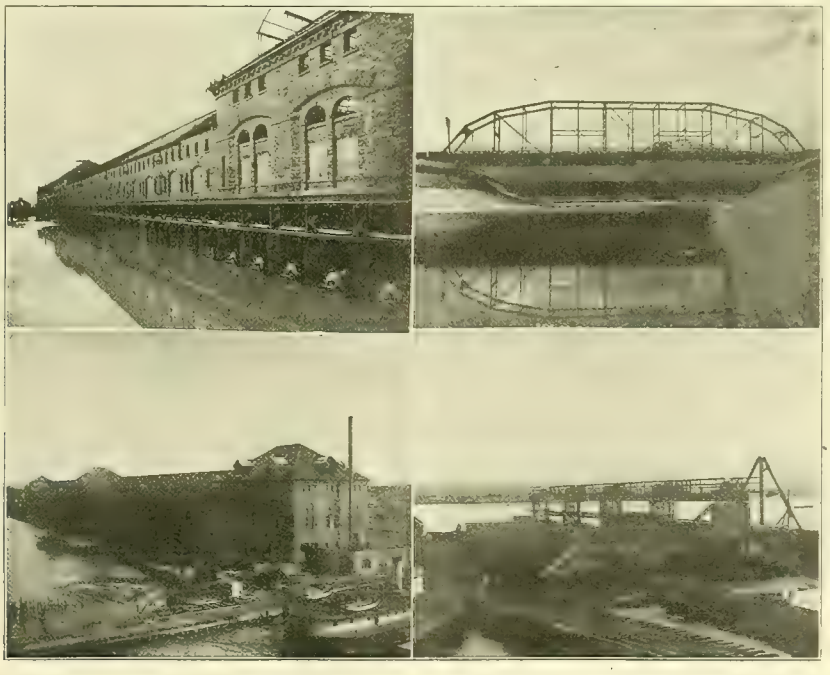


Arrangement of Impulse Wheel in Power House. Method of Ditch Construction.
Transmission Line Passing over Gorge. Transmission Line Crossing the Great Slough. Coyote Slough, Showing Patrol Ditch.
VARIOUS PHASES OF CALIFORNIA POWER DEVELOPMENT.

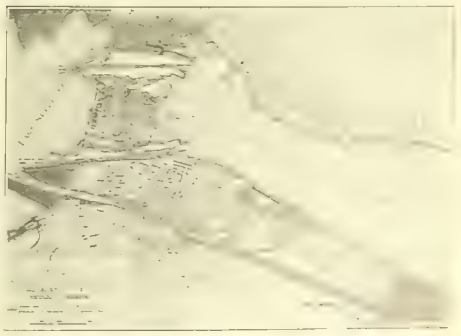
In the cities themselves simple sub-stations are used for the distribution of the current, where often large amounts of power are made advisable without any accompaniment of dust or dirt and in a space much less than could avail for the steam engine doing a similar amount of work.

The pictures shown give one an idea of the typical high-head plant of the Pacific Coast, where nothing is considered high head when the pressure is less than 100 pounds per square inch, representing a fall of water of about 200 feet, and from such heights the heads increase to a maximum of about 2,000 feet, which represents almost the maximum in the developments accomplished up to the present time.

It will be interesting now to examine one that is almost the extreme in the opposite direction, and for that purpose we will take a glance over the plant at Sault Ste. Marie, Mich. To be sure, the financial difficulties of the company developing this power have lately attracted much attention, but we are now discussing engineering and not finances. Of



View of Power House, Showing Separate Wheel Pits. Power Canal, with Power House in Distance
Another View of Power House. Compensating Works.
HYDRO-ELECTRIC PLANT AT SAULT STE. MARIE.



MAP SHOWING POWER

engineering of a high order there has been no lack at the Sault.

In carrying the water of Lake Superior around the St. Mary's Rapids to the power house below them, where the small head of 18 feet is being utilized, one of the deepest and widest canals of the world has been built, 25 feet deep and 210 feet wide. This canal curves around the back of the town, emptying into St. Mary's River through the power house which has been built across the forebay at the end of the canal, the house itself being 1,465 feet long, over a quarter of a mile. In this great power house 80 small generators, each of 400 horsepower, are set, each being directly coupled to four waterwheels set without any flumes or pipes directly in the waters of the forebay itself.

The difficulties encountered in the development of this great power plant have been those of handling such a great volume of water; but, in spite of the great difficulties that have been met, the cost

GREAT FALLS OF THE POTOMAC.

of the whole work has not been excessive, and when this plant is entirely completed there need be no fear of drought or flood, for from that greatest of storage reservoirs, Lake Superior, the flow at all seasons is remarkably constant and at all times sufficient for the generation of above 100,000 horsepower.

Some of the most beautiful natural scenery surrounding these power developments is to be found in our neighboring state of Mexico. There the characteristic plant is one with a diverting dam in the river, a large canal along the mountain side, and a waterhead at the wheels of from 80 to 100 feet. The work done in Mexico is of a surprisingly stable character; in every point of detail the extensive use of hand labor is made manifest, whether in dams, canals or power houses, all of which is warranted by the fact that the fuel supply of Mexico is severely limited and the prices paid for power make large returns in revenue upon the investment in the power plants.

Let us not think that the development that has been made covers either the needs or opportunities of the present day, or that the installations now being undertaken are simply those of which consideration has been previously suspended on account of more favorable opportunities of power development at other locations. On the contrary, among the developments now being studied are some of whose importance there has been an early appreciation. It is true that by reason of the advancement in electrical machinery for the development, transmission and utilization of energy there is now a possibility of larger stations than in any previous period of the world's history, and, furthermore, the question of accessibility and nearness to market is less important than heretofore; since there is now almost no limit to the size of development that may be successfully undertaken, though 10 years ago there was hardly a 5,000-horsepower waterpower plant in the country, and today transmission distances up to 25 or 30 miles are considered short.

At present our engineers are engaged upon the studies for a plant of great magnitude on the Potomac River at the very point where George Washington was engaged as a civil engineer before he entered Braddock's army.

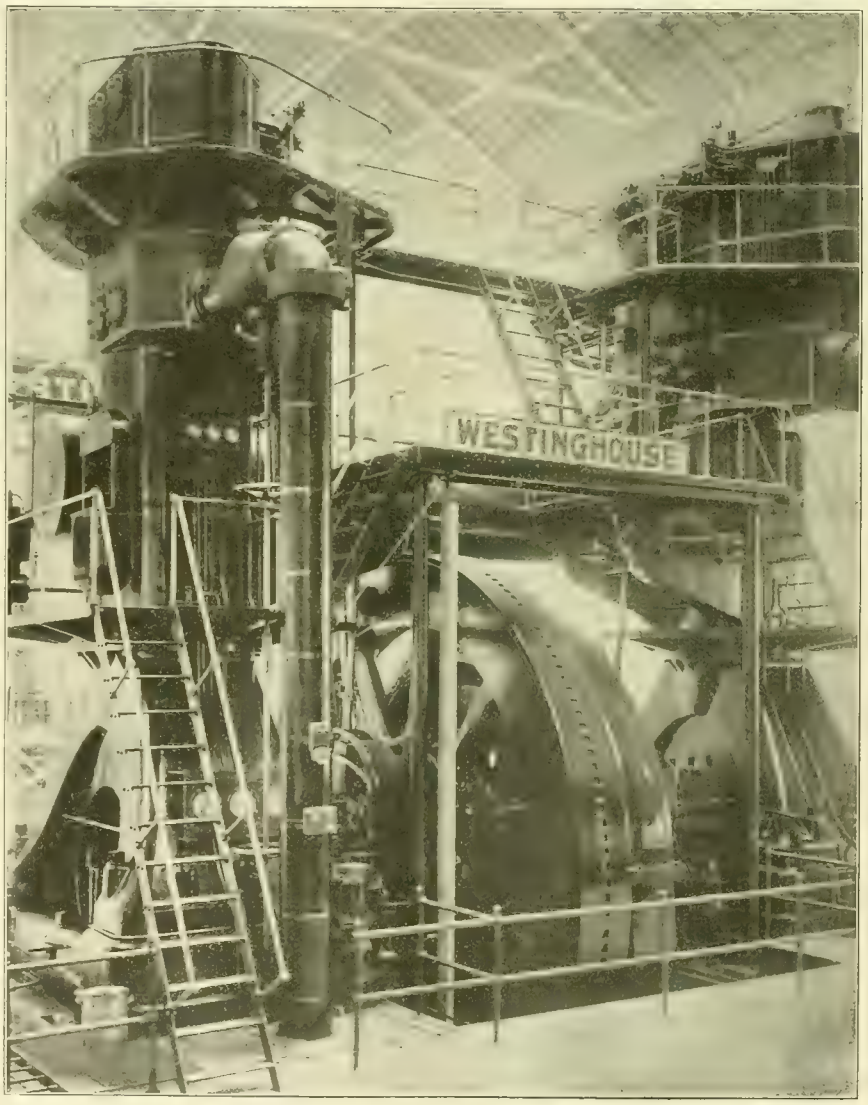
The great falls of the Potomac operated flour mills before the revolution, and Benjamin F. Butler devoted much of his time and money toward securing control of all power rights, leaving to his heirs a property that soon will be utilized in operating the lights and railroads of the city of Washington. The great falls of the Potomac River present engineering difficulties on account of the great fluctuations in the flow of the stream and on account of the peculiar fact that below the falls the river enters a narrow gorge about two miles in length, where, during flood periods, the variation in the river's depth is as much as 60 feet. Only after continued study of the situation has a plan been evolved overcoming these difficulties by running a long canal and tunnel completely around the gorge and locating the power house at a point where the river widens and the ebb and flow of the flood waters is not great.

I trust that I have here given you some slight idea of the problems our engineers have overcome, and have given you some insight into the fascinating side of the engineer's work, who always in doing his work is facing nature in all her moods—facile, fickle and wild—and who is ever benefiting those abroad as well as those at home and leaving behind him a work accomplished of benefit for all the future.

Westinghouse Exhibits at St. Louis Exposition.

The main service plant at the Louisiana Purchase Exposition, for which the Westinghouse Electric and Manufacturing Company received the general contract, is naturally a notable feature of the Westinghouse exhibits and one which appeals to visitors at the fair because of the size of the four electric-generating units, each of 2,000 kilowatts capacity, and their location in the central aisle of Machinery Hall. Entrance to the service plant exhibit is through a large 35-foot plaster ring molded in close representation and in exact duplicate size of the stationary armature of the 5,000-kilowatt alternating-current Westinghouse generators constructed for the elevated and subway train service in New York city.

Although the service-plant generating units are not of the largest type known today, the skill shown in their design and construction and the character of their performance point to an advance so great in the last 10 years that there is little in common in the 1,000-horsepower Westinghouse generators of the Chicago World's Fair of 1893 and the St. Louis service plant of 1904 save the name of the manufacturer. It is interesting to note that the advantage in floor-space economy of direct-connected generators was conclusively demonstrated at Chicago, six of the 12 750-kilowatt generators there used being driven direct by upright engines, the other six being belt-driven by various types of engines, the space occupied by the smallest of the belt-driven generating units complete being about 65 by 27 feet. The units at St. Louis, almost three times as large, are direct-driven, and the space occupied by each over all with the 36 by 76 by 54-inch Westinghouse-Corliss vertical cross-compound engines is only about 35 by 15 feet and 32½ feet in height, the flywheels being 23 feet in diameter.



ONE OF THE 2,000-KILOWATT UNITS IN SERVICE PLANT.

The total space devoted to the service-electric plant in Machinery Hall, with the exciter units, condensers, cooling towers and the 35-panel switchboard is 26,260 square feet. The entire steam and electric station was designed and equipped by Westinghouse, Church, Kerr & Co., and all the motive-power apparatus in connection with the generators and in the steam-generating plant in the nearby boiler house was furnished by the Westinghouse Machine Company. The electric plant, although within the Westinghouse walls at the west end of Machinery Hall, has not been laid out on elaborate lines to combine the diverse characteristics of exhibition and service, and is an exhibit plant only in so far as it is representative of thoroughly modern practice at minimum cost. The various organizations associated with the Westinghouse name, which have united in representation at St. Louis under the title of the "Westinghouse Companies at Louisiana Purchase Exhibition," have additional adjoining exhibit space in Machinery Hall of 26,260 square feet, space in the Palace of Electricity of 10,100 square feet, where Baldwin-Westinghouse electric locomotives also are shown, and space in the Palace of Transportation of 3,000 square feet, a total of 65,620 square feet, or nearly 10 times the space occupied by the same interests at the Pan-American Exposition at Buffalo in 1901. The organizations associated in these joint exhibits are the Westinghouse Electric and Manufacturing Company, Westinghouse Machine Company, Westinghouse Air Brake Company, Westinghouse, Church, Kerr & Co., Westinghouse Brake Company (London, Paris and Hanover), British Westinghouse Electric and Manufacturing Company, Westinghouse Automatic Air and Steam Coupler Company, Westinghouse Traction Brake Company, Canadian Westinghouse Company, Société Anonyme Westinghouse (Havre, France), Société Anonyme Westinghouse (St. Petersburg, Russia), Westinghouse Electricitäts-Actiengesellschaft (Berlin), Sawyer-Man Electric Company, Union Switch and Signal Company, American Brake Company, Nernst Lamp Company, Pittsburg Meter Company, R. D. Nuttall Company, Cooper Hewitt Electric Company, Bryant Electric Company and the Perkins Electrical Switch Manufacturing Company.

In Machinery Hall, in addition to the electric-service plant and the main exhibit of Westinghouse gas engines, turbo-generators, rotaries, exciters and motors in operation, all enclosed within ornamental staff walls and columned entrances of classic design, is the Westinghouse auditorium, which seats 350 persons, in which are displayed at regular hours through the day the biograph and mutoscope pictures of scenes in and about the various Westinghouse works in the Pittsburg district, including the first interior photography of the kind ever taken by means of the Cooper Hewitt mercury vapor lamp. Through the courtesy of the companies this auditorium, which is of ornate architectural design, rendered cool and comfortable at all times by a ventilating system which provides a continual supply of pure air and brilliantly lighted by the four principal systems of electric illumination, will be used throughout the fair as a meeting place for scientific societies and

technical congresses. The lighting of the hall is with the incandescent lamps of the Sawyer-Man Electric Company, Bremer arc lamps, Cooper Hewitt mercury vapor lamps and the Nernst glowers, all of which are used extensively throughout the Westinghouse display.

The Cooper Hewitt lamps are shown in the booths in Machinery Hall and in the Palace of Electricity as designed for use in general illuminating, photographing and photoengraving, with samples of work by some of the best operators in the latter lines. The most striking use of the lamp is in the eight-foot tubes which are hung over the entrance to the Westinghouse auditorium and over the entrance to the Cooper Hewitt booth in the Palace of Electricity.

There are in all about 10,000 Nernst glowers in use in the exhibition buildings, 6,000 of them being in the Fine Arts Museum, where they effectively solve the problem of artistic illumination. The Westinghouse companies use 300 big street glowers in their exhibits. It is interesting to recall that the first public appearance of the Nernst lamp in any considerable number was only three years ago at the Pan-American Exposition.

On exhibition or in service the Westinghouse companies have installed within the exposition grounds 14,000 horsepower in generating machinery and 30,000 horsepower in other apparatus.

The Sawyer-Man Company's display of various types and sizes of incandescent lamps is in the general Westinghouse exhibit space in the Palace of Electricity. There also the Bryant Electric Company shows a variety of lamp sockets, receptacles, switches and other products, including details manufactured by the Perkins Electrical Switch Manufacturing Company. The R. D. Nuttall Company's exhibit of trolleys, trolley gears and pinions for electric-railway, mine and industrial-haulage motors is in Machinery Hall, near the Westinghouse headquarters.

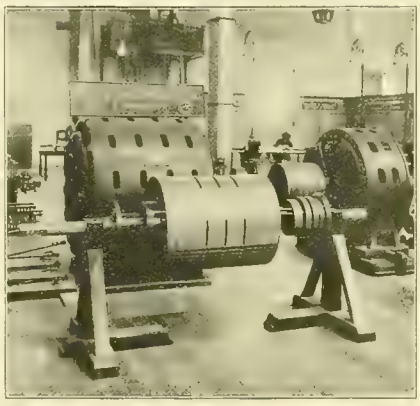
The Pittsburg Meter Company has a separate booth in block 35 of Machinery Hall. There the Keystone water meters and parts, with Westinghouse fish traps, Westinghouse gas meters, water-meter provers and a Westinghouse proportional 12-inch gas meter of the new straight-line type, with a capacity of 100,000 cubic feet an hour, are shown. A graduated assortment of Keystone water meters on a revolving pyramid frame, with a six-inch meter at the base and a one-half-inch meter at the apex, constitutes the moving feature of the display.

Steam for the Westinghouse electric-service plant is piped from the boiler house, known as the Steam and Fuels Building, near by.

The auxiliary apparatus in the electric plant includes three 80-kilowatt, direct-current, 125-volt, direct-connected, engine-driven exciter units, two of which are sufficient to operate the entire plant and adjacent auxiliary machinery in the exhibit sections. Each of the four chief generating units receives steam from a separate line, supplied by a separate battery of boilers, the entire plant thus consisting of two sections, which may be operated independently or together.

The exhibit-service plant, immediately west of the companies' headquarters, is utilized to furnish power for various purposes, and includes a Westinghouse-Parsons steam-turbine generating set of 400-kilowatt capacity, operating at a speed of 3,600 revolutions per minute and delivering three-phase, 60-cycle current at a potential of 440 volts. The unit selected for exhibit is of a size that has met with most extended introduction by reason of its applicability to power stations of moderate size. As a matter of fact, it is at the present time the smallest turbine unit built by the Westinghouse Machine Company. The construction of the rotating field of the generator shown in connection with the turbine on exhibit may best be studied in the Westinghouse exhibit in the Palace of Electricity, where one of similar type is set up but not in operation. Here are also to be seen a 125-horsepower vertical and a 225-horsepower horizontal gas engine, the first direct connected to standard two-wire, the second to standard three-wire, double-voltage, direct-current generators. The horizontal engine will be of particular interest to engineers, as its development has been coincident with the introduction of gas power upon a large scale in this country.

An important part of the Westinghouse installation which is seen by few is the pumping apparatus under the beautiful cascades in front of Festival Hall. This equipment was designed to supply 90,000 gallons of water a minute for these cascades by three



PARTS OF TURBO-GENERATOR SET IN WESTINGHOUSE EXHIBIT.

large centrifugal pumps, each driven by a 2,000-horsepower Westinghouse induction motor, probably the largest motors ever constructed. The famous engine which alone operated all the machinery of the Philadelphia Centennial Exposition in 1876 was rated at 1,000 horsepower. Here, in a single plant, operating but one feature of the St. Louis Fair, is machinery with six times that capacity.

In the Palace of Electricity the Westinghouse Electric and Manufacturing Company occupies a space of over 10,000 square feet, including 1,600 square feet devoted to the display of electric trucks and locomotives constructed in conjunction with the Baldwin Locomotive Works. Two locomotives built for mine service are exhibited, one weighing 20,000 and the other 30,000 pounds, each equipped with two No. 79 500-volt motors. Another 20,000-pound locomotive for switching is equipped with two No. 75 220-volt motors. In the regular electrical-equipment display are a 400-kilowatt turbine-type generator; typical generators for direct and alternating currents, for belt or direct connection; rotary converters, motor-generator sets, oil-insulated and air-blast transformers, direct-current and alternating-current railway motors and controllers, single-phase and polyphase induction motors of constant and variable speeds; direct-current motors of many types, including motors for variable-speed service from single and double-voltage circuits; switchboard apparatus, ammeters, voltmeters, wattmeters, synchroscopes, power-factor meters, circuit-breakers and switches, many of them electrically operated; portable instruments, instruments of precision, potential regulators and other forms of auxiliary apparatus and instruments. The alternating-current, series-wound, single-phase crane motors, similar in type and general construction to the single-phase railway motors exhibited in the Transportation Building and the new Westinghouse unit-switch system of multiple control are also to be seen in this section. The spectacular high-tension sign, using a potential of 50,000 volts, which spells the name "Westinghouse" in lightning-like discharges radiating from large letters over a plate-glass surface—one of the attractions at the Pan-American Exposition—is to be seen in the Westinghouse auditorium.

The combined exhibit of the various Westinghouse brake companies extends for 150 feet down the aisle from the turntable in the Transportation Building. At the end nearest the turntable is a reception room for guests and at the other end is a booth fitted up as a Russian kiosk by the Westinghouse Company of St. Petersburg, to be used as a rendezvous for Russian visitors to the fair. Included in this operating exhibit is the display of the Westinghouse Electric and Manufacturing Company's alternating-current single-phase railway motors.

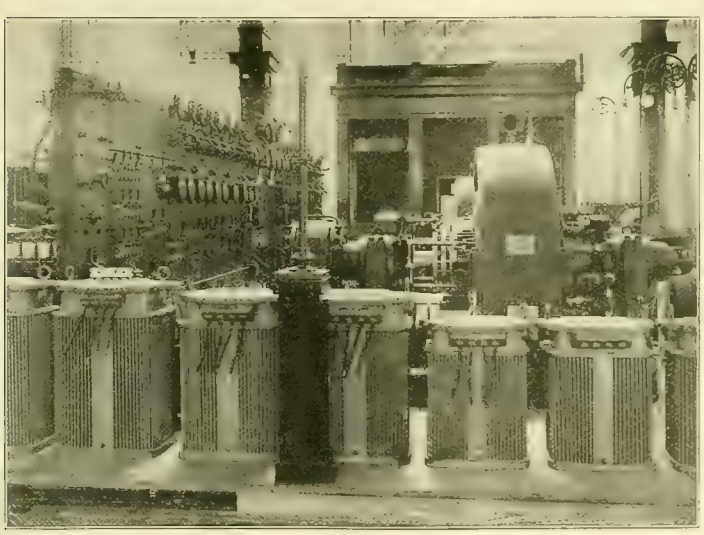
The Westinghouse Air Brake Company's exhibit shows a rack made up of apparatus constituting the equipment for a six-coach passenger train, with engine and tender, all fitted throughout with the high-speed brake and signal equipment. The engine and tender are equipped also with the combination automatic and straight air brake which is now so much in use. The method at present generally adopted when two pumps are used on one locomotive is to be seen, and one of the novel features of the rack is that all valves are placed in duplicate, one sectioned so as to show the internal working mechanism and connected to the valve in use in such a manner that it moves as the regular valve is operated. The operation of the various valves is thus readily studied.

The Westinghouse friction-draft gear also is shown in section, with a machine especially designed for testing it in operation. The available power which can be exerted on the draft gear approximates 2,000 pounds. A triple valve-testing rack is presented to show the manner in which this device is now being installed in many railroad shops. Sectional parts also are shown of the other apparatus of the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company. The latter's exhibit consists of the magnetic brake and car-heating apparatus and the straight air brake for both motor-driven and axle-driven compressors. The magnetic brake is applied to a truck operated on a track 45 feet long, the truck being equipped on both ends with friction draft-gear buffers, showing the use of this device. In this connection also is shown the separate brake controller for use with the magnetic brake when it is decided to add the latter to street-railway equipment having an ordinary controller for the motor.

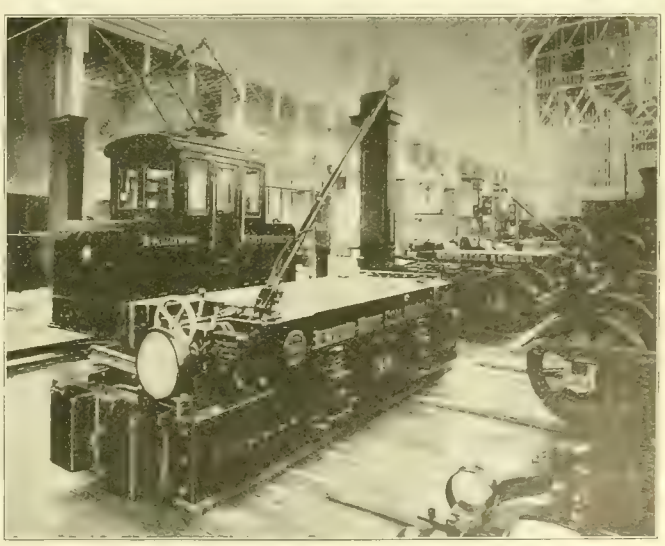
The straight air-brake rack shows the equipment now used in the straight air outfit on electric cars that are operated by one of their standard compressors. The compressors shown are of the axle and motor-driven types, in section for inspection of their internal working parts. One of the sectional compressors is fitted to move with a regular compressor in operation.

In the exhibit of the American Brake Company is shown a model of the outside equalizing brake for locomotives and the American automatic slack adjuster. The Westinghouse Automatic Air and Steam Coupler Company shows the ends of two freight cars fitted as movable models to show the operation of the device in actual practice. This also is shown on two small models fitted with air and steam and signal coupler. Under this model is another working model of the magnetic brake arranged to show the operation of the device.

The Union Switch and Signal Company's exhibit is a group of signals, full size and in working condition, erected in the Transportation Building. The company shows also examples of electrical apparatus for the operation and control of signals, photographs of various installations and a signal designed for use in the tunnels of the Pennsylvania Railroad under the Hudson River to New York city, shown in position in a full-size model of one of the tunnel tubes.



Switchboard and Rotaries.



Baldwin-Westinghouse Locomotives

WESTINGHOUSE EXHIBITS IN THE PALACE OF ELECTRICITY, ST. LOUIS.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.

TELEPHONE: MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

Association of Railway Telegraph Superintendents (annual meeting), Hotel English, Indianapolis, Ind., June 15th and 16th.

Canadian Electrical Association (annual meeting), Hamilton, Ont., June 14th to 17th.

High-pressure transmission convention of the American Institute of Electrical Engineers, Chicago, June 21st and 22d.

Indiana Mutual Telephone Association (annual meeting), Lafayette, Ind., June 28th and 29th.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 14th to 16th.

National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.

American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 17th and 18th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

AMID a multiplicity of conventions readers of the Western Electrician should not forget the "High-tension Transmission" meeting of the American Institute of Electrical Engineers to be held on June 21st and 22d in Chicago. This is a special meeting for transmission problems alone, and in that respect is something new—an indication of the increasing tendency toward specialization in the widespread electrical field. Particulars of the programme are given elsewhere in this issue, and there is reason to believe that there will be a good attendance.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

WHEN Leigh Hunt confidently declared that "Elia" was in plain truth a certain Mr. Lamb, the brilliant essayist described his distress as he lay "writhing and tossing under the cruel imputation of nonentity." As he very justly remarked, "When a gentleman is robbed of his identity, where is he?" In like manner the N-rays, about which so much has been said, might protest that they really exist, despite the incredulity of certain German and British physicists, for Blondlot's photographic evidence of N-ray activity seems to be sufficient to dispel the last lingering doubt. But it is curious that only French investigators, like Blondlot, Charpentier and a few others, are able to detect the phenomena attributed to the elusive N-ray. The fact has called in question the very existence of the new form of radiation, but on the whole there seems to be insufficient ground to relegate the stranger from Nancy to the limbo of nonentity of which Elia so touchingly complains.

DRAINAGE-CANAL power, when available, is to be sold to the city of Chicago by the Sanitary District at a "reasonable price," not donated at cost, as the city hoped. The resolution of the District trustees provides that "the surplus power over that required by the Sanitary District shall be devoted primarily to public uses and shall be disposed of at a reasonable price to the various cities, villages and towns within the Sanitary District or adjacent to the main channel, to be used in lighting the streets, or for the operation of pumping plants or machinery used for municipal purposes, or for public services, and that only such part of said waterpower as shall not be required for these public uses shall be disposed of to private persons or corporations, and then only at the highest prices at which it can be sold from time to time." As the city constitutes the greater part of the Sanitary District, it hoped to get the power for street lighting at actual cost. But undoubtedly the trustees do well to make a "reasonable-price" provision, for unless the enterprise is managed differently from the average municipal-ownership plant, no one will know, or, knowing, care to tell, what the real cost of producing the power is after two or three years of operation.

PRACTICAL hints about the installation of lightning rods are useful, for while there are many who are skeptical of the value of these contrivances, the preponderance of opinion is that they promise some immunity on isolated structures which are not themselves conductors. We find the following suggestions in the Monthly Weather Review of the United States government and credited to Professor W. S. Franklin of Lehigh University:

Good connection of a lightning rod to ground is a prime necessity in lightning-rod construction.

Straightness and directness of path to earth is the most important condition in so far as the arrangement of the rod is concerned.

A given weight of metal is much more effective as a carrier of rapid electrical oscillations or abrupt electric pulses when it is in the form of a ribbon or thin-walled tube or wire cable than when it is in the form of a solid rod.

If the path along the rod to ground is roundabout, the more direct path through the protected (?) structure is apt to be chosen by the electrical discharge, notwithstanding its poor electrical conductivity and in spite of any ordinary degree of insulation of the rod.

Given a good ground connection, then directness of path to ground from the region which is to be protected is so important that the matter of insulating the rod from the building, either by air space or by glass, is of no importance whatever in comparison. If the path is direct, there is no need of insulation; and if the path is roundabout, effective insulation is not practically feasible.

These are sensible suggestions, which should be useful to those interested in the subject.

One believer in lightning rods describes his experience during a thunderstorm at a mountain hotel in New York. He was standing on the piazza when "the most tremendous shock or concussion conceivable took place. I had a sudden sun dazzle in the eyes, a bitter taste in the mouth, a violent singing in the ears, a pungent, sulphurous odor in the nose and a severe headache. Then I learned that the house had been struck by lightning; that is to say, that the conductors had functioned effectively and had safely conducted the electricity into the lake, instead of the discharge falling upon the hotel and wrecking it."

STEAM TURBINES continue to attract the earnest attention of mechanical and electrical engineers, as is shown by the number of papers devoted to the subject at the meetings of the technical societies, both in this country and abroad. Several of these papers have appeared or will appear in the Western Electrician, although if we attempted to print them all in full there would not be room for much else in the paper. Papers by such men as Rateau, Emmet, Hodgkinson, Parsons, Eglin, Sargent and others have been presented within the last month, and the standing of the authors indicates the importance of the subject.

One of these papers was entitled "The Steam Turbine as Applied to Electrical Engineering," and was written by Charles A. Parsons, G. G. Stoney and C. P. Martin for the Institution of Electrical Engineers of Great Britain, before which body it was read on May 12th. This paper derives special interest from Mr. Parsons' prominence as a steam-turbine designer. The authors say that the first compound steam turbine (directly connected to a dynamo) was built in 1884. It was of about 10 horsepower and ran at 18,000 revolutions a minute, the diameter of the armature being about three inches. This machine, which worked quite satisfactorily for some years, is now in the South Kensington Museum. The greater part of the paper has to do with the economy of the turbine when supplied with superheated steam and a very high vacuum. From the data given it appears that for every additional inch of vacuum above 23 inches a gain of from three to five per cent. in steam consumption is effected, depending on the size of the turbine. In order to get a high vacuum, say above 27 inches, the authors recommend an increase in the circulating water from 30 to 50 times the weight of the steam consumed. This involves larger pumps to deal with the extra amount of water, but it is said that this only makes a difference of 0.4 per cent., which is not to be compared with the gain of four or five per cent. in the turbine by the use of increased circulating water. Beyond this, the authors also recommend a "vacuum augmentor," which acts in the same way as a steam exhauster, and sucks nearly all the residual air and vapor from the condenser and delivers it to the air pumps. The steam jet of this device consumes about 1½ per cent. of the steam required by the turbine at full load.

A noteworthy contribution to the discussion of this paper was made by Mr. Samuel Insull of Chicago, who was in England at the time of the meeting. Mr. Insull is credited with the statement that the cost of a turbine station in America is only about 50 per cent of the cost of a reciprocating station. This is taking into account the smaller buildings and foundations and the lower cost of plant. His experience was not in connection with the Parsons turbine, as that type was not made in sufficiently large sizes at the time the stations he referred to were put down, but with the vertical Curtis type. Mr. Insull's company has the largest steam-turbine central station in existence, and if he has been correctly quoted as to the relative first costs of steam-turbine and piston-engine stations, the statement, coming from such a source, is of importance.

ALTERNATING-CURRENT WORKING.

By W. B. Gump, Asso. Mem. A. I. E. E.

Part VI.

Power Transmission.

The articles thus far have dealt almost entirely with the apparatus used in the generation and utilization of electric power. The present description will take up the matter of transmitting power and will consider especially the features concerning high-tension transmission, since the latter involves features of its own in addition to those associated with the low-tension system.

It is useless to attempt to treat this subject in anything like a comprehensive manner, and it must be emphasized here that power transmission is indeed one of the broadest branches of modern engineering. Therefore the present discussion will concern itself only with the fundamental principles and supplement these with an outline of such problems as are commonly met in practice.

Classification of Systems.

Transmission systems are usually classified as "low-tension" when the line pressure is 1,000 volts or under, and as "high-tension" when the line pressure is above 1,000 volts. Systems above 1,000 volts are almost without exception alternating-current systems, since direct-current apparatus cannot handle such pressures successfully. The voltages commonly employed on direct-current circuits are 110, 220, 500, 550, 600 and 750. Of these the first four are the most common. On alternating systems the most common primary voltages are 1,000 and 2,000 volts for lighting systems, where the maximum distance of transmission is within one or two miles. The secondary voltages on such systems are from 52 to 104 volts, step-down transformers being used at the lamps. For arc-lighting or alternating systems, voltages from 1,000 to 3,000 are common, the lamps, of course, being connected in series.

The typical high-tension system is one in which the alternator has a pressure upward of 2,000 volts and the transmission line a voltage of from 10,000 to 40,000 volts. The maximum voltage which can safely be generated at the terminals of a well-designed alternator is about 13,000 volts. The limit of the voltage is restricted to the conditions of good insulation, and the difficulties in maintaining the latter increase rapidly when 13,000 volts is reached. The voltage on the line may be made considerably higher, since no moving parts are required to make the transformation, stationary coils being more effectively insulated. The question of voltage will be discussed more at length further on.

Determination of Frequency.

One of the first questions which confront the engineer who is about to design a transmission system is what frequency to adopt. In order to determine this question the conditions of the case have to be weighed carefully. No hard and fast rules can be given which will settle this question, as each particular case must be decided by the demands of power required, the nature of the power and cost of the same. This can be done only by a careful study of the local conditions followed by the exercise of a liberal amount of good judgment. The tendency of present-day practice in this country is toward low frequencies—60 cycles and under. A frequency above 60 cycles is considered a high frequency. Where the greatest portion of the load is power, a low frequency should always be adopted—40 cycles or under. This will depend somewhat upon the size of the plant. The Niagara Falls Power Company has adopted 25 cycles, which is used for the bulk of power generated. Where it has been found necessary to use a high frequency, such as the Buffalo lighting system, a frequency changer is employed which raises the frequency to 60 cycles. Forty cycles have been used quite successfully in connection with mixed loads (both power and lighting). This frequency is used by the Hudson River Power Company, whose system conveys power both for railways and for lighting.

The cost of apparatus, especially transformers, is often the determining factor as to frequency, since high-frequency transformers cost less than those of low frequency. This fact may easily be shown mathematically:

It was formerly shown that $E = \frac{4.44\,\phi\,N\,f}{60 \times 10}$

when ϕ = total flux (maximum),
f = frequency,
N = number of turns,
E = Electromotive force, primary or secondary, as the case may be.

Now, $\phi = A \times B$ when A = area, and B = flux density.

Therefore $E = \frac{4.44\,A\,B\,N\,f}{60 \times 10^5}$

From which $A = \frac{60 \times 10^8\,E}{4.44\,B\,N\,f}$

The last equation is the fundamental equation of transformer design, and it shows that for the same flux density and voltage the product of the area of iron cross section and number of turns varies inversely as the frequency, hence the cost decreases in proportion. The cross section of copper remains constant for the same capacity regardless of frequency. A saving in copper is of course affected because diminishing the cross section of iron decreases the length of the copper path surrounding it.

Generators of high frequency may be built at a lower cost than low-frequency machines. This will be evident from the fact that high frequency denotes high-armature speed, and therefore a greater output. For arc and incandescent lighting high frequencies are always to be recommended. Arc lamps do not operate with satisfaction on frequencies below 40 cycles. The satisfactory operation of incandescent lamps depends primarily upon voltage and candlepower. High-voltage lamps have thin filaments, while (for the same candlepower) low-voltage lamps have thick filaments. The former filaments radiate heat much more readily and for this reason are not suited to low frequencies, because more time is allowed for the filament to cool while the current is passing through its zero value. Low-voltage lamps (on the other hand) having thick filaments consequently have a greater heat capacity. Such lamps may be operated on frequencies as low as 25 cycles.

While high frequencies point to a material reduction in cost, there are some other features encountered which may more than offset the advantages gained by the former. In the first place the inductance both of the apparatus and transmission line increases directly with the frequency. The wattless currents which are due to inductance (and to capacity) will also increase. This will incur a greater loss in the generator, line and apparatus used, and will therefore necessitate a greater output to make up for these losses. High-frequency generators, synchronous motors and rotaries are much less satisfactory on high frequencies, and the difficulties met in connection with paralleling become very serious.

Induction motors are not suited to high frequencies. With a constant power factor and constant speed the size of an induction motor must increase with increase of frequency, the power remaining constant.

In summing up the matter of frequency it is safe to say that for power installations a frequency of 60 cycles is almost never exceeded. Forty cycles is often used for a mixed load both for local use and on large distribution systems. For power alone 25 to 30 cycles is to be recommended in the majority of cases.

Determination of Voltage.

The next question which arises is what voltage to use. The general statement may be made that the voltage for transmission within an immediate locality should be as high as safety will permit. On long transmission lines where step-up transformers are used the line pressure should be as high as the physical conditions of the case allow, together with due consideration of human life. For example, a transmission line extending along a sparsely populated district, such as a western plain, could carry current at a working pressure as high as 60,000 volts, while a similar system in a thickly populated district would have to use a lower voltage in consideration of life and property in the neighborhood through which it passed.

If the frequency, the amount of power to be transmitted and the percentage of line loss remain constant the cross section of conductor will vary inversely as the square of the impressed voltage. If the impressed voltage is increased V times, the drop may be increased V times without changing the line loss, for the line loss is to the total power as the drop in volts is to the impressed voltage on the line. To produce the same power at V times the voltage, only $\frac{1}{V}$ times the current in first case is necessary. In order for this current to produce a drop equal to V times the first, the resistance must be increased V^2 times.

According to the above demonstration it would be natural to infer that there is no limit to the distance that electric power may be transmitted with a given loss. While this is true from a theoretical standpoint, it cannot be carried out in practice on account of the serious mechanical difficulties encountered with reference to suitable insulation. For voltages up to 15,000 the difficulties of insulation are not serious. When 20,000 is reached difficulties begin to multiply rapidly and the problem of insulation becomes a grave one. In dry sections of the country pressures of from 40,000 to 60,000 volts are handled successfully, but where the atmosphere is damp or saline these pressures cannot be adopted with safety.

As the voltage increases the leakage increases very rapidly. This fact was learned by means of an

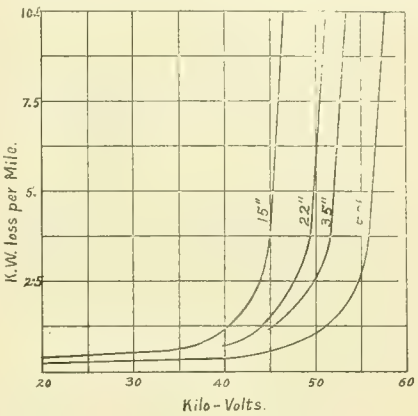


FIG. 55. CURVES SHOWING RELATION BETWEEN LINE LOSS AND VOLTAGE.

experimental transmission line upon which a series of tests were made. These experiments were conducted by Mr. C. F. Scott, and the results are of such interest that they should be noted. In Fig. 55 a series of curves is shown, which are plotted between values of line voltage and line loss. The figures on the respective curves denote the distance between wires in inches. It will be seen that the loss decreases for a given voltage as the distance between wires is increased, a marked difference being shown between the first and last curve. It was found that rain, snow and ice had very little effect upon the line loss. It was also noted that a peaked wave form gave a greater loss than a flat top, and that the loss decreased as the diameter of the wire was increased.

The size of wire has an influence upon the leakage, a small wire causing a greater loss than a large wire. This may be understood from the fact that the nature

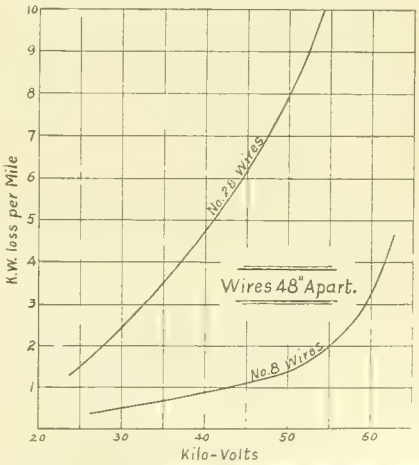


FIG. 56. CURVES SHOWING RELATION OF LINE LOSS AND VOLTAGE IN LARGE AND SMALL WIRES.

of a large conductor is such that it will withstand a greater electrostatic stress than a small conductor. Curves are shown in Fig. 56 which indicate the superiority of a large wire over a small one.

Resistance Inductance and Capacity of Transmission Lines.

The resistance of an alternating-current line is greater for the same impressed pressure than that of a direct-current line of the same dimensions. The difference is not appreciable on small line wires; but where the conductors are very large the effect is quite noticeable. The reason for the increase in resistance is due to counter-electromotive forces set up in the conductors, which cause more flux to circulate around the wire, since more current tends to

flow in the larger wire than in a small one. These counter-electromotive forces are set up inside the wire and they tend to keep the current away from the center of the wire, forcing it toward the surface. This is called the "skin effect." In the majority of transmission systems up to 20 miles in length and for voltages of from 10,000 to 15,000 the skin effect does not have to be taken into account.

On long transmission lines the inductance is considerable and should be taken into account. The flux surrounding the line conductors varies with the frequency and therefore sets up a counter-electromotive force on the line, which, if any considerable length, amounts to a material loss. The inductance together with the resistance causes an impedance which may be calculated quite accurately. For convenience in making calculations tables of impedance factors have been constructed for several standard frequencies, giving values per mile of wire for various sizes and for different distances between wires. Methods of computing transmission lines using these line constants will be demonstrated later.

The capacity effect on a transmission line is obviously opposite to that of self-induction and becomes quite appreciable on a long system, especially when the conductors lie close together. It should be noted that the capacity of a line increases as the distance between wires is decreased. With reactance the opposite is true, the reactance, and hence the impedance, decreasing as the distance between wires decreases. In almost all cases in practice the inductance is greater than the capacity. A relation may be had, however, in which the capacity will exactly balance the inductance. When this condition is reached the circuit is said to have "resonance." The equation for a circuit having resonance is $2\pi f L = \frac{1}{2\pi f C}$, in which L = inductance in henrys and C = capacity in microfarads. Resonance indicates that the current has neither lag nor lead, and that each impulse sent over the line is perfectly balanced. Under these circumstances the circuit is said to be "in tune."

When such a condition exists the voltage at the receiving end may be much greater than the voltage

TABLE I.

Distance Apart 24 [illegible] — Size Wire B. & S.	Impedance Factor — 60 Cycles.	Impedance Factor — 120 Cycles.
0000	2.3	[illegible]
000	2	[illegible]
00	1.7[illegible]	[illegible]
[illegible]	1.5[illegible]	2.8[illegible]
1	1.3[illegible]	2.1[illegible]
[illegible]	1.28	1.8
[illegible]	1.1[illegible]	1.6[illegible]
[illegible]	1.12	1.[illegible]2
[illegible]	.98?	1.[illegible]
6	1.[illegible]	1.2[illegible]

at the terminals of the generator and may rise to a value sufficient to break down the insulation of all the apparatus involved. In cases where resonance exists the relation between electromotive force, current and resistance follows Ohm's law and becomes $C = \frac{E}{R}$ where C, E and R are the effective values, respectively.

LINE CALCULATIONS

While there are "cut-and-dried" formulæ devised to be used in line calculations, the majority of such formulæ are of little value in themselves, since they fail to take into account the local conditions of the line in question, such, for example, as leakage due to a damp atmosphere, probable increase of power demanded, cost of installation and the interest on the investment. The latter features have no bearing on the theoretical conditions, but they do have a decided bearing on the practical side; so much so that the theoretical formulæ are often greatly distorted in order to meet the commercial demands of the case. Here again judgment and common sense are necessary as well as the mathematical principles.

The rudiments of transmission-line calculations will now be given, with a sufficient number of examples to demonstrate the methods of procedure ordinarily followed.

Having decided upon the voltage to be adopted and the amount of power to be delivered the next item to be settled is the loss on the line. Suppose, for example, that 3,000 horsepower is to be delivered 12 miles by a three-phase, 60-cycle transmission system, the voltage at the receiving end being 10,000 and the line loss not to exceed 12.5 per cent. of the generated power. Assume further that the load is to be mixed, containing both lighting and power, the latter to exceed the former, and be utilized in operating induction motors. It is safe to assume that the induction motors will run normally on a power factor of 85 per cent.

On a system of this kind it will be necessary to use transformers. Instead of using step-up transformers at the generator, suppose they are dispensed with, using only the step-down transformers at the receiving end. As to transformer efficiency, 97.5 per cent. is a good figure to assume. The line loss will then be

$$12.5 - 2.5 = 10 \text{ per cent.}$$

3,000 horsepower = 2,240 kilowatts delivered; that is, to be taken from the secondary terminals of the step-down transformer. With a loss of 12.5 per cent. the amount of power delivered is 87.5 per cent. of the power generated, and 97.5 per cent. of the power at the terminals of the high-tension mains, or

$$\frac{2{,}240}{97.5} = 2{,}300 \text{ kilowatts (nearly).}$$

On a power factor of 0.85 the apparent energy will be

$$\frac{2{,}300}{0.85} = 2{,}700 \text{ kilowatts}$$

Now, since the number of watts transmitted by a three-phase system is expressed by

$$W = \sqrt{3}\, E\, C,$$

then

$$C = \frac{W}{\sqrt{3}\, E}$$

From this equation the current flowing will be

$$C = \frac{2{,}700{,}000}{1.732 \times 10{,}000} = \frac{270}{1.732}$$

$$= 156 \text{ amperes per conductor.}$$

Allowing a C R drop of 10 per cent. (according to the conditions stated), the voltage at the generator necessary to overcome the ohmic resistance will be

$$\frac{10{,}000}{0.9} = 11{,}111 \text{ volts.}$$

Therefore the line resistance will be

$$R = \frac{E}{C} = \frac{11{,}111}{156} = 74 \text{ ohms}$$

$$\text{Ohms per mile} = \frac{74}{12} = 6.16 \text{ ohms.}$$

According to B. & S. wire table, this resistance corresponds to No. 10. It is seen at once that a No. 10 will not carry more than 32 amperes. Therefore a No. 1 wire (which carries 156 amperes) is the smallest size that can be used. The resistance per mile of No. 1 wire is 0.671 ohm, and for 12 miles = $12 \times 0.671 = 8.05$ ohms. The C R drop in the line will therefore be $156 \times 8.05 = 1{,}250$ volts (approximately).

The reactance must now be considered in order to obtain the impedance on the line. Observing Table I. it will be seen that the impedance factor for No. 1 B. & S. wire is 1.39. The impedance electromotive force will then be $1{,}250 \times 1.39 = 1{,}740$ volts (nearly). The electromotive force at the generator terminals must therefore be $10{,}000 + 1{,}740 = 11{,}740$ volts.

In the above example it was necessary to make a compromise between the generator electromotive force and the size of wire. More often the voltage of the generator is decided upon at once and the size of the wire made to suit. In such cases it is generally necessary to make several preliminary calculations since the line impedance cannot be determined without knowing the size of wire.

When the conductors are large it is always advisable to use several small ones in place of a single conductor; for example, if it were necessary to have a cross section equal to a No. 0000 wire, it is better to divide it into two No. 0 wires, or better still, four No. 000 wires. In this way the system may be better balanced and the impedance reduced.

Looking at the commercial side of the problem just given, the cost of the high-tension line will show that a large part of the investment is in the line itself. In order to determine the approximate cost of the copper alone it is first necessary to ascertain the total weight of copper involved. It has been found that 1,000 feet of wire with a cross section of 1,000 circular mils weighs nearly three pounds. This being true, it is a simple matter to construct a formula for the weight of copper of given dimensions.

If L = length of wire (all three conductors) in thousands of feet, then the total weight is

$$\text{Wt.} = \frac{L \times 3 \times c\ m}{1{,}000}$$

In the problem given above

$$L = 12 \times 3 \times 5.28 = 190$$

Therefore,

$$\text{Wt.} = \frac{190 \times 3 \times 83{,}690}{1{,}000} = 47{,}700 \text{ pounds (approx.).}$$

At 20 cents per pound this would represent an investment of $0.2 \times 47{,}700 = \$9{,}540$. Interest at six per cent. per annum on this amount is $572.40. These items of cost are of course exclusive of every item except copper. The cost of poles, insulators and crossarms depends upon so many conditions, which vary in different localities, that it would be fruitless to attempt to compute the cost of the equipment.

In making preliminary wiring calculations there are several formulæ which may be used to determine at once the quantity sought, and for ordinary calculations they are sufficiently accurate. The fundamental formula used is based upon Ohm's law, being modified by constants depending upon the system.

If D = distance of transmission (feet) one way,
W = total number of watts delivered,
P = per cent. of watts lost in line,
E = voltage between main conductors at consumer's end,

then
$$\text{c. m.} = \frac{D\,W\,K}{P\,E^2}$$

and
$$\text{volts lost in line} = \frac{P\,E\,M}{100}$$

$$\text{Current in main conductors} = \frac{W\,T}{E}$$

The quantity K is a constant for the particular requirements of the system. Values of K and T are tabulated in Table II. for several power factors.

TABLE II.

System	Values of K. Per Cent. Power Factor. 95	90	85	80	Values of T. Per Cent. Power Factor. 95	90	85	80
Single phase	2400	2660	3000	3380	1.052	1.111	1.172	1.250
Two-phase (4 wire)	1200	1330	1500	1690	.526	.555	.585	.625
Three-phase (3 wire)	1200	1330	1500	1690	.607	.642	.675	.725

The values of M are empirical and depend upon the size of wire and also upon the nature of the load. Values for several sizes of wire and frequencies are tabulated in Table III. The convenience of these

TABLE III.

No. B. & S.	Area in C. M.	Values of M. — 30 Cycles. Lighting Only. 95% P. F.	30 Cycles. Motors and Lights 85% P. F.	60 Cycles. Lighting Only 95%.	60 Cycles. Motors and Lights. 85	125 Cycles. Lighting Only. 95%.	125 Cycles. Motors and Lights. 85%.
0000	211,600	1.26	1.27	1.61	1.55	2.44	3.06
000	167,805	1.20	1.1	1.4[illegible]	1.63	2.15	2.62
00	133,079	1.15	1.08	[illegible]	1.46	1.92	2.25
0	105,592	1.10	1	1.30	1.32	1.73	1.96
1	83,694	1.06	1	1.23	1.21	1.57	1.74
2	66,373	1.03	1	1.16	1.11	1.44	1.51
3	52,633	1.02	1	1.11	1.04	1.35	1.38
4	41,742	1	1	1.07	1	1.26	1.26
5	33,102	1	1	1.04	1	1.19	1.16
6	26,250	1	1	1.02	1	1.14	1.08

formulæ is readily seen, and for short transmission systems they are accurate enough for practical purposes. In very large transmission systems such equations cannot take into account the additional losses and the commercial features, which are the important factors in large systems. The more extensive the system the more minute are the details, and in such cases there is no short road to the solution; indeed a large transmission system demands a liberal amount of the closest and most accurate calculating before its character can be determined. In concluding this description it will be well to show a comparison of the relative amounts of copper required for different systems, since this has an extremely important bearing on problems relating to transmission. A comparison of various systems and the amount of copper required by each is tabulated in Table IV., in which the single-phase system is

TABLE IV.

System.	Number of Wires.	Per Cent. Copper.
Direct Current.	2	50
Single phase.....	2	100
Two-phase	[illegible]	145.7
Two-phase...	4	100
Three-phase	[illegible]	75

100. This table was constructed by Mr. Steinmetz, and in preparing it he has taken into account the thickness and cost of insulation and the danger to life and property, all of which depend upon the maximum value of the electromotive force. Upon this basis the items tabulated have quite a different value from those which would result by considering merely the electrical conditions of each system.

[*To be concluded.*]

Underground Construction.

By W. P. Hancock.

Part II.

I have found by experience that a mason's helper at $2.50 a day of 10 hours will mix and deliver to the mason in the trench, or the duct layer, one yard of mortar, and that one yard of mortar will lay 1,500 feet of duct, same having beveled edges and a length of 18 inches, and an ample provision for wasted material is also considered in the amount of mortar stated for 1,500 duct-feet.

The cost of mortar per duct foot would be $0.0026 and the cost of mortar for our 15-duct line would be per conduit-foot $0.0390; cost of labor to mix and place mortar would be per duct-foot $0.0016 and per conduit-foot for 15-duct line would be $0.0240.

Ducts Laid.—Cost is based on the ducts being laid beside the trench at $0.0502 per duct-foot, and this includes teaming from the cars to the trench at a cost of $0.75 per ton. (The weight of an 18-inch length of three-inch duct is 13 pounds, or nearly nine pounds per foot.) The ducts, then, for our 15-duct line would cost $15 \times 0.0502 = \$0.7530$ per conduit-foot; cost of labor to lay ducts is based on mason's labor at $4 a day of 10 hours, and a helper at $2 a day of 10 hours, or a total of $6, and these two men will lay an average of 1,500 feet or 1,000 length a day; therefore, the cost of labor per duct-foot will be $\frac{6.00}{1,500} = \$0.0040$; and the cost of a conduit-foot in our 15-duct line will be $\$0.0040 \times 15 = \$0.0600$.

Paving.—Cost of paving is based on actual bids submitted by Boston contractors for replacing paving, no new blocks being furnished by the contractor to make up any deficiency or loss by breakage of blocks. The price which I shall designate as the average cost of paving is for stone block paving only, and does not include asphalt nor wood paving. Our bids have come along as follows:

	Per yard.
Replacing stone blocks on six-inch concrete base, pitch and pebble joints	$2.00
Replacing stone blocks on six-inch concrete base, Portland cement joints	1.85
Replacing stone blocks on six-inch concrete base, gravel joints	1.40
Replacing stone blocks on gravel, gravel joints	.50

making the average cost approximately $1.44 per square yard for this work. (If the surface is of asphalt the cost of replacing will be $3.50 per square yard or 39 cents per foot.) For the cost of repaving our street over our 15-duct line we will use the average price per yard, and we know that the net width of the trench is 32¼ inches, and we will add to this a margin of 12 inches on each side, thus making the width to estimate from 56 inches approximately; and if we multiply this figure by 12 and divide by 144 we shall have the number of square feet of paving, per conduit-foot, on the 15-duct line, which is 4.7 feet. Our paving costs $1.44 per yard or 16 cents per square foot; then the paving per duct-foot would cost $0.0500, and per conduit-foot $0.7500.

Haulage of Dirt.—Cost is based on bids submitted of 50 cents per double-team load of 35.1 cubic feet, or $0.0142 per cubic foot, and this figure is obtained on the basis of a double tip cart removing to the most convenient dump or other point 10 loads a day of 10 hours (the laborers filling the carts) at a cost of $5 a day for the team. On our 15-duct line we still have surplus earth which must be removed, and at such times and in such quantities as will prevent criticism from the city officials and from the abuttors, and therefore, as we know our trench is 32.25 inches wide and the total depth of the construction is 22.25 inches, then $\frac{32.25 \times 22.25 \times 12}{1,728}$ equals the amount of earth or refuse we must remove for each conduit-foot of the line constructed. This amount will be 4.9 cubic feet, and the cost per duct-foot will be $0.0047 and per conduit-foot $0.0705.

Inspection.—In most cities the municipal corporations will insist on placing on your payroll an inspector or inspectors, and I have found that the amount of money required for this purpose in several separate seasons amounts to nearly $5 a day of 10 hours, and the amount has been so near $5 that I have used that figure in all tabulations. Then it follows that if we are completing 1,500 foot of duct a day, or 100 feet of the 15-duct line, the cost of inspection would be $\frac{5.00}{1,500} = \$0.003$ per duct-foot, and per conduit-foot $0.0495.

Engineering Expense.—The cost of engineering expense on the trench and in the office for 43,706 duct-feet amounted to $0.0214 per duct-foot on data kept very accurately, and as this figure is from actual experience we will use it.

Incidentals.—Cost of incidentals is based on five per cent. of the total cost, including every expense.

Manholes.—I believe we agreed that we would have four manholes in the line and that the dimensions would be as follows: Five by five feet area inside, seven feet deep, eight-inch walls without shelves, drained to the nearest sewer and having on each manhole a heavy frame and cover of the "sewer type." (See Figs. 1 and 2, given last week.) Then we shall need for material:

23.76 cubic feet concrete, cost in place $0.202 per foot	$ 4.78
2,500 hard sewer brick, cost $9 per 1,000	22.50
1¾ S. six-inch trap and connections, cost	5.65
30 feet six-inch Akron sewer pipe, cost 30 cents per foot	9.00
Railroad steel (60 pounds to the yard), eight pieces six feet four inches long (1,013 pounds), cost $0.0125 per pound	12.67
1⅓ yards mortar, cost per yard $3.98	4.47
One manhole frame and cover, 962 pounds, cost $0.015 per pound	14.43
	$73.50

We shall need labor that will cost as follows:

Excavate and backfill part of same, including that for sewer connections, 785 cubic feet, cost $0.0278 per foot	$ 21.82
Remove from street 304 cubic feet of dirt, cost 50 cents double load or $0.0142 per foot	4.30
Pave 11.08 yards (including manhole and sewer connection), cost $1.44 per yard	15.95
One mason 10 hours, cost 40 cents per hour	4.00
Two mason helpers, 10 hours each = 20 hours, cost 15 cents per hour	3.00
	$49.07

Total cost one manhole, complete..... $122.57

We have now found the cost of the line per conduit-foot and also the cost of one manhole, and we may now summarize and show in tabulated form what the cost will amount to for each item included in the line, both for material and labor and for one duct-foot, one conduit-foot and the total line, and we will make the table conform with the order in which we have taken up the separate items so that the whole will be as plain as possible and at the same time complete, and when the table is complete the central-station man can, it seems to me, easily figure the cost of a line other than our 15-duct line, the cost of which we have tried to find; but as a matter of course the prices of material change from time to time, and that must certainly be considered, and the increased or decreased cost of labor if necessary.

Material—	Cost per Duct-foot.	Cost per Conduit-foot. Total Expense.	Total Cost for Each Item for the Total Line.
Lumber at $15 per M. or .015 cents per square foot B. M.	$.0105	$.1575	$233.10
Concrete at $4.85 per cubic yard or 18 cents per cubic foot	.0231	.3465	514.15
Mortar at $3.98 per cubic yard or 14 cents per cubic foot	.0026	.0390	58.00
Ducts laid down beside the trench at $.0502 per duct-foot	.0502	.7530	1114.44
Labor —			
Excavate and backfill at 15 cents per hour or $.0278 per cubic foot.	.0266	.3990	592.06
Cut and place lumber at 20 cents per hour or $.0006 per square foot B. M.	.0004	.0060	9.32
Mix and place concrete at 15 cents per hour or $.0222 per cubic foot	.0029	.0435	63.48
Mix and place mortar at 25 cents per hour or $.0925 per cubic foot	.0016	.0240	37.00
Lay the ducts at 60 cents per hour or $.0040 per duct-foot	.0040	.0600	88.00
Haul away the dirt at 50 cents per hour or $.0142 per cubic foot	.0047	.0705	104.72
Pave the trench at $1.44 per square yard or $.16 per square foot	.0500	.7500	1109.02
Cost of manholes per duct-foot Total cost of manholes 490.28	.0221	.3315	490.28
Total number of duct-feet 22,200			
Inspection at 50 cents per hour or $.0033 per duct-foot	.0033	.0495	73.26
Engineering expenses at $.0214 per duct-foot	.0214	.3210	475.08
Incidental expense at 5 per cent. of total	.0116	.1740	248.22
	$.2359	$3.5385	$5210.73

Now that we have the table we had better see how we obtained the figures—that is, what method we employed, even though on preceding pages the figures themselves appear. The total line is 1,500 feet long and has four manholes, and the duct line will extend to the inside of the walls, and as the manholes are five feet square inside, it follows that 1,500 less $4 \times 5 = 1,480$ feet, or the total length of the duct line, and as the cross-section contains 15 ducts, the total duct-feet when the line is complete will be 22,200; and as we have already determined the cost per duct-foot and per conduit-foot, we have only to bear in mind that the total amount of duct-feet in the line are the figures to multiply by instead of any other, and it is the proper method by which to arrive at the total cost of the duct line; and the total cost of the manholes should be divided by the total duct-feet in order to arrive at the proper cost of manholes per duct-foot of line, and which, when added to the cost per duct-foot of the duct line, gives a total cost per duct-foot for the total line. A deviation from this method is liable to lead one astray, as small fractions will make a very considerable difference when a large number of duct-feet are to be used. We now have a tabulated form and have shown how we arrive at these conclusions, and we know the cost of our duct line alone, per duct-foot, its cost with the cost of manholes per duct-foot added, the total cost per conduit or total trench-foot which includes the manholes, also the total cost of each item for the total line, and in fact everything needed in the nature of an itemized estimate, and with the data on the preceding pages it is perfectly easy to tell how much material of each kind you need, and even how much money you need for your payrolls.

Of course the table is not correct for all types of duct, paving or manholes of a different type or size from those given herein, but you now have the method at hand showing how the cost of the line, or a line, can be obtained, and also the sketches which will indicate the reasons for basing the figures as shown.

We have gotten at the estimated cost and now we will take up the methods of starting and carrying forward to completion the total line.

We can assume that the engineer and contractor are on the ground and that the former has the requisite permits at hand to enable him to open on the first part of the line, and that you intend to make a start by opening about 300 feet, or 20 per cent. of the total length, and we will also assume that you intend to finish 100 feet per day, or more, until the work is complete. You therefore can afford to have 50 men ready to go to work on the start, and your first move will be to measure off from the curb or other mark, and with a piece of chalk or a line indicate the distance from the curb, and the next, the width of paving to be removed, and as soon as this is done have the men begin to bar out the paving, and as soon as you have a space showing dirt only for a distance of 25 feet get some of the men in the opening with the picks and let them work ahead. As more blocks are removed, and where the men have used the picks, get in some others with shovels and have the line followed in this manner until the blocks are out for the total 300 feet, and then put all of them on the picks and shovels, except what you need to open on the first manhole location, for this part of the excavation should be completed as soon as the trench. We can assume that in due season the trench and manhole excavations have been bottomed out, and in the meantime your material has arrived and sideboards have been cut and cleated, one or two bridges installed over the trench, concrete has been mixed and is ready to go in; so the first sideboards are set, and then the concrete can begin to go in for the bottom, and as soon as the first 25 feet of concrete is in and rammed the duct-laying can begin, as close to the manhole location as possible, and the duct layer must not forget to start his mandrels as soon as sufficient duct is laid to take them, and continue to draw them as the line lengthens and keep the ducts clear.

Now you have the trench fully under way and you find that the sewer trap is set and the concrete is going in for the base of the manhole, and that the mason's helpers have got the material at hand to start brickwork; and now all of the work is started, and by the next day, or 24 hours later, you find that a system of working the men has been established, your duct is being laid, the side and top concrete goes in, the top planking is laid on, and you begin to backfill the trench with the best of the material that came out; then you are ready to replace the paving and clean up as much as you can where the work is completed, and now you want to go ahead faster. By faster I mean that having started with a few men and having got them broken in, so to speak, you must arrange practically to duplicate your force and complete at least 3,000 duct-feet (200 conduit-feet) or more of this size of line a day; for with the conditions favorable and work properly superintended it should not require more than nine days at the outside to complete our 15-duct line, 1,500 feet long, with four manholes. Of course, if you are in a district in which you will encounter tidewater, or if you have difficult obstructions to overcome, such as water or gas mains, or any other services, and if you have to build waterproof manholes or spend a great deal of time in getting such services as spoken of removed, then the time required will be greater, as will the expense, and under such conditions as above there is a good opportunity for your general foreman to exercise his skill in finding work for his men of a profitable nature on other parts of the line and to show his judgment in laying them off, if necessary, until such arrangements are completed as will admit of procedure on the line at a rate of speed that will warrant the figures that will show on the coming payroll.

I think, perhaps, that the central-station man can now see fairly plain what is required to build his line, from the first step necessary down to the time when he is well under way with the installation of the same, and we can assume also that he can finish it without difficulty; but we have talked of a plain and simple line, for that is the easiest to illustrate, and shows what you must do in order to complete the installation of any line of a like nature.

I realize, however, by experience, that at times we must build lines under bridges, perhaps over or through them, and under, over or through all sorts of obstructions, and constructions, some of which may be our own, but if they are visible on plans before we open ground and proper thought is given such matter, they are not difficult as a rule, and if we meet them after opening ground we must think the matter out as soon as possible, always keeping in mind that if it is required to obtain permission to cross in any way another corporation's property a start should be made at once in that direction, and not find, when your plans are nearing completion for any special work that such permission is impossible to obtain and that the time of several men has been wasted. In fact, the principal part of the proper method of handling underground work lies in the ability of those in charge of it to look ahead and be ready to let the working force, which they know are coming behind them, into the location without

delay, and unless this condition obtains the work will be expensive.

Cables.—When the central station man has completed his conduit the next item he needs will be cables, and as we speak of them you will recall that in preceding pages I said that "it was the imperative duty of the assistant engineer to make notes on the conduit line, with such accuracy and in such volume as to absolutely correct the original plans," and if this has been done you can easily find out how much cable you need from the measurements he has furnished, as the plan for each section of the line should plainly state the length of cable needed in that section and have included in the figure 12 inches square on each end of the length, so that the cable jointer will be able in his work to cut back any distance within that limit and cut the cable at a point where there is no dampness (which may or may not have accrued on the extreme ends of the length) and where the form of the sheath, insulation and core of the cable is perfect.

If you have a low-tension distribution system you will use perhaps cables from 2,000,000 circular mils concentric and 1,000,000 circular mils single conductor down to 500,000 circular mils single conductor for feeders, and from 500,000 circular mils down to 200,000 circular mils for mains. If alternating current is in use probably you will use a great deal of cable which has more than one conductor under the same sheath, and of course the saving of duct room is added to the other advantages when you can use such a cable, whether it be in the alternating-current or direct-current system. The insulation for the feeders and trunk lines will probably be paper, as it is best adapted for an overload of amperes, and its insulation to the ground shows a very high resistance if it is well jointed. Do not, however, insist on having a paper-insulated cable test too high. I have learned from more than one reputable manufacturer of cable that they could give you this type of insulation on a cable to test 1,000 megohms to the mile, when in their judgment 500 megohms to the mile was much better, as the resistance of the insulation was dependent, if the same cable was considered in each case, on the amount of drying out by heat that the ingredients used in the insulation received, and that the drying-out process reduced the flexibility of the insulation and made it more liable to crack when being bent into place; and we know by experience that a cable with the paper insulation cracked or broken will be used in service but a short time on either a high or low-tension line. The better way is to determine what cables you need in sorts and sizes, and specify the quantity of each, and submit the list to several reputable concerns, with your request for a price and guaranty from them on each type of cable, to cover a term of years, say five, being careful to state in your specification what the cable is to be used for, whether alternating-current or direct-current work, the voltage to be used on the line and the ampere-carrying capacity required, and then let the manufacturer furnish such cables, with an insulation resistance (to be specified by him) to the ground, that he thinks will stand with the specified voltage, and still maintain his guaranty given you in the contract.

Installation of Cables.—I would much rather see the concern which furnishes cables for new work install them, and for the reason, first, there is a guaranty on the goods, and if, when the dealer installs them, after the total line or lines are drawn and jointed they do not test out properly the burden of making them right falls on the vendor without question.

I would first tell him in specification that he must rod the ducts, at the same time informing him that the company had drawn mandrels through every duct as it was laid, and that they were clear to the best of your knowledge; but notwithstanding that fact, if he did not rod them and then encountered difficulty, such as having cable sheaths cut in process of drawing, that he would be responsible for any expense incurred thereby. When the ducts were known to be clear and the drawing-in done to an extent that jointing could begin, it would not be necessary to say to the cable contractor, you must not joint cable in wet weather, or you must not delay jointing in dry weather, for the conditions of the contract, with reference to the guaranty, would not consistently admit of progress in one case nor delay in the other, when by the contract we know that he is to rod the ducts, draw in and joint the cables at a stated price per foot, and the sooner he can get the work done, and well done, the better off financially his company will be.

[*To be concluded.*]

Samuel Insull on the Steam Turbine.

Under date of May 25th the London correspondent of the Western Electrician writes: "At the last meeting of the Institution of Electrical Engineers a paper on turbines read by the Hon. C. A. Parsons, was discussed. The most interesting part of the discussion was a neat speech made by Mr. Samuel Insull of Chicago, president of the Commonwealth Electric Company, who referred to the installation of Curtis turbines at his company's new power house in Chicago. He gave it as his opinion that, upon American prices, the capital cost of a power house using turbines could be cut down by one-half, and the working expenses by 30 per cent. The latter he did not attribute entirely to the turbines, but to the better design of the station generally and particularly to the excellence of the mechanical arrangements. Later on in the discussion a tribute was paid to Mr. Insull for the good such men as he had rendered the industry in giving new inventions such an early trial, as had been the case at Chicago."

Joint Meeting of the British and American Mechanical Engineers.

Chicago was the scene, last week, of what was probably the largest gathering of mechanical engineers ever held, the occasion being the joint convention of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers of Great Britain. Nine hundred and thirty-three persons were registered, the large number in attendance and the excellent programme, which was prepared and carried through without a hitch, making the convention a complete success.

Members of both associations began to arrive on Tuesday, May 31st, and repaired to the headquarters at the Auditorium Hotel for registration. Each member or visitor received a blank which he filled out with his name, grade, home address and convention address; a convention number was also given each. From these blanks a complete list of those in attendance was printed for distribution during the convention. Badges were given each member of the two societies upon which were the name and number of the wearer. Guests received numbers. This method of registration and numbering was found to be most convenient.

The opening session was held Tuesday evening in the Fine Arts Building and the members of the two societies were welcomed by City Controller McGann. President Ambrose Swasey of Cleveland responded in behalf of the American Society and President J. Hartley Wicksteed in behalf of the British Institution. Following the meeting the delegates were given a reception in the parlors of the Auditorium Hotel. About 100 delegates were present from abroad.

Business began in earnest at the session Wednesday morning, which was held in the hotel, "The Wages Problem," by Harrington Emerson of New York, being the first paper. "A minimum living wage below which no one should accept employment" Mr. Emerson believed to be one of the solutions of the labor question. Following Mr. Emerson, George Watson of Leeds, England, presented a paper on "Some Recent Examples of Destructors for Town Refuse." A paper on a similar subject, entitled "Refuse Destruction by Burning and the Utilization of the Heat Generated," by Russell Newton of London, finished the morning's session. During this session the ladies assembled and, directed by the ladies' committee, took a tally-ho trip through the boulevards and South Parks. In the afternoon the members and guests were taken through the plant of the Illinois Steel Company at South Chicago.

Wednesday evening's session was held in the Fine Arts Building, where five important papers were read. Four were upon the steam turbine and were: "Some Theoretical and Practical Considerations in Steam-turbine Work," by Francis Hodgkinson of Pittsburg; "The De Laval Steam Turbine," by E. S. Lea of Trenton, N. J., and E. Meden; "The Curtis Steam Turbine," by W. L. R. Emmet of Schenectady, N. Y., and "Different Applications of Steam Turbines," by A. Rateau of Paris, France. The remaining paper of the evening was by C. V. Kerr of Rutherford, N. J., upon "The Potential Efficiency of Prime Movers. These papers were all of especial importance, in that the subjects were of interest not only to mechanical engineers but those interested along electrical lines as well. Mr. Hodgkinson confined his paper chiefly to some special features of turbine work having a bearing upon the successful operation of the machines. He took up first the ideal turbine and the laws of the expansion of steam upon which the theoretical design is dependent and then went on to describe the causes for the departure of the practical working turbine from the ideal conditions. He then described briefly the different types of turbines now most prominent, including the Stumpf, Curtis, Zoelly, Rateau and Parsons, with a brief description of turbo-generators. The subject of economy was then taken up, and appended to the paper was a table of the results of several hundred tests upon turbines of all sizes and under varying conditions of operation. The method of procedure in making these tests was described fully.

Thursday was one of the busiest days of the convention. The principal session of the day was held in the morning at the hotel, where the following professional papers were read: "Power Plant of the Tall Office Building," by J. H. Wells of New York; "Power Plant of Tall Office Buildings," by R. P. Bolton of New York; "Middlesbrough Dock Electric and Hydraulic Plant," by Vincent L. Raven; "Use of Superheated Steam and of Reheaters in Compound Engines of Large Size," by Lionel S. Marks of Cambridge, Mass., and "Commercial Gas-engine Testing and Proposed Standard of Comparison," by William P. Flint of Pittsburg.

During this session the ladies visited the retail store of Marshall Field & Co. Thursday afternoon excursions were taken to the Fisk Street station of the Commonwealth Electric Company, as guests of that company, and to the stockyards and packing houses as guests of Swift & Co. Mrs. R. W. Hunt was at home to the ladies of the convention party on Thursday afternoon. In the evening a reception was tendered by the local members of the American Society of Mechanical Engineers to the members of both societies at the Art Institute.

Friday morning the last regular session of the convention was held at Lewis Institute, about 200 being present. During the first half of the session President Wicksteed was in the chair, while President Swasey presided during the latter part. Five papers were read, as follows: "Cast-iron Composition, Strength and Specifications," by W. J. Keep of Detroit, Mich.: "The Effects of Strain and of Annealing," by William Campbell; "Experiments with a Lathe-tool Dynamometer," by J. T. Nicolson (abstracted by President Wicksteed); "Road Tests of Consolidated Freight Locomotive," by E. A. Hitchcock of Columbus, Ohio, and "Locomotive Testing Plants," by W. F. M. Goss of Lafayette, Ind. A paper on "Notes on Testing Locomotives" was also briefly abstracted by Edgar Worthington of London, the secretary of the British society.

After the regular programme was over G. M. Carman, director of Lewis Institute, was called upon to speak, and, with a few well-chosen words, he expressed his pleasure at the fact that the institution was enabled to entertain such men as were there gathered together—men who could "do things." After Mr. Carman President Swasey made a few remarks, followed by President Wicksteed, who read a formal resolution of thanks on behalf of the British Institution to the members of the American society for the pleasant and profitable days which had been spent in Chicago. Before reading the resolution he said that he highly appreciated the opportunity to come to what was without doubt the largest mechanical engineers' convention ever held. Secretary Worthington next read resolutions of thanks to the city of Chicago and to the various industrial institutions which had contributed so largely to the entertainment features of the convention. Luncheon was then served by Lewis Institute.

Friday afternoon two parties were made up, one for visiting the Fisk Street station and the other for a trip to the clearing yards of the Chicago Union Transfer Railway Company and the Drainage Canal, as guests of the Transfer company and the Western Society of Engineers. In the evening a special concert by the Thomas Orchestra was given by the local members at the Auditorium Theater.

The convention was a great success. The local members did everything possible to make their foreign friends feel at home and enjoy themselves, and they succeeded admirably. Much credit is due the members of the local committee and the ladies' committee for their efficient work.

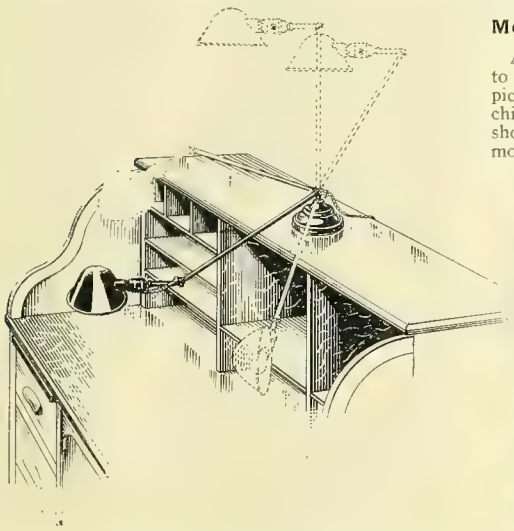
Among those who attended the convention were William L. Abbott, Chicago; L. R. Alberger, New York; John B. Allan, Chicago; Bion J. Arnold, Chicago; Ward S. Arnold, Chicago; Edward Barr, Chicago; John I. Beggs, Milwaukee; B. A. Behrend, Cincinnati; H. M. Brinkerhoff, Chicago; Morgan Brooks, Urbana, Ill.; Storm Bull, Madison, Wis.; W. E. Carlton, Chicago; Charles A. Chapman, Chicago; Henry L. Doherty, New York; Alex Dow, Detroit; William Fergus, Chicago; George B. Foster, Chicago; T. P. Gaylord, Chicago; E. M. Hewlitt, Schenectady; Francis Hodgkinson, Pittsburg; Dugald C. Jackson, Madison, Wis.; William B. Jackson, Madison, Wis.; Peter Junkersfeld, Chicago; Edwin B. Katte, New York; E. E. Keller, Pittsburg; A. D. Lundy, Chicago; George C. Marsh, Chicago; E. H. Mullin, New York; J. S. Neave, Cincinnati; Samuel G. Neiler, Chicago; J. D. Nies, Chicago; George P. Nichols, Chicago; S. F. Nichols, Chicago; G. J. Patitz, Milwaukee; H. F. J. Porter, Pittsburg; H. G. Reist, Schenectady; Calvin W. Rice, New York; Julian Roe, Chicago; George S. Searing, Chicago; B. E. Sunny, Chicago; R. H. Taft, Chicago; F. W. Van Ness, Chicago; H. H. Wait, Chicago; Arthur Warren, Chicago; C. H. Wilmerding, Chicago; F. Woodmansee, Chicago; P. B. Woodworth, Austin, Ill.

The town of Aberdeen, Md., will vote on June 18th on the issuance of $8,000 of bonds for the erection of an electric-light plant.

Universal Portable and Desk Lamp.

The Universal is the name of a new combined portable and desk lamp, shown in the accompanying illustration, which is put on the market by the Central Electric Company, Chicago. It possesses many desirable features. The lamp consists of an adjustable arm mounted on a finely finished base and is fitted with a parabolic shade, which serves as a reflector and may be moved by a touch to any desired angle without resorting to the loosening of screws.

The shade is furnished with a patent holder attachment, which can be adjusted to fit any lamp at will. The adjustable arm admits of the light being instantly drawn forward or back, or swung to right or left at pleasure without rising from the chair. The



UNIVERSAL PORTABLE AND DESK LAMP.

distinctive feature is that the joint is so made that the adjustable arm is self-maintaining in any position in which it is placed. When changing it from one position to another it is not necessary to loosen a set screw at the joint, move the arm to the desired position and then tighten the set screw in order to hold it. The only thing necessary is to swing the light into the desired position and, the arm being self-maintaining, it remains there.

The fixture is provided with a finely finished base, felt covered to prevent marring or injuring the most highly polished wood, and the fact that this base weighs 5½ pounds prevents the lamp from becoming unbalanced when the arm is extended in any of the different positions in which it may be used. The fixture is finished in polished brass or oxidized copper, and while the picture shows it merely for a roll-top desk, it is also adapted for use in the drawing room, for the piano, as well as for show windows and decorative lighting.

High-tension Convention in Chicago.

A special meeting of the American Institute of Electrical Engineers will be held at Chicago on June 21st and 22d. The meeting will be conducted by the transmission committee, assisted by the Chicago branch of the Institute. "Introductions to Discussion," similar to the "Introductions" presented at the meetings on High-tension Transmission held at New York, March 27, 1903; Niagara Falls, July 1, 1903, and New York, March 25, 1904, will be presented. A tentative programme of the time of presentation of papers is as follows:

TUESDAY, JUNE 21ST.

10 a. m.—"Line Construction with Steel Supporting Structures and Long Spans," by F. O. Blackwell, New York.

"Protection of Cables from Arcs Due to Failure of Adjacent Cables," by W. G. Carlton, Chicago.

2:30 p. m.—"The Use of Ground Shields in Transformers," by John S. Peck, Pittsburg, Pa.

"Conditions for Continuous Service Over Lines Operated in Parallel," by M. H. Gerry, Jr., Helena, Mont.

WEDNESDAY, JUNE 22D.

10 a. m.—Synchronous Motors for the Regulation of Power-factor and Line Voltage," by B. G. Lamme, Pittsburg, Pa.

"Protection of High-tension Lines Against Static Disturbances," by H. C. Wirt, Schenectady, N. Y.

2:30 p. m.—Report of the transmission committee on data collected.

General discussion on topics presented at this meeting.

ENTERTAINMENT.

The Chicago Edison Company, General Electric Company, Westinghouse Electric and Manufacturing Company, Western Electric Company, Bullock Electric Manufacturing Company, Arnold Electric Power Station Company and Sargent & Lundy have offered to entertain the visitors on Wednesday evening.

As this meeting will be held at the same time as the National Republican convention, reduced railroad rates will be offered from all parts of the United States to Chicago and return. It will only be necessary for the members to apply to local ticket offices for excursion tickets. Price of round-trip tickets is to be one fare, plus 25 cents. This rate is good throughout the United States except the Pacific Coast, where special arrangements apply.

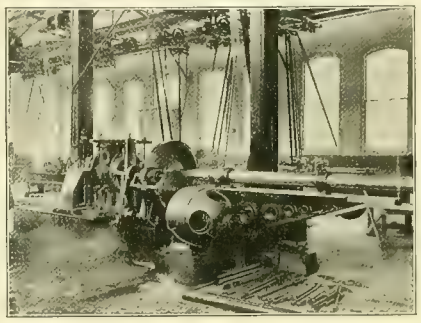
REGISTRATION.

Immediately upon arrival in Chicago, members are requested to register at the rooms of the Western Society of Engineers, 1737 Monadnock Building.

Out-of-town members expecting to attend this meeting will please send word to that effect at an early date to James Lyman, Monadnock Building, Chicago, who will arrange for hotel accommodations.

Motor-driven Cylinder-boring Machine.

A particularly effective application of motor drive to a machine tool is illustrated in the accompanying picture. A No. 2 locomotive cylinder-boring machine, made by the Newton Machine Tool Works, is shown, driven by a 15-horsepower Crocker-Wheeler motor. The machine, as installed by Dodge & Day,



MOTOR DRIVEN CYLINDER-BORING MACHINE.

is in use in the plant of the Jeanesville Iron Works Company, Hazleton, Pa. It will bore cylinders up to 30 inches in diameter and will bore and face both ends of cylinders up to 42 inches in length. The motor is a Crocker-Wheeler standard type I, semi-enclosed. The C.-W. multiple-voltage system of speed control is applied to the machine. Two sets of sliding gears for speed reduction are also provided, which double the speed range of the motor and controller alone.

"Under and Over the Sea" by Electricity.

One of the attractions on the Pike at the St. Louis Exposition which is said to give a foretaste of advanced twentieth-century navigation is called "Under and Over the Sea." It consists of a large fish-like submarine boat capable of holding 500 passengers, the great hull of which seemingly sinks to the bottom of the sea. Here, with the aid of powerful searchlights, the wonders of the deep are revealed to the traveler. When once at the bottom the boat appears to journey for miles past coral reefs and a deep-sea garden of isis and fungi where mermaids and fishes disport themselves. Finally, after the sea journey is over, the boat rises to the surface and the passengers are elevated to the top of the "Eiffel tower" and put aboard a great air ship, from which the panorama of the fair is spread before them.

The unique production is dependent for its natural effects entirely upon electricity. And in order to appreciate in some measure the magnitude of the undertaking, the following figures, from the chief electrician, will be instructive:

There are used 24 stereopticons, ranging from 50 to 200 amperes at 220 volts; six moving-cloud machines, two lightning machines; two cyclone machines, and two electric water-ripple machines. The submarine illusion requires 600 amperes, direct current, at 220 volts and 100 amperes, three-phase, three-wire alternating current at 110 volts pressure.

The motor service demands 25 amperes at 500 volts pressure. The illusion while on the air ship requires 1,200 amperes direct current at 220 volts and 100 amperes, three-phase, three-wire alternating. The motor service is 50 amperes at 500 volts pressure. The current consumed by the Cooper Hewitt mercury-vapor lamps is 20 amperes at 110 volts pressure. The decorative lighting at the front, etc., consumes 500 amperes, three-phase, at 110 volts. Fifty-six blending dimmers are used, ranging in capacity from 10 to 250 lights. All projecting lamps are operated by individual electric motors, controlled from the two main switchboards.

Danger of injury to operators, resulting from the heat created by the heavy current, has been eliminated by the installation of a system of water circulation, by means of tubes throughout the building. As a preventive of uncomfortable temperature, a complete ventilating equipment has been installed.

At a recent meeting of the City Council of Carlinville, Ill., a franchise was granted to the Springfield and St. Louis Electric Railway Company to construct and operate an electric railway on the streets of that city.

Some New Rheostat Designs.

The accompanying illustrations show three new types of rheostats manufactured by the Union Electric Manufacturing Company of Milwaukee. Fig. 1 is an automatic starter, which has some new features. A particular object of this starter is automatically to open the switch when the current ceases or is reduced to less than normal, and to accomplish

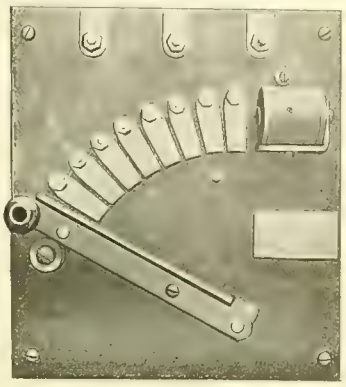


FIG. 1. NEW AUTOMATIC STARTER.

this by actuating means entirely independent of the hand switch and controlled by a magnet. A spring-actuated armature lever in the path of movement of the hand switch when being moved to its "on position" returns the hand switch to its initial position if released at any intermediate position. A magnet holds the spring-armature lever when it reaches its full-on position, and a button contact short-circuits the magnet to release the armature lever when the hand switch is moved off from its on position. The hand switch is pivoted on the same post as the spring-actuated armature lever and has a

FIG. 2. NEW SPEED REGULATOR

small bronze brush fastened to it, and is so arranged that it will short-circuit the holding magnet before the hand switch entirely leaves the full-on segment. In opening the circuit it is not necessary to exert force in moving the hand switch. The segments are made of copper of ample size and are easily replaced by removing only one nut, and are so shaped that the break occurs along their entire length, thus preventing arcing and burning of the

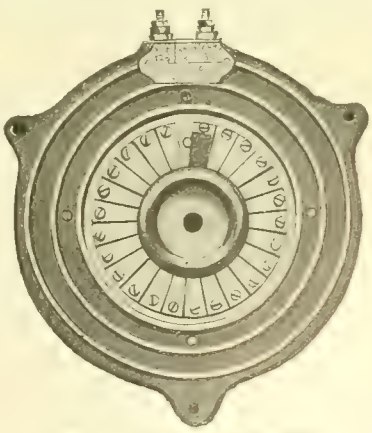


FIG. 3 NEW [illegible]

segments, so commonly [illegible] break and take the arc at a point

All front metal parts of this starter are made from drawing steel with dies, and are not brittle and easily broken, like cast iron. Fig. 2 shows a speed regulator which is similar in construction to the starter and has the feature that the ratchet segment is pivoted on the same post as the hand switch, but is independent of it. Fig. 3 shows a field regulator which is so arranged that steps of resistance can be easily replaced, if burned out, without returning the regulator to the factory.

Ohio Independent Telephone Association.

A permanent organization was effected at a meeting of about 200 Independent telephone men at Hotel Hartman, in Columbus, Ohio, on June 2d. It will be known as the Ohio Independent Telephone Association, and the memberships will be made up of companies instead of individual members, as in the past. The membership fees are fixed at $5 for all exchanges with less than 1,000 telephones and 100 miles of toll line, and $10 for all with a larger business.

One of the principal features of the meeting was the discussion of the insurance question. The managers were unanimous in their opinion that the stock companies are charging too much for protection, and it was proposed to devise a mutual plan by which the companies will carry their own insurance. The state, under the constitution adopted, is to be divided into nine districts, and a committee made up of one member for each district will have general charge of the business and policy of the association. This committee will take up the insurance question, investigate various plans for co-operative protection and make a report at the next meeting. Reports will probably be made on various other matters that were brought up at the Columbus meeting recently.

President Thompson of Lebanon opened the meeting with a brief address, in which he outlined the aims and purposes of the association. He was followed by H. A. Lanman, president of the Citizens' Telephone Company of Columbus, in an address of welcome. G. P. Thorpe of Wilmington responded. J. B. Hoge of Cleveland made an address on the "Aims of the Association," which was an outline of the work that is expected to be accomplished by such an organization. Mr. Hoge believes in co-operation for common interests and thinks that it can be reached in no other way better than through an organization of this kind. His talk was listened to with marked interest all through.

A question box, opened in the afternoon, furnished food for a number of short discussions. Among the important facts brought out in these talks was that the number of Independent telephones in actual use in Ohio is 145,000.

Mr. Gates of the Queen City Telephone Company, which has just been granted a franchise by the Probate Court to operate in Cincinnati, gave an interesting talk on the events in connection with the long fight they have had there. This is important, from the fact that other such contests may occur in the future and members will be better prepared to meet objections by having heard the history of this case.

Some of the members were in favor of holding two meetings each year, one in March and the other in October. After some discussion the matter was left to the executive committee to decide. A constitution and by-laws were adopted. The following-named officers were chosen for the coming year: President, Frank L. Beam of Columbus; vice-presidents, W. G. Thompson of Lebanon, G. P. Thorpe of Wilmington, J. B. Hoge of Cleveland, R. E. Hamblin of Toledo, J. C. Reber of Dayton, D. E. Sapp of Mt. Vernon, G. A. Matheny of Lima, W. F. Laubach of Akron, and J. B. Rhodes of Zanesville; secretary, E. E. Knox of Portsmouth, and assistant secretary and treasurer, Ralph Ramer of Columbus.

NEW COMPANIES.

A charter has been granted to the Interstate Telephone Company of Lenexa, Kan., with a capital stock of $7,500.

The Perryman Telephone Company of Morrison, Okla., has been incorporated with a capital of $12,000. James T. Perryman heads the incorporators.

M. C. Young and associates of Clarksville, Ga., have organized the Standard Telephone Company in that city. The company has been incorporated.

The Goodwater Telephone Company of Goodwater, I. T., has been incorporated with $2,000 capital. W. J. Whitemore is president, and B. S. Harris, vice-president.

The Schulenberg (Texas) Telephone Company has been incorporated to construct telephone lines in Fayette, Lavaca, Gonzales and Colorado Counties, Texas. The incorporators are W. E. and C. A. Perlitz and John Schumacher.

The New England Telephone and Telegraph Company contemplates making a new issue of stock this year, it is stated. The last addition to the stock output was in June, 1902. The company's business increases at the rate of about 15,000 new subscribers annually, and for the first quarter of the present year the number was close to 4,000, the total on March 31st being 130,138. Among the plans for the current year is the construction of 300 miles of new lines in Western Massachusetts, among the rural sections heretofore not served.

Ohio Telephone Notes.

A hearing was held last week before the council committee on telephones in Cleveland on the question as to whether the Cuyahoga Telephone Company has the right to readjust its rates. President Dickson was called on for an explanation of his views on the matter. He told the committee that his company could not give an extended service unless allowed to increase the rates in proportion to the number of telephones in use, after a certain number was reached. No action was taken by the committee, and the subject has been referred to Corporation Counsel Baker for advice upon a number of legal points.

Officers of the Queen City Telephone Company will meet in a short time to decide upon what steps will be taken toward beginning work on a plant in Cincinnati, and how far it will be safe to go pending a decision of the Supreme Court on the matter of a franchise. Attorneys for the city have asked Judge Nippert to make some changes in his decision, preparatory to filing an appeal.

Work on improvements of the Central Union Telephone system at Mansfield has been begun. A large amount of new wire will be strung and some other work done.

The Acme Telephone Company of Phillipsburg has filed notice of an increase of capital stock from $8,000 to $15,000. The Rockford Toll Line Telephone Company of Rockford has also increased its capital stock from $10,000 to $20,000.

Harry Sotzen, manager of the local telephone company at Shelby, was married to Miss Mary Putnam of Bellevue at the Hotel Euclid in Cleveland one evening last week.

The Waldo-Bell Telephone Company of Waldo has been incorporated with a capital stock of $5,000 by W. F. Groll, C. P. Groll and others.

The City and Suburban Telephone and Telegraph Company of Cincinnati has the contract for installing a private exchange in the Burnett House.

The United Telephone Company of Bellefontaine has notified the secretary of state of an increase of capital stock from $214,800 to $300,000.

The Morral Telephone Company of Morral has been incorporated with a capital stock of $10,000. J. A. Baer, L. C. Baker and others are interested.

The Gilbert Telephone Company of Gilbert has been incorporated by E. L. Roe, Chalmer Menefee, H. L. Nve and others. The capital stock is $2,000.

Plans for the building of the Citizens' Telephone Company at Columbus have been completed and it is probable that work on the excavations will be begun within a few days. The structure is to be completed by December 1st. It will be four stories in height. The automatic exchange will be installed on the fourth floor and the remainder of the building has been planned for the business and operating departments.

The Bainbridge Telephone Company of Bainbridge has been incorporated with a capital stock of $10,000 by William Howard, C. R. Post, A. B. Chamberlain, S. A. McFarland and others.

The Eldorado and West Manchester Telephone Company has been incorporated with a capital stock of $40,000 to build a line in Preble County. Exchanges and offices will be maintained at both Eldorado and West Manchester. Conrad Ripp, F. S. Conkling, J. A. Reis, W. D. Rush and C. R. Leftwich are the incorporators.

C.

Indiana Telephone Items.

The New Telephone Company of Indianapolis is preparing to lengthen its underground-conduit system and has filed two plats showing the extent contemplated. As soon as the material is purchased work will begin.

Improvements to the extent of $25,000 are to be made by the Central Union and the Independent telephone companies in Newcastle and vicinity. Several miles of new cable will be put in and extensions of lines into the rural districts are to be made.

The Orestes Telephone Company has just completed a new line to Frankton, Independence and Summitville and promises free connection to Elwood and Alexandria in a short time.

The Central Union Telephone Company has just issued a new order reducing toll rates in Indiana, Ohio and Illinois. This is one of the reforms of the new management which took charge of the plant in the three states last year. New toll lines have been built and the company is now able to handle more business and give lower rates.

The City Council of Crawfordsville has adopted rules regulating the placing of wires in that city. The Home Telephone Company, the Central Union Telephone Company and the telegraph companies have been notified that no guy wire shall come closer to the ground than eight feet and shall be attached to wooden poles at least eight feet above ground.

The Northwestern Traction Company is installing a model telephone system along its line between Lebanon and Crawfordsville.

The telephone system being installed by the Illinois Central Railway at Evansville and vicinity is attracting considerable attention. The system connects all the offices and stations used by the company in the city and vicinity, including Henderson, Ky.

Ashjian Bros. ask $5,000 damages from the Indianapolis Telephone Company for failure to place their name and number in the latest issue of its directory.

At Evansville the Home Telephone Company, recently organized, filed an application for a 30-year franchise whereby it agrees to pay the city $4,000 annually or $125,000. The application suggests allowing this money to remain in the hands of the telephone company to be applied on the purchase price of the exchange by the city at any five-year period after the first 10 years, the city to receive three per cent. interest compounded annually. No sooner had the Home company applied for a franchise than the Citizens Telephone Company, which has been granted a franchise by the Board of Works, sent a communication to the council withdrawing its application, stating that it does not wish a franchise if, in good faith, any other company offers better terms to the city. F.

Telephone News from the Northwest.

The Watertown (Minn.) Telephone Company has been incorporated with a capital of $25,000.

The Tri-state Telephone Company expects to have its long-distance line through from the Twin Cities to Grand Forks, N. D., by October 1st. The line is now 40 miles west of Minneapolis, and is to be built via Litchfield and Willmar to Breckenridge, Minn., thence north to Grand Forks.

The Clarkfield (Minn.) Telephone Company has been formed with $3,000 capital.

The Wisconsin Telephone Company will string 15,000 feet of cable in La Crosse, Wis., during the summer.

R. E. Johnson of Morgan, Minn., has installed a local exchange at Barnum, Minn.

Howard Crawford has resigned as manager of the Mutual Telephone Company of Rhinelander, Wis., to take a similar position with a company in Wausau, Wis.

The Sheyenne Farmers' Telephone Company of Kindred, N. D., will build 18 miles of telephone lines this summer.

Mager & Camden have bought an outfit for a local telephone exchange for Walhalla, N. D.

The city of Glencoe, Minn., has granted admission to the Norwood-Young America Telephone Company for a toll line only.

It has been decided by the Ottumwa (Iowa) Telephone Company to sell the plant at that city at private sale.

The Odell (Neb.) Independent Telephone Company has been incorporated with a capital of $10,000. The company will also build a line to Beatrice.

The Farmers' Connective Telephone Company has been incorporated at Bonaparte, Iowa. The capital is $10,000.

Municipal ownership of the telephone system is being agitated at Council Bluffs, Iowa.

The Michigan Telephone Company will spend $50,000 this season in improvements in the copper region.

The Orilla (Iowa) Telephone Company has been incorporated. George Allis is president. A line will be constructed from Orilla to Cumming. R.

Bell Extensions in Michigan.

The Michigan State Telephone Company has closed a deal with a railroad company of the state upon whose right-of-way new trunk lines will be built. The contract will give the right-of-way over 1,000 miles and will allow the building of lines which will be free of foliage interference. It is expected that the subscribers of this company will number 70,000 at the close of this year, an increase of more than 15,000 over last year, and that approximately 36,000 miles of copper metallic circuit will be in use in the interurban system, reaching every city and village in the state. It is stated that farmers are taking telephones, and that the work of installing them has been going on very rapidly.

TELEPHONE MEN.

R. P. Dodge, manager of the local telephone exchange at Tallmadge, Ohio, died a few days ago.

Charles A. Otis, Jr., has been elected to the directorate of the United States and Cuyahoga Telephone companies to take the place of J. R. Sprankle, whose death occurred some time ago.

Manager Murray of the Rocky Mountain (Bell) Telephone Company states that business in Salt Lake City has greatly increased since the entry into the local field of the new competing company, due to the increased advertisement the telephone business has received.

William A. Vail, former division superintendent of the Central Union Telephone Company in Indianapolis, died in Minneapolis last week, after an illness of six days. Mr. Vail was general manager of the Northwestern Telephone Exchange Company in Minneapolis at the time of his death.

Eugene H. Satterlee of the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y., spent a few days in Salt Lake City recently inspecting the newly completed building and system of the Utah Independent Telephone Company. After looking over the property of the company, which represents a total expenditure of about $1,000,000. Mr. Satterlee was elaborately entertained by officers of the company.

The Island Telephone Company's entire outfit was sold at auction at Charleston, S. C., recently, for $8,200 by George E. Gibbon, said to be representing stockholders of the company. The system, with its numerous connections, may be operated again shortly.

Steam-turbine Discussion at Boston.

At the Boston convention of the National Electric Light Association an important discussion followed the reading of the committee's report on steam turbines, prepared by W. C. L. Eglin, F. Sargent and A. C. Dunham, and the paper by Francis Hodgkinson of Pittsburg on "Practical Notes on Steam Turbines," presented on May 25th. The committee report was given in abstract in the Western Electrician last week. The papers were considered together and the following is taken from the discussion:

Richard H. Rice, Lynn, Mass.: The Curtis turbine consists, in its simplest form, of one or more stationary nozzles, which discharge steam at high velocity into several rows of moving buckets alternating with stationary buckets, the office of which is to reverse the jets of steam and redirect them in a manner suitable for use in the next row of revolving buckets until finally the steam is discharged from the last row of buckets and its velocity practically absorbed. By removing only a portion of the velocity from each row of buckets and by providing a succession of rows the velocity of the wheel is proportionately reduced. We also possess in the Curtis turbine another and most effective way of keeping down the speed of the buckets. If we confine ourselves, instead of expanding our steam from boiler pressure to vacuum in one operation, to an expansion of one-half or one-quarter of this amount, we considerably reduce the losses in the nozzle and also the velocity of the steam. In having a lower velocity we can absorb this velocity with a considerably lower bucket velocity. It is then simply necessary to divide two or more sets of expanding nozzles in series, each with its several rows of moving and stationary buckets, to entirely neutralize the energy of the steam. These groups are termed stages, and the Curtis turbine is at present built with one to three or four stages, depending on size, the steam pressure and whether we are expanding into the atmosphere or into a condenser. The flow of steam through a nozzle follows perfectly definite laws, and enough is known of these laws to enable us to predict the velocity developed by nozzles of various forms with accuracy. Furthermore, the flow of steam at any given pressure through a nozzle of given size can be calculated as accurately as it can be condensed and measured.

We have, therefore, means of accurately determining the weight and velocity of the steam as it strikes the buckets. If the velocities of steam used in the Curtis turbines were utilized in the single row of buckets the speed of the bucket rows would have to be nearly one-half the velocity of the steam in order to obtain the highest efficiency. However, by using several rows of buckets a portion of the velocity is utilized in each row, and we can use the steam at conservative speeds of 250 feet per second as a minimum up to 450 feet as a maximum. This low-bucket speed also brings along with it another very important advantage, combined as it is with the use of a very moderate number of nozzles to admit the steam to the first stage. I refer to the low speed of rotation which follows from low-bucket speed and the possibility of large wheel diameters, since we are not, as in some types, obliged to admit steam around the entire circumference of our wheels.

The Curtis buckets are machined from the solid material of the bucket wheel, or from the metal of a substantial solid segment, securely fastened to the wheel rim, or cast from appropriate material in the same solid way, and the ends of the buckets are covered by metallic bands riveted to the bucket ends. The bucket wheels are free to expand in the direction of their diameters, and the buckets are free from possibility of injury by coming in contact with stationary parts.

These turbines are constructed in sizes varying from 1.25 to 5,000 kilowatts. Up to and including 500 kilowatts the turbines are constructed on the horizontal type. Above and including 500 kilowatts the shafts are vertical. The packings used between the steam and the atmosphere are sealed by steam, no oil coming in contact with the steam. Therefore, the condenser steam can be returned to the boiler and used over and over again without fear of deterioration of the boiler surfaces. The advantage of the vertical arrangement, where the weight of the rotating element is considerable, is almost self-evident. Friction and wear on the bearings are reduced to a minimum, and in the largest Curtis turbine it is possible to move the rotating parts by hand when the oil pressure is on the step bearing. This step bearing consists of a pair of cast-iron discs, one rotating with the shaft and attached to the bottom end, the other stationary, placed vertically under the shaft and adjustable upward and downward, to adjust the position of the rotating elements. These discs are kept out of contact by means of a film of oil, which is forced between them by a pump, sufficient pressure being exerted to lift the shaft. The shaft, therefore, rotates on a film of oil of definite thickness. The oil pressure is maintained to a uniform amount by means of an accumulator.

Regulation of speed is performed by a shaft governor of great power and sensitiveness, which actuates instantly through suitable apparatus a series of valves, each one of which admits or cuts off the supply of steam from one or more nozzles. These valves are always either fully opened or closed. No throttling occurs, and the nozzles therefore always work at their maximum efficiency. To this fact is due the high efficiency of the Curtis turbine at variable loads. Tests under actual working conditions have shown that with a variable load the turbine maintains its efficiency, due to the fact that the nozzles are always operating under their designed conditions.

Fortunately it is easy to obtain a high vacuum with the turbine at a very moderate increase in the cost of the condensing apparatus as compared with that necessary to obtain 26 or 27 inches, and although a high vacuum is not essential to the proper operation of the turbine, the turbine is capable of utilizing the energy contained in steam to a much greater extent, and therefore the economy of the turbine is increased by the increase in the vacuum. The turbine is free from air leaks, and, with a short connecting pipe between the condenser and turbine and a condenser of liberal size, 29 inches vacuum is being obtained in many cases. Objection has been made by some that an excessive quantity of cool water is necessary, but that is not the case, only 2.5 to three times the usual amount of water being used, and its quality is not important. Roughly speaking, it may be stated that the gain by increasing the vacuum varies with the amount of the vacuum, becoming greater as the vacuum increases. Other forms of condensing apparatus than surface condensers are used to some extent in connection with turbines. When the water supply is limited cooling towers may be used, and when it is ample and it is not desired to return the condensed water to the boiler, syphon condensers with dry-air pumps may be installed with good results.

Without going into the details in the matter of steam consumption, it may be stated that the turbine uses no more steam than the best reciprocating engines, both tested when new and under other similar test conditions. In practical work, with the load varying considerably, for instance when the engine is driving a street railway, the efficiency of the reciprocating engine is considerably reduced. The turbine is not subject to this reduction of economy, but gives the same average economy with varying load under the most unfavorable conditions. Tests with a very variable load have shown that the average steam consumption at the average load is exactly the same as if the load had been stationary at this average amount for the same length of time. The steam engine deals with the pressure and application of the steam; consequently the valves and pistons must be steam tight and always remain so. The steam turbine deals with mass and velocity, and is therefore independent of tightness for its economy, and it has no packings similar to piston or valve packings. The advantage of this is that it retains its original economy as long as it is operated, while the steam engine rapidly loses efficiency, due to the wear of these parts. While, therefore, there may be equally high efficiency at the beginning of service, ultimately the turbine will be in the lead. The only probable effect which is unfavorable is that of deterioration of the surfaces of the nozzles and buckets. As a matter of fact, if such wear should take place, it would be confined to parts not expensive and readily replacable, and turbines operating for two or more years show no sign of it.

As regards the advantage of the small floor space required by the turbine, a case has recently come to my notice where the conditions were unfavorable to the installation of turbines, yet in this case two engines of 500-kilowatt capacity were all that could be installed in a certain power station, whereas five turbines of the same size could be readily located.

The valves of the Curtis turbine are always under the control of the governor even up to an overload of 50 per cent.; therefore the economy load is continuous and does not change its characteristics. The cost of foundations is extremely small as compared with those of reciprocating engines, and in fact very little foundation is necessary. We have some turbines of 500-kilowatt capacity operating on the second floor of a mill and standing on floor beams.

Henry L. Doherty, New York: There are one or two points touched on by the various speakers which I think they should go into more fully. One is the small space occupied by the steam turbines. In my own work I have not found that we could always avail ourselves of the lesser space required by the turbine, or at least could not avail ourselves of it without using a system of steam piping that would not readily appeal to good engineering practice. We have got to have boilers which give us a bigger capacity per lineal foot of the boiler room, and I am just now trying to interest one manufacturer in the building of a very deep but narrow boiler. The present boilers will stretch out a considerable distance in lineal feet, while the steam turbine could be put in a small space in the center and in front of these boilers. There are two or three ways in which we have proposed to overcome that difficulty: One was to have our boilers in stacks, back to back, and have practically a double boiler room with a fire door on each side, and lead the steam piping from one firing alley to the engine room. Another plan is to build the boilers with the firing doors at right angles to the turbine and have short alleyways running up into this group of boilers. Another way was to design a special boiler having little width and considerable depth, and probably going to a vertical boiler. Another method that was suggested, but was not looked on with favor, was to put the boiler room on each side of the turbine room.

The question of condensers and superheaters has been touched on here slightly. I have never been able to satisfy myself that I cannot get a higher vacuum from a jet condenser than can be secured from a surface condenser, and I am sorry not to be in shape to give figures at this convention, but will be ready to do so next year, I hope. We are going after it in a different way from that which is usually followed and expect to get higher vacuum with the jet condenser. The question of superheaters seems to be a rather serious one. It is hard to control the degree of superheat. The superheaters burn out. No one seems to be able to give any definite figures on the heating value of a unit surface of a superheater. We know pretty well what we can do. At certain times of crowding we can put 3,000, 4,000 or 5,000 B. T. U. per square foot through the boilers, but when we get to the superheaters the capacity per square foot diminishes considerably. The design of the superheater in question has a great deal to do with this. The relative thermal capacity between the water in your boiler and your steam would be as 1 is to something over 3,000. Unless you have active circulation in the interior of the superheater you have a condition of transforming heat from one gas to another through a metal diaphragm, and while the metal diaphragm interposes but little resistance as soon as the first layer of the gas on each side has taken the same temperature, then you must transfer your heat virtually through a non-conductor of unknown thickness, a metal diaphragm of low resistance and then another layer of gas, which is almost a perfect non-conductor. Therefore, active circulation of your combustion products on one side and active circulation of the superheated steam on the other side must be the solution of high capacity per unit of surface of a superheater.

OBITUARY.

E. B. Chandler.

Edward Bruce Chandler, a few years ago a well-known figure in electrical circles in Chicago, died at his home, 2512 Indiana Avenue, Chicago, on June 6th. Mr. Chandler was the first city electrician, or rather superintendent of fire-alarm telegraph, in Chicago, and held that position at the time of the fire in 1871. Several years after he resigned to become western agent of the Gamewell Fire Alarm Telegraph Company. He retired from active business 10 years ago. Mr. Chandler was born in Hartford, N. Y., in 1838, and went to Michigan when a boy. He came to Illinois in 1858 and was employed in the telegraph department of the Rock Island railroad, being located at Springfield and Rock Island. In 1868 he came to Chicago. In 1872 he married Miss Emily Moseley of Princeton, Ill., who died in 1893. Two children, Mrs. Oliver L. Spaulding, Jr., and George M. Chandler, are living. Mr. Chandler was graduated from the University of Michigan and was a member of the Beta Theta Pi fraternity, of Chevalier Bayard Commandery, and of the Calumet Club. He was also a member of the old Chicago Electric Club. The funeral services were held at the residence and the burial was at Oakwoods.

James A. Myers.

The death of James A. Myers, president of the Robbins & Myers Company of Springfield, Ohio, on May 26th is announced. Mr. Myers, who was about 55 years of age, died at his home in Springfield from typhoid fever. His company manufactured motors, fans and other electrical apparatus, and Mr. Myers actively superintended the business, spending much of his time in New York city. He was a man of high character, interested in church work, particularly that of the Methodist Episcopal denomination, to which he belonged, and greatly respected by all who were thrown in contact with him. He was a member of the board of education of Springfield and leaves a wife and two sons.

German Electric Companies Unite.

Final arrangements, it is said, have been made for the amalgamation of the Edison and Thomson-Houston interests in Germany, as represented by the Berlin Allgemeine Electric Company and the Berlin Union Electric Company. About a year ago a community of interests was established between the two companies and at the time it was reported that this might be followed by a complete amalgamation of the concerns.

The former company has now increased its capital to $22,500,000 for the purpose, among others, of entirely absorbing the Union company. The former has already acquired 95 per cent. of the latter's shares, and an exchange of the balance for new shares in the Allgemeine company is now on the point of being effected, when the undertaking of the Union company will pass into the possession of the other company.

S. B. Medairy and R. B. Fentress of the Baltimore Refrigerator and Heating Company, who recently applied for a franchise in Baltimore, talk of expending nearly a million dollars in the equipment of a modern electric-light and power plant in Baltimore. They will soon ask for competitive prices on the equipment.

Purchased Electric Power in Factories.[1]

By W. H. Atkins, S. Morgan Bushnell and G. W. Brine.

The committee tried to ask such questions as would bring out as much information as possible without making the work of answering so formidable to the larger companies that they would not answer at all.

The small number of replies received, and the fact that only three of the very large companies replied, lead the committee to believe that its efforts were not very successful.

The number of circulars sent out was 462; the number of answers received was 61. Of these, 19 reported that they sold no power to factories; 11 either gave no information or answered but one or two questions, and 31 replied more or less fully. You will readily see that reports from 31 out of over 400 companies will not furnish data upon which to base a comprehensive or definite report.

If we examine the reports with a view to learn what power is being sold to different classes of users, we find that the sale of power to boot and shoe factories is small. Only 10 companies report selling any, and these have a total of 354 horsepower connected. This amount of horsepower is divided among 27 customers—an average of 13 horsepower to each shop.

The showing among printers is much better. Twenty-seven companies report that they have in 375 printing establishments 6,247 horsepower. This is an average of 16 horsepower to each office, showing that most of the business comes from small users, although there is one motor of 100 horsepower, and there are several of 30 and 40 horsepower each.

Ten companies report cotton factories as customers. There are 48 factories having 3,060 horsepower—an average of 63 horsepower to each factory. This is a remarkably good showing, for cotton manufacturers are not inclined to believe that the central station can supply power as cheaply as they can make it.

Only one company reports sale of power to a woolen factory. This company has five customers, with 115 horsepower.

Twenty-three companies are selling power to 172 woodworking shops, where 1,953 horsepower are installed. The largest motor in this class is of 60 horsepower, the average installation being 11 horsepower.

The metalworkers, especially the smaller ones, have adopted electric power to a fair extent. Twenty-nine companies are supplying 334 shops, which are driven by motors of 6,744 horsepower—an average of 20 horsepower to each shop. Forty horsepower is the largest unit reported in this class.

The bookbinder is a very unimportant user of electric power. Seven companies report 15 customers, 69 motors and 306 horsepower, 49 motors of 196 horsepower being in one shop.

Of nearly equal insignificance is the business of paper-box making, but 10 companies having any business of this kind. They supply power to 18 shops, having 277 horsepower. In this class, again, we find one shop with 14 motors of 139 horsepower.

The manufacture of clothing has always been a profitable field for the electric motor, but the committee is surprised at the small number of companies having any of this class of customers. Only 14 companies report any clothing factories, but these have 225 customers (and of these, 137 are supplied by one company) with 1,015 horsepower; the installations average five horsepower. One company reports supplying power to 400 clothing factories, but as all details are omitted the committee could not use the report. Another company, although omitting formal mention of clothing factories in its report, yet supplies power to a very large number, but all of small size.

That the candy lover is found all over the country is proved by the widely scattered points from which 13 companies report a total of 34 factories, with an installation of 446 horsepower, an average of 13 horsepower.

Laundries do not come under the head of factories, but the committee included them in its inquiries, as it was supposed that many such shops used electric power. Reports from six companies show but 14 laundries connected, with 14 motors of 61 horsepower. The requirement of a constant supply of live steam imposes a heavy handicap upon the sale of electric power to laundries.

Among other classes of manufactures reported upon, the most important is food products, such as sausages, canned meats, fruit and vegetables, biscuits, etc. Nine companies supply power to 55 factories of this class. These are equipped with 1,102 horsepower, the average size of the installation being 20 horsepower.

Six companies report the use of motors in cutting marble and other stone, 20 yards having the same number of motors of 465 horsepower, an average of 23 horsepower per motor.

One important installation is reported from Chicago, which comes under none of the above classes—the manufacture of absorbent cotton and porous plasters. This factory has 35 motors of 160 horsepower.

Other installations worthy of mention are:

[illegible]	[illegible]
2 Glass factories	60 horsepower
[illegible]	[illegible]
2 Breweries	115 horsepower
4 Ink and color works	111 horsepower
1 Cotton seed oil mill	135 horsepower
2 Fertilizer factories	135 horsepower
1 Spring-bed works	120 horsepower
1 Chemical works	50 horsepower
1 Belting factory	150 horsepower
1 Tannery	50 horsepower
2 Cement works	75 horsepower
And glove factories having	90 horsepower

In giving the above statistics, the committee would not have the association understand that the figures of customers, motors or horsepower represent the total installation of the companies reporting. In many cases, as may be seen by referring to the Chicago report, only certain typical and important installations are reported, as it would manifestly be impractical to make a complete analysis of all the company's power business.

The number of steam and gas engines reported replaced by electric motors is not large, but this is owing to the difficulty of getting at the facts as to number and horsepower of such engines, not because the engines have not been taken out, for one company alone has replaced 130 gas engines, besides as many or more steam engines. The reports give so few details that the committee can offer no information upon this point.

Driving machines by individual motors seems to make very slow headway, if we may judge from the reports received. Only 71 shops report such installations, 187 have their machines driven in groups to a greater or less extent; but the overwhelming majority still operate with a single motor.

There seems to be very little information to be had as to the relative efficiency of "group drive" and "individual drive." Managers are very cautious in expressing an opinion upon this point. The few that did offer an estimate, consider that "individual drive" would save from five per cent. to 25 per cent., according to circumstances. While the average load on individual-motor installations runs from 15 to 30 per cent., as against an average load on a group drive of from 30 to 50 per cent. on a 10-hour basis, we must remember that the installed horsepower in motors is frequently twice as large with individual motors as compared with group drive for the same number of machines. This means a larger investment, and hence increased fixed charges.

In remodeling old machine shops for electric drive it is impracticable to figure on individual installations of motors for each machine, as the first cost of motors would be very large. The committee would favor for ordinary cases a group-drive system, using motors of from five to 15 horsepower each. For large tools, requiring 10 horsepower or over, individual motors are recommended. This would especially apply to large punch shears, beam saws, air compressors and very large machine tools.

In some classes of work, such as printing, engraving and machine-tool driving, it is better to use individual motors, even on the smaller machines, in order to secure flexibility in the control of each machine, a great range of speed being very important, and such range as the electric motor will supply can be obtained in no other way.

In woodworking shops, the conditions vary so greatly that, while group drive is desirable in large shops having steady runs for the machines, at the same time individual connection is much more economical in shops that work their machines intermittently.

The cost of production has almost invariably been reduced by the substitution of electricity for steam or gas, the principal factors in such reduction being the elimination of shafting, the ability to shut down the power a part of the time, the saving in attendance and the low rate at which electricity is sold.

In this connection the committee quotes verbatim from the report of the Chicago Edison Company, as the words quoted seem very much to the point:

"While there is no doubt but what in the great majority of cases there has been a saving in the cost of operation by the use of electric power, it is hard to get specific data in regard to this. The customer seems to be afraid that if he reports a large saving by the use of central-station service, it may have an unfavorable effect on his future bills for power, and his effort is naturally to keep the bills down as much as possible. A good many, however, have frankly admitted that they are saving money by the use of our service, and we have a number of complimentary letters, notably from customers Nos. 5, 30 and 26. Customer No. 31 on the schedule informs us that his total cost for power, heating and labor is less than one-third of the cost when he was operating an independent plant. Moreover, he has been enabled in one branch of the factory to run a night shift of men, thereby getting double the results out of a $10,000 investment, and, at the same time, keeping the power rate down to a minimum. He also tells us that he is enabled to determine the exact cost of each department by having separate meters for each department and in this way determine just what prices he can make on different classes of product. Customer No. 35 claims that this ability to determine the cost of different departments is of very great value to him in determining how low he can go in price on certain classes of goods. There is also the advantage that, by charging up the actual amount of power used in each department of a factory, the department foremen are made to feel the responsibility for keeping down the cost of the power in their respective departments, and the result is that there is not nearly as much power wasted as before."

The percentage of increase in the connected motor load during the year 1903 varies from three per cent. to 1,200 per cent., the latter figure being reached by a company that had but four horsepower connected at the beginning of the year.

The average increase of the 25 companies reporting was 84 per cent., or, omitting the extremely high figures given above, the average of 24 companies was 37 per cent.

The average increase in connected load during 1903 by 17 companies reporting was 23 per cent., the extremes being 10 and 80 per cent.

It would seem, therefore, that the power business was increasing in a larger proportion than the light load, a condition that is exceedingly encouraging, for you all appreciate the importance of the motor load in evening up the low places in the daily output.

Nearly all companies appear to supply alternating current for power; several furnish both alternating and direct, and five deliver direct only.

With very few exceptions the companies report that they sell power by meter, the rates being from two cents to 15 cents per kilowatt-hour, the usual range being from four to 10 cents.

The committee omits all data upon the amount of current used by different classes of work, for the reason that reports which could be used were received from but 13 companies, and generalizations based upon so few figures would be of little practical value.

An examination of the reports received leads to the conclusion that the sale of electric power by central stations to factories has been limited largely to such industries as have to carry on their business in the centers of cities or towns where space is costly and where the trouble and danger of steam engines become large factors.

The great industries of boots and shoes, cottons and woolens, usually produce their own power.

Among printers, we have a large patronage from "job shops" and a good proportion of the newspaper offices, but practically none of the book printers, whose "runs" are long and whose "make-readys" are comparatively short.

The committee sees but two ways by which to reach the large consumer. First, to reduce wholesale rates until they become attractive.

In looking over the reports we notice that wherever the rates are especially low the motors in circuit are especially large and the number of wholesale customers is also large. Although a reduction in rates is very sure to bring large customers, the committee does not believe that this course is necessary.

The alternative suggestion—to educate the prospective customer—is much more rational and more satisfactory in the end. Although electric power has been in use for 15 years, yet it is not the first power of which a man thinks when he is about to start a new factory. If the central station could have its solicitor on hand to explain the advantages of electric drive over mechanical drive before the prospective customer has purchased his gas engine or steam engine, or made his contract for power from a belt, a great amount of business might be obtained which is lost simply through unfamiliarity with electric power on the part of the power-using public. In this connection it is of the highest importance that the solicitor be thoroughly conversant with different manufacturing processes, and be a man of great power of observation, so that he can take in the situation quickly, and give the customer the needed points which will "tell" and turn the scale to electric drive supplied from central station.

After a customer has been secured, he should not be left to his own resources, but should be advised as to the number of motors to purchase and their arrangement. Careful attention to the details of installations at the time the motors are purchased will effect economies, and these will go to the credit of the central-station service. The customer is naturally quite reluctant to buy several motors, when, so far as he can see, one will do the work just as well; but the solicitor should have at hand facts and figures that will prove conclusively that the extra motors will return a good dividend upon the investment, and that with the individual-motor equipment or the group drive, the central station can supply power more cheaply than the customer can produce it himself.

Discussion.

Louis A. Ferguson, Chicago: In many of the larger cities the growth of the power business has been enormous, greater in proportion than the lighting business. In the large cities there are scores of large installations of power, running from 100 to 1,000 horsepower, and it seems to me if the small companies took up this work they could make as great strides in proportion to the size of their cities. I think many of you know, from the talks you have heard in these conventions in previous years, of the success in large cities of cutting out isolated plants. It is an old story now—I am not going to talk much on it, but make the statement to show you what can be done. We in Chicago, at the present time, it is safe to say, have on our circuits nine-tenths of the office buildings in that city; it is also safe to say we have not a part, but all of the club buildings in Chicago, and in nearly every case it has been done only by taking out the isolated plants. This applies to the Chicago Club, the Chicago Athletic Club and the Union League Club. All of these have been operating isolated plants for about 10 years, but we now have all that business on our own station. I offer this to show what can be done. If we can

do that in the case of clubs and office buildings, there is no reason why we cannot do it in the case of factories. What I was after in making the recommendation for the appointment of this committee was not to have a report on the use of small motors, but a report of the success in getting big business, big factories, the class you would least expect to get. It is well known that the best engineers in the country recommend electrical transmission for factory work. As illustrations, we can point to the Deering Harvester Works in Chicago and the Chicago and Northwestern railway shops, and a number of other installations of this kind. It happens that in these particular cases they are beyond the reach of the central-station system, being in the outskirts of the city, and are operated by isolated plants. That does not interfere at all with our argument. If electrical transmission is the proper thing, it comes down to a question, whether the central station can handle the business or allow the isolated plant to come in. In an effort to get this business there is one thing the solicitors forget to consider, and which has been omitted from the report on this subject, and that is the question of load factor—the load factor, where single or individual motors are used is 25 per cent., based on the running time of the factory. In places where group driving is used it ranges from 25 per cent. to 50 per cent. When a solicitor goes in to see a customer and gives him a price per horsepower per hour, the proprietor immediately takes that and multiplies the price given by the number of machines in use and says he cannot afford it. The solicitor is not smart enough to divide it by four, and say that is really the price. I will give you a few illustrations of the value of electric power as against hand power, and in order that I may get the figures correctly I will ask you to allow me to read from a memorandum I have made:

We have on our lines a factory at Twenty-fifth Street and Armour Avenue for the manufacture of porous plasters and absorbent cotton. This factory has two five-horsepower motors, each of which will operate a line of 40 sewing machines. The manager of the factory tells me that a girl can do double the amount of work where the sewing machine is run by motor than can be obtained from her if she runs the sewing machine by a treadle. In other words, electrical power doubles the amount of work done by each girl employed. The pay of these girls runs from $8 to $9 per week, or from 15 cents to 20 cents per hour. The average load on these motors is about four horsepower, so that the average total cost of running the motors is from 18 cents to 20 cents per hour, allowing liberally for loss of efficiency in motors and figuring the cost of current at 4½ cents per kilowatt-hour. This would make the cost of current for each sewing machine 0.5 cent per hour. From this we can see that the expenditure of one-half cent per hour has effected a saving of an expenditure of 15 to 20 cents per hour for manual labor, the ratio in favor of electrical power being as one is to 30.

Let us take a second example. The Corbitt Railway Printing Company has been using our power for about two years in the Brock & Rankin Building. It formerly used steam power, furnished by the owner of the building. Mr. Corbitt tells me that the old steam-power installation enabled him, by different-sized pulleys, to vary his speed on his presses over a range of four speeds. The present installation gives him his choice of any speed whatever over a range of about 300 per cent. This difference corresponds to the difference made in most printing offices by the substitution of electric drives for the old system of steam engines with belts and pulleys. The Corbitt Printing Company figures that it gets eight per cent. larger output for the same labor by means of this greater flexibility in speed, since it is now enabled to use in each case just as high a speed as is practicable for the work it is doing.

Assuming that the pay of a printer is 50 cents per hour, we would have a saving of four cents an hour on each press, or about 35 cents a day. The ordinary size of the motors used on these presses runs from 1½ horsepower up to 7½ horsepower, the average being about three horsepower.

The average cost of power in this particular establishment runs $2.57 per month per horsepower connected. Figuring 26 days per month, we would have about 10 cents per day, or, for three horsepower presses, 30 cents per day. We have already shown that the saving in labor amounts to 35 cents per day; in other words, if steam power were furnished absolutely free without any cost whatever, it would still pay the printer to buy his power from the central-station company at regular rates, and he would save money by doing so.

Another example is the Chicago Candy Company, southeast corner of Fulton and Sangamon Streets. This company formerly operated an isolated plant, getting its power from a steam engine. About a year ago we installed 10 motors, having a total capacity of 65 horsepower. The steam engine was shut down, and since that time the power has been furnished from these motors, operated by the Edison central-station current. Mr. E. K. Corle, the manager, states that they are more than satisfied with the change. Before the motors were installed the power account was $600 per month. Since the motors have been installed the bills for Edison service have been about $125 per month, and the total power account has been $285, including the salary of an engineer to run a low-pressure boiler for cooking the candy; in other words, there has been a saving of over $300 per month.

If every company in the association would agree to see to it that during the coming year no factory should start up within the limits of their lines, without first having the merits of electric motors driven by central-station service carefully explained to the owners, the result would be an enormous stride onward in this branch of the business. Every station should make it a point during the coming year to employ men fully posted in this line of work, or, if they cannot find the men, they should employ bright men of good mechanical ability and give them the opportunity to get the necessary information, so that these men in their turn may educate the public.

The subject of electrical power is one which is but very little understood by the vast majority of users, and until the power user has been informed as to the merits of using electrical power and the advantages to be derived thereby, it is useless to expect him to discard the steam engine and the old methods which he has been accustomed to for so many years.

Arthur Williams, New York: Mr. Ferguson drew attention to a very important point in selling power—the tendency of our competitors to take the rated capacity of the motor, multiplying it by the number of hours of daily operation by the cost per horsepower, and saying that the result is the cost of the electric service. From an electrical standpoint, this is absurd. Fifteen to 60 per cent. of the capacity, depending upon the class of work, should be taken. In a recent test it was found that about 50 per cent. of the power is consumed in shafting and belting, and that is the usual result in most of our tests. While the percentage varies from 40 to 70 per cent. as an average, I have not the slightest doubt that 50 per cent. of the power expended in New York city is used for driving the shafting and belting. The solicitor should have schedules and examples at his fingers' ends in talking in behalf of electric motors. The incidental advantages of electric power service are very great. I have stated this before, and have carefully verified it. In the government printing office at Washington, the sick list was reduced 55 per cent. by the substitution of individual electric motors and the elimination of shafting and belting, with the attendant noise and vibration, which seemed to wear on the nerves of men as well as women.

The cost of elevator service on our lines averages $18 annually per horsepower, ranging from $12 to about $25. The general power service will probably average between $40 and $60 annually, and the cost of coal delivered at the doors of the boilers will in itself average $30 to $35 annually where coal is $3.50 per ton, to which must be added the cost of labor in the engine room, oil and other supplies, interest and depreciation. One of the most interesting power developments is that at Montreal, instituted by Mr. Gossler, and I think we should ask him to give us a description of it.

P. G. Gossler, Montreal: In reply to Mr. William's inquiry, I will say that I noticed a statement was made in the report that there are two ways to reach the customer—first, reduce the rates, until they are so low as to be attractive, and the alternative suggestion of educating the customer. I regret that the committee has overlooked or ignored the possibility of selling power on a limited basis, i. e., that it does not have to be supplied at the time of the peak load. I have suggested that possibility on several occasions, and have generally been met with the statement that it could not be done, especially in large manufacturing establishments. The best answer I can make to that is that it has been done and is being done, and at the present moment the Montreal company has connected to its lines power, not nominal rating of motors, but actual power supply on the limited basis of 7,500 horsepower, among which is the Dominion Cotton Mills, to which we are under contract to supply 3,500 horsepower, and which has an average load of 3,000 horsepower. They do not use power from four to six o'clock in the afternoon from the 15th of September until the 15th of March. At the same time, the number of factory hours is 3,000. They accomplish that by reducing the time for luncheon, starting 15 minutes earlier each day, and operating until five o'clock on Fridays. In consequence of that we have obtained a power load in December at the time of our heaviest lighting load. I think, last December, on several days during the days just preceding Christmas, our power load from seven o'clock in the morning until six o'clock in the evening was about 74 per cent. of the maximum demand. In the last six weeks the average power load from seven in the morning until six at night has been 85 per cent. of the maximum demand. We have numerous contracts which require that one part of the power be discontinued during the time of peak load, and we have an average 24-hour output, selling power from seven o'clock at night until seven o'clock in the morning, such as pumping stations, railway work and running printing presses. We have had an all-day average load of 75 per cent. of the maximum load.

The Salem Light, Heat and Power Company of Salem, Ohio, has been incorporated with a capital stock of $20,000. J. S. Khinefelter, I. C. Wilson, C. M. Wilson, William M. Crumrink and E. N. Grove are the incorporators.

New German Moving-coil Galvanometers.

Many important improvements have been made from time to time in moving-coil galvanometers which enhance their sensitiveness, constancy and general utility. Special care is paid to the treatment of the magnet, in order to fill the most severe requirements for constancy and power and very accurate centering of the cylindrical core is necessary to produce an equal radial magnetic field.

The accompanying illustrations, Figs. 1 and 2, show the construction of a new German moving-coil galvanometer, with light-ray pointer, as constructed at Frankfort-on-the-Main, by the Hartmann & Braun Actien-Gesellschaft. This combination is said to be very convenient where quick but accurate readings

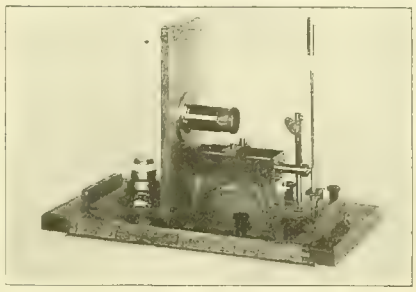


FIG. 1. NEW GERMAN MOVING-COIL GALVANOMETER.—COVER REMOVED.

are required. The moving coil is suspended horizontally by two metal strips in tension, and is fitted with a mirror which reflects the image of an incandescent-lamp filament vertically on a scale mounted on the case, containing the instrument, as noted in the accompanying view. The damping action is provided by a short-circuited winding and the resistance of the working coil is about 150 ohms. The sensitiveness of the instrument is a deflection of one meter on a scale one meter distance, with about 0.0000002 ampere. And the complete weight of the galvanometer is 5.4 kilograms.

A moving-coil reflecting galvanometer is constructed at Frankfort with a telescope and scale mounted on a swinging arm, which can be extended to one-half meter. The sensitiveness with a 700-ohm coil is one meter deflection at one-half meter scale distance, with about 0.000000003 ampere.

A moving-coil reflecting galvanometer for the high-

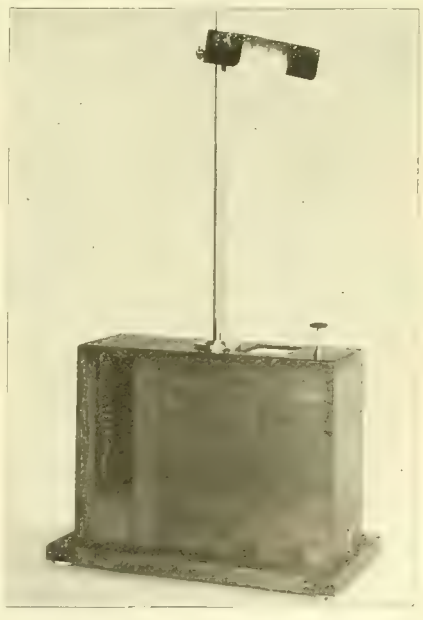


FIG. 2. NEW GERMAN MOVING-COIL GALVANOMETER—LIGHT-RAY POINTER.

est sensitiveness is constructed with special suspension and a manganin series resistance fitted in the instrument, raising the coil resistance to 10,000 ohms. The sensitiveness of this instrument is one meter deflection at one meter scale distance, with about 0.000000007 ampere, and it has a weight of about 3.4 kilograms. The latest type of instruments of the Deprez-D'Arsonval system are constructed with a great improvement in the sensitiveness, swing and accuracy of the reading, on account of a considerable reduction in the weight of the moving coil. In one group of the pointer instruments constructed at Frankfort, Germany, the vertical axis of the coil is pivoted in jewels, the coil working against an opposing spring, while in the other groups various

methods of suspension, either horizontally or vertically, on fine wires or strips are employed for the moving coils. At the present time frameless winding in two unequal sections, has been adopted, this winding being connected to the terminals on the base of the instrument by silver-foil strips. Of these windings, the more powerful is used for measuring purposes, the smaller, comprising only comparatively few turns, can be more or less short-circuited through a suitable resistance, yielding an adjustable damping action, which can be varied to suit all purposes. By constructing the instruments with very powerful fields, they are said to be practically unaffected by terrestrial or other magnetic influences, and the equal scale of deflections throughout the entire range renders them serviceable for most purposes. P.

Chicago Street-railway Situation.

If the plan embodied in an order passed at the last meeting of the Chicago City Council is carried out the committee on local transportation of the council will now open negotiations directly with the individual stockholders of the North and West Side companies, the underlying properties of the Union Traction Company, for the solving of the traction problems.

There is said to be considerable dissatisfaction among the eastern stockholders of the North and West Side companies, and a plan is being advanced by them to combine with the Chicago City railway, which has issued no bonds. The new company would be bonded for an amount sufficient to pay all indebtedness of the underlying companies, and the Union Traction Company, according to the plan, is to be left to shift for itself.

The recent decision of Judge Grosscup on the 99-year act has stirred the counsel, officials and receivers of the Union Traction Company and many conferences are being held. Much anxiety has also been created among stockholders by statements of insolvency on the part of the North and West Side companies published in the daily papers. According to these reports, when the North and West Chicago street-railroad companies were taken over by the Chicago Union Traction Company, July 1, 1899, their alleged earnings were at the rate of 12 per cent. per annum on the stock of the North Chicago company, and six per cent. per annum on the West Chicago company. Not only, it is asserted, have these dividends been discontinued but income accounts of both companies for the six months ended February 29, 1904, show the North Chicago company was unable to meet expenses and depreciation by $191,360, while the West Chicago company for the same period was in arrears $392,188. Following these reports of insolvency and failure the receivers, it is announced, are this week to file a report with the court showing the financial transactions of the Union Traction Company through the receivership and up to the present time. On the whole some interesting developments may be in order before the troubled situation is cleared.

Government Control of Space Telegraphy.

In relation to the report that the government might assume control of all space-telegraph stations on the coast, a high official of the Navy Department is credited with the statement that it is wholly premature to say that the government will take such action. He is quoted as follows: "What has taken place has been a consideration of the fact that the government is duplicating its service and that frequently the government systems clash with those of private individuals and companies. In time of war this would be a serious matter, and necessarily for the purpose of defense the government would be forced to insist on exclusive rights. The fact is that the Department of Agriculture is sending its weather reports by wireless, the War Department is using the system, the Navy Department is making use of it, and the Lighthouse Board employs it. Now the government might well consolidate all this work into one system and have good service. That may be the foundation of the notion that the government is going into the wireless-telegraph business. It may happen that private persons will not be allowed to use the government reservations for wireless stations, but that is a small matter and has no bearing on the broad question of establishing a government monopoly of the system."

Protection of Patents.

Before its final adjournment in Berlin a few days ago the International Congress on the Protection of Patents and Trademarks, adopted unanimously a resolution to the effect that citizens of the signatory powers should not be required to establish a factory in each country in order to enjoy the protection of samples and models therein, and, further, that an office be organized in connection with the International Bureau at Berne for the announcement of the construction of models and preparation of samples for use in the signatory states. The next session of the congress will be held at Liege, Belgium.

CORRESPONDENCE.

Great Britain.

London, May 25.—With the increasing experience of the advantages of electricity supply on a large scale, it is somewhat surprising that combinations of adjoining municipalities with this object in view are not more common in England than is actually the case today. In 1901 the Stalybridge, Morsley, Hyde and Dukenfeld corporations combined and obtained an act of Parliament authorizing the establishment of a board to control the supply of electricity in those districts as well as the working of tramways. A year or two later some five local bodies in the suburbs of North London endeavored to do the same thing, but after a large expenditure the project fell through. Thus the Stalybridge combination, which is in the vicinity of Manchester, is the only one of its kind. The total area of the scheme is 11,399 acres and the population numbers some 100,000 inhabitants. A few days ago the first unit in the power house was started. Eventually the main generating station will contain six Lancashire boilers, supplying steam to three 750-horsepower triple-expansion engines, direct-coupled to three 500-kilowatt, 6,000-volt, three-phase generators, having a frequency of 40 cycles per second. There are four sub-stations, where the current is transformed and converted to low-pressure continuous current for distribution for the purposes of lighting and traction. Each sub-station also contains a 270-cell battery, having a capacity of 3,000 amperes and a maximum discharge rate of 400 amperes. The tramways are over 21 miles in length, mostly single-track with turnouts.

Now that all the inconvenience owing to the lamented death of Mr. McMillan, the secretary to the Institution of Electrical Engineers, has been largely overcome, the council has been able once more to devote its attention to the projected visit to America in a few months' time. The idea is to leave Liverpool on August 25th and arrive at Boston on September 2d. New York will be visited on September 4th, and between that time and September 24th, when the dispersal takes place, the following cities will be visited: New York, Schenectady, Montreal, Niagara Falls, Chicago, St. Louis, Pittsburg, Washington and Philadelphia.

The Royal Commission on London Traffic meets next week for the last time for the purpose of hearing evidence. The commission has been working for over 12 months, and last summer paid a visit to America.

The bill which was introduced into the House of Lords a few months back, and which seeks to legalize the metric system in Great Britain, has been sent forward for final reading in that House.

The bill of the Marylebone (London) Borough Council has now passed the third reading in the House of Lords, and this being the final stage prior to royal assent being given to the measure, it may be assumed that, for the present, the electric-lighting troubles in the district are at an end. The way is now clear for the council to borrow the necessary funds to purchase the undertaking of the Metropolitan Electric Supply Company within its borders, and to set about its own scheme of reconversion.

Several new provincial electric-tramway undertakings have been put into operation during the last week. The largest is at Leicester, where the local horse-tramway company has been bought out and an extended electric service substituted. There is already an electric power station in Leicester for electric-supply purposes, but it was deemed wiser to put down a separate power house for the tramways. The track is an equivalent of 42 miles of single line. The Darlington tramways are of somewhat more modest proportions, the supply of current being taken from the existing power house. The mileage of track is only some five miles, and the gauge is three feet six inches. The cars are, contrary to the usual practice here, divided into three compartments, the two end ones being reserved for smokers.

Considerable progress is being made with the construction of the Great Northern, Piccadilly and Brompton tube railway, one of Mr. Yerkes' lines, which will connect the north with the southwest of London. More than half the tunneling is now completed. G.

New York.

New York, June 4.—Westinghouse, Church, Kerr & Co. are making rapid progress with the work of erecting the 50,000-horsepower generating station at Long Island City, as well as with the sub-stations at Jamaica, L. I., and at Hammel's Landing, Rockaway Beach.

The terms upon which cars may be operated upon the Williamsburgh Bridge were made public yesterday by Commissioner Best. The Bridge company, consisting of the Brooklyn Rapid Transit, the Metropolitan Street Railway and the Coney Island and Brooklyn Railroad companies will pay an annual rental of $10,000 in addition to five cents per round trip for every car passing over the bridge. The fare for local bridge passengers will be three cents, but through passengers must be taken across the bridge without extra charge. The northern pair of tracks across the bridge is to be so equipped that the underground trolley cars of the Metropolitan system can cross it, while the southern tracks will be fitted for the overhead trolleys of the Brooklyn Rapid Transit. It is expected that the Brooklyn Rapid Transit cars will be able to cross the bridge on July 15th.

An alarmist writes to the New York Times this week pointing out the possible dangers of a gas explosion in a rapid-transit tunnel if, as has been recently proposed, special provision should be made for the location of gas mains in the new tunnels now being discussed.

Quite a quantity of electrical equipment is being put into some of the public schools. Oberg & Blumber, electrical engineers of 112 West Forty-second Street, have the contract for Public School No. 123, Manhattan, and Peet, McAvenury & Powers of 225 Fourth Avenue are fitting up Public School No. 47 in Brooklyn. In Richmond borough, T. Frederick Jackson of 592 Columbus Avenue is equipping Public School No. 8.

Patrolman G. G. Vosatka of the Nineteenth police precinct has been permitted to receive a reward of $100 from the New York Telephone Company for effecting the arrest of two cable thieves.

Charters of incorporation have been granted to the following firms: National Battery Company, Buffalo, capital $500,000, directors, R. L. Coleman, W. H. Miller and W. L. Hodges, all of New York; the Electrical Chemical Glass Company of Harrison N. J., $50,000, incorporators, M. F. Wilfong, J. A. Zuncak, E. G. Nissley, J. R. Wilfong and H. H. Zuncak; the Acme Equipment Company (electrical and mechanical engineering), $100,000, Felix Lamond, F. W. Jewell and Charles Dodson.

Mrs. William C. Gotshall, wife of the popular president of the Portchester Railroad Company, was hit with a stone last week while traveling in her automobile. Police investigation has proved that the stone was thrown at Mrs. Gotshall by a boy named Rosso, but when it was revealed at the Children's Court that the culprit was only 3½ years of age the magistrate discharged the boy on the ground that he was too young to be guilty of a crime. Mrs. Gotshall, moreover, refused to appear against him for the same reason.

The bid of the Consolidated Gas Company, which has been the subject of prolonged dispute, has been accepted at last for the supply of 22,500 Welsbach lamps at $24.75. The price includes the cost of repairs.

The Red Star steamship Vaderland, which reached here Wednesday from Antwerp, reported that on May 25, while in midocean, she got into wireless communication with the Cunarder Campania, in which Marconi was a passenger. The inventor sent word that his experiments with long-distance wireless messages on the Campania had been a great success and that the Campania then was in communication with both sides of the Atlantic.

Within a few days the New York Telephone Company will make announcement of a general reduction in telephone tolls between the different boroughs of Greater New York. The charge for telephone messages between Manhattan and Brooklyn will be 15 cents instead of the prevailing rate of 20 cents. There will also be a reduction in telephone tolls to the various localities in the boroughs of Richmond and Queens, and to certain outlying sections of the Bronx, but what the new schedule will be the telephone company has not as yet announced. The rate in these boroughs, however, will not be a uniform one, as in Brooklyn. The new rates will apply only to the public pay telephones. Subscribers who, in the case of messages to Brooklyn, are only paying 10 cents now against the 20 cents paid by the man who uses a public telephone, will go on paying the same rate. The readjustment of rates is the result of complaints which have reached the company and of a belief on the part of the officials that the new tariff will lead to an increase in the use of the telephone.

Tentative agreements have been reached between the members of the Rapid Transit Commission with the Pennsylvania Railroad and the New York and New Jersey Tunnel Company whereby on Monday next the committee on contracts will recommend the granting of the franchises for the New York Connecting Railroad on Long Island and for the tunnel company to extend its line to Herald Square.

D. W. W.

New England.

Boston, June 4.—The electric-light companies, the electric-light commissioners and the railroad commissioners of Massachusetts are all up in arms against the bill to incorporate the Western Massachusetts Street Railway Company, now pending in the Legislature. The broad powers which would be conferred by the bill, if enacted, are contrary to all precedent, comprising authority to not only run cars by electricity, but to furnish light and power in the towns through which the railway would pass. There are consolidation privileges also embodied in the bill, and the press of the state has teemed with editorial opposition to its passage. The bill is backed by a powerful lobby and has passed the Senate.

The Boston and Worcester Street Railway Company reports for the six months ended March 30th as follows: Operating expenses, $104,307; net earnings, $28,503; taxes and interest, $89,100; surplus, $92,903. The road has been a good earner since it commenced operating, and is expected to pay excellent dividends.

The Massachusetts railroad commissioners have approved the discontinuance of free transfers by the

Newton and Boston Street Railway Company, in view of its unsatisfactory earnings during the last year. The period covered by the grant of the commission is until September 30, 1905.

Counsel for the Massachusetts Electric Companies, operating the Old Colony Street Railway Company, which runs through the city of Brockton, have communicated to the city their intention to make a test case of a disputed bill presented by Brockton against the railway company for repairs to a certain crosswalk on the line of the road. The sum involved is only $4, but the principle at stake is one that the railway company considers worth a court contention. The novelty of the situation will cause the city's suit to be watched with unusual interest.

In pursuance of the plan of organization of the New York, New Haven and Hartford Railroad Company for the management of its numerous trolley-line acquisitions, a meeting was held in New Haven last week and officers of the newly formed Consolidated Railway Company, under which name the trolley lines will be grouped, were elected as follows: President C. S. Mellen; first vice-president, E. H. McHenry; second vice-president, H. M. Kochersperger; secretary, J. G. Parker; treasurer, A. S. May; assistant treasurer, T. F. Paradise; directors, George J. Brush, Edwin Milner, F. S. Curtis, Charles F. Brooker, C. S. Mellen, H. M. Kochersperger, J. S. Hemingway, E. D. Robbins, A. D. Osborne, F. W. Cheney, I. D. Warner, D. N. Barney, E. H. McHenry, John M. Hall, Percy R. Todd. All these officers are directly identified with the New York, New Haven and Hartford railroad, with the exception of J. S. Hemingway, who was president of the Fairhaven and Westville Street Railway Company.

The absorption of the Mystic Electric Light Company and the South Shore Electric Light Company of Mystic, Conn., by the Westerly Gas and Electric Company of Westerly, R. I., terminates litigation that has been pending over the question of the invasion of the charter rights of the Mystic companies in the town of Stonington, wherein the Westerly company has been extending its service. B.

Mexico.

City of Mexico, June 2.—Steps have been taken by the owners of the Jauja cotton mills at Tepic, Mexico, to furnish that city with electric light and power.

The Mexican government has granted Mackin & Dillon of Monterey an extension of their concession for the construction and operation of an electric railway from Monterey to Villa Guadalupe until December 5th. This concession also gives the right for the construction of electric lines on several of the principal streets of Monterey.

A strong company is being organized for the purpose of constructing a system of electric railway in Parral. It is stated that a liberal concession and franchise for the use of the streets will be granted. The same persons have obtained a concession to build and operate an extensive long-distance system of telephones in the state of Chihuahua.

Antonio A. Moll has obtained a concession from the Mexican government for the establishment of an electric-power plant in the southern part of the state of Vera Cruz.

The active work of constructing an electric railway between Puebla Nueva and Navidad del Puerto, state of Sinaloa, is in progress by the European syndicate which owns the Puebla Nueva mines. The road will be used chiefly for the transportation of the ore from the mines of the syndicate.

The work of constructing a large electric-power plant at Guyanopita, state of Chihuahua, will soon be commenced. J. W. Taylor of El Paso, Texas, is interested in the project.

A German company has applied to the City Council of Guanajuato for a franchise to establish an electric-light and power plant there. The franchise of the company which is now supplying the city with electric lights and power will expire in August.

The City Council of Puebla has extended the contract of the local electric-light and power company for furnishing the city with electric lights for a period of 25 years on condition that the capacity of the plant be increased and the free service of 200 additional arc lights be furnished the city for a period of five years.

Miguel Morga of Topia has been granted a concession to establish an electric-light and power plant at that place. H.

Indiana.

Indianapolis, June 6.—In the case of the city of Crawfordsville and the Consolidated Traction Company against the Indianapolis and Northwestern Traction Company, involving the most intense rivalry for the occupation of certain streets in that city, a ruling has been made by Judge Baker of the Federal Court in favor of the Northwestern company. This action of the court sustains the claims of the Northwestern company and gives it the legal right to the streets of Crawfordsville for the use of the company's tracks as against the claims of the Consolidated company, and incidentally fixes the legal status of both companies. The Northwestern company is authorized to proceed with the construction of its lines in the city of Crawfordsville. The Northwestern was first granted a franchise, but later the city rescinded its action and granted a similar franchise to the Consolidated company, which provided that all other companies must enter the city over its tracks. Later the Northwestern company succeeded in laying its tracks in the coveted streets, where they remained pending the action of the court on the injunction against further construction.

The Richmond City Council has at last agreed on a franchise to be granted to the Columbus, Greensburg and Richmond Traction Company. It will be accepted by the company.

The Portland, Montpelier, Warren and Huntington electric railway has been financed. The bond issue will amount to $1,600,000. The company completed its organization by electing the following officers: President and general manager, James West; vice-president, Scott Mills; secretary, D. A. Williamson; chief engineer, George Champe.

The numerous changes and improvements under way by the Indianapolis Terminal and Traction Company have necessitated the purchase of an electric crane, which is being used in loading and unloading the 90-pound rails and heavy crossbeams and crossings. The crane is operated on a flat car and moved from place to place by a trolley car. Three men do the work of a score under the old way. Drilling is also done by electricity procured from the trolley wire.

The Indianapolis and Eastern Traction Company has adopted a novel but apparently successful scheme to popularize Spring Lake Park, a beautiful resort 15 miles east of Indianapolis on the company's line. The company secretly buried, not to exceed two inches, a number of medallions, promising the finders thereof $10 to $100 in gold, according to the denomination of the medallion. The number buried calls for $250 in gold. In consequence large crowds have visited the park during the last week and the finding of two $10 medallions occasioned a multitude to visit the park on Sunday. The scheme is said to have been borrowed from England. F.

Michigan.

Detroit, June 4.—E. M. Hopkins and associates, who are promoters of the Grand Rapids-Ionia and the Ionia and Owosso (electric) railways, have now in project the organization of another line from Owosso to Pontiac, which will be capitalized at $1,600,000. The Farnham Construction Company of Detroit will build all the lines of this system, which, when constructed, will form a continuous chain from Grand Rapids to Detroit. The line from Grand Rapids to Ionia will be 32 miles long, and that from Ionia to Owosso, 48 miles; from Owosso to Pontiac, 51 miles long. The Detroit-Pontiac line now in operation is 26 miles long, the total length of the road from Grand Rapids to Detroit is 157 miles. The Farnham third-rail system will be used.

The Detroit United Railway has made several important changes in its official staff. C. B. King, assistant to the president, has been appointed assistant superintendent of the Jefferson division. The position of assistant to the president has been abolished. Albert E. Peters, assistant secretary and purchasing agent, will devote his time entirely to duties as secretary and to the work heretofore performed by the assistant to the president. A. F. Edwards will become purchasing agent.

The Cheboygan Electric Light and Power Company has issued $100,000 in bonds covering improvements. The Union Trust Company of Detroit is trustee.

It is understood that the Coldwater-Battle Creek Interurban Railway Company will commence the building of its road this summer.

The Detroit, Flint and Saginaw electric railway has completed the line from Saginaw to Bridgeport and cars are now running; the line has also been partially completed toward Frankenmuth, but the affairs of the company have been carried into court and a receiver is asked for. A temporary restraining order has been granted, forbidding the incurring of any further obligations and the sale of any bonds of the company until further orders from the court.

The Bay City Street Railway Company has raised the wages of its employes without having been asked to do so.

A movement is on foot to compel the Detroit United Railway to provide for an interchange of three-cent and workmen's tickets during the hours that workmen tickets are in effect. It is possible that the council may go further in this matter and request transfer from three to five-cent lines on workmen's tickets. It is claimed that such an action would relieve the congestion on the three-cent lines. C. G. W.

Northwestern States.

Minneapolis, June 4.—C. F. Wood has sold his electric-light plant at Fort Madison, Iowa, to A. Atlee.

The Montevideo (Minn.) Electric Light and Power Company has organized. E. H. Sorlien was elected president and E. A. Aspnes, secretary.

The White Bear (Minn.) Electric Company has increased its capital from $10,000 to $25,000.

The Oskaloosa Traction Company is considering the advisability of building an interurban line from that city to the Iowa coal fields. H. L. Spencer is president of the company.

H. E. Stevens has resigned as superintendent of the St. Cloud (Minn.) waterworks and electric-light plant to accept a position as assistant in the plant at Miles City, Mont.

George A. Isaac, a lineman of the Electric Light and Power Company at Anaconda, Mont., was instantly killed by a live wire recently.

A company has been formed at Creston, Iowa, for the purpose of building a trolley line to Des Moines. J. H. Mack of Macksburg is president and R. Brown of Creston is secretary.

The Twin City Rapid Transit Company has applied to the federal court for an injunction preventing the city of St. Paul from levying a five per cent. gross-earnings' tax before allowing extensions of the company's lines. The city has filed a counter suit in the state courts, asking for an annulment of the old horse-car franchise, on account of non-use. R.

Ohio.

Cleveland, June 4.—A disastrous accident occurred on the Lake Shore electric line at Wells Corners Thursday evening. Six persons were killed outright and 18 were injured more or less severely. In some way the eastbound limited, with a number of passengers aboard, and the westbound package car met in head-on collision while both were going at a good rate of speed. All but one person in the smoking compartment of the passenger were killed. This is the first accident in which there was loss of life that the Lake Shore has had, and President Warren Bicknell is making a thorough investigation and will locate the fault, if possible.

The directors of the Sandusky, Norwalk and Mansfield Electric Railway Company, recently incorporated, have chosen S. S. Burtsfield of Toledo as president. The intention is to build a line from Sandusky to Mansfield, through Erie, Huron and Richland Counties.

It is planned to have cars running over the Springfield, Troy and Piqua line by July 4th.

The date for the completion of the municipal lighting plant in Columbus has again been put off four months. It is stated that plans have been changed in the interest of safety in the installation of the large turbines. The Board of Public Service has entered into a contract with the Columbus Railway and Light Company for an exchange rental of poles on the basis of 15 cents a contract annually.

The special car carrying the commercial travelers from Dayton to Zanesville, some days ago, made the run over the Appleyard lines from Dayton to Columbus, 77 miles, in two hours and 11 minutes, and no notice was taken of the stops and slow-ups at crossings, nor was the regular schedule on the roads interfered with. This is an average of 46½ miles per hour. The car was transferred to the Columbus, Buckeye Lake and Newark line at Columbus and made the run east in good time.

On the occasion of his visit to Cincinnati, Randal Morgan of Philadelphia was tendered a banquet at the St. Nicholas Hotel, that he might meet Cincinnati business men. The banquet was one of the finest ever served in the Queen City, and was enjoyed by 76 guests. It was given by W. Kelsey Schoepf, president of the Cincinnati Traction Company.

The Lebanon and Franklin electric railway has been opened from Lebanon to a point 11 miles out, where it makes close connections with the Cincinnati, Dayton and Toledo cars.

The Warren Water and Light Company of Warren has been incorporated with a capital stock of $250,000. The company represents a consolidation of the Warren Electric Light and Power Company and the Warren Water Company.

The tax value of the Lake Shore electric line has been increased $67,167 over the amount last year. Increases have also been made on several other lines in the northern part of the state, due to improvements and increasing business, it is said. The valuation was made by county auditors through whose territory the road passes, and the value of the power house was counted in on the track mileage, according to the law passed by the last Legislature. O. M. C.

PERSONAL.

A dispatch from Berlin, dated May 27th, says: "F. Siemens, a noted electrical engineer and a member of the Siemens family, which has included a number of inventors, is dead."

The German Society of Engineers, in session at Frankfort-on-the-Main, recently conferred medals on Messrs. Parsons and De Laval in recognition of their inventions and developments in steam-turbine design.

Samuel R. Calloway, president of the American Locomotive Works and formerly president of the New York Central railroad, died at his home in New York city on June 1st. He was prominent in railroad circles, having been connected at different times with some of the leading roads of the country. Mr. Calloway was born in Canada in 1850.

H. H. Vreeland took occasion at a recent meeting of the New York Railroad Club to enlighten the members on what they may expect when steam roads begin using electricity as a motive power. He spoke at the conclusion of discussion on a paper entitled "The Roundhouse Foreman of 1904," and pointed out that the "intricacies in connection with roundhouse work electrically are much greater than anything that goes with the motive-power proposition." He concluded by saying: "The greatest difficulty we have today in connection with our operation is

in securing competent men, by reason of the limited experience that necessarily could be gathered in the short interval in which this great electrical development has taken place. It has been almost impossible to secure the type of men required."

Svante August Arrhenius of Stockholm, Sweden, has been appointed delegate for Sweden to the international electrical congress to be held in St. Louis next September. Dr. Arrhenius is professor of physics in the University of Stockholm and is one of the most eminent scientists in Sweden. He was winner of the Nobel chemistry prize in 1903.

Paul M. Mowrey has assumed the office of vice-president of the Engineering Company of America in New York city. Mr. Mowrey has been prominently identified with the engineering and contracting business since 1888, when he became connected with the Edison Illuminating Company. Among his numerous successful enterprises was the purchase and consolidation of the street-railway and power companies of Richmond, Va., which were later turned over to Frank Jay Gould.

Arthur Warren, chief of the department of publicity of the Allis-Chalmers Company, has written for the June number of the Review of Reviews an excellent article entitled "The Turbine: A New Era of Steam." In the article Mr. Warren cites the changes which the turbine is making in the engineering world and his first paragraph is significant: "It is probable that the last great reciprocating engine-driven power plant has been ordered. Hereafter, the steam turbine will be the prime mover of the new installations."

C. C. Tyler has resigned his position as superintendent of the works of the Westinghouse Electric and Manufacturing Company at East Pittsburg, Pa., and has been appointed general superintendent of all the works of the Allis-Chalmers-Bullock interests in the United States. Mr. Tyler, who will enter upon his new duties on June 15th, will make his headquarters at Milwaukee. His record in the practical management of great machine shops is noteworthy, and it has long been under the appreciative observation of men who understand the value of such ability. Before Mr. Tyler went to Pennsylvania he had made an excellent reputation, and at Pittsburg, where he has been for half a dozen years, he enhanced this by the results he achieved in increasing the efficiency of the Westinghouse electric works. In the equipment of manufactories, in the design and construction of machine tools, in the handling of machinery and material in process of manufacture, and, in fact, in all that pertains to the economy of machine-shop administration, Mr. Tyler is recognized as an expert of the first grade.

William L. Abbott, chief operating engineer of the Chicago Edison Company, was nominated as one of the trustees of the State University by the Illinois Republican convention at Springfield last week—the convention that attracted so much attention by the prolonged "deadlock" on the gubernatorial nomination. Mr. Abbott is an alumnus of the University of Illinois, class of '84, and his nomination is the result of a movement set on foot by the alumni, particularly the engineering alumni, for Mr. Abbott took the course in mechanical engineering. Mr. Abbott is a native of Morrison, Ill., and was born in 1860. After leaving college he came to Chicago and engaged in mechanical and later in electrical pursuits. He was at one time an assistant of the late Charles J. Vandepoele. Afterward he embarked in the electric-lighting business for himself as principal owner of the National Electric Construction Company, which supplied current to a downtown area. When this company was sold to the Chicago Edison Company, Mr. Abbott joined forces with that company, first as chief engineer of Harrison Street station. He has held his present position for several years and is highly esteemed, both inside the company and out of it, for his technical ability and his straightforward, manly character, mellowed by a serene and kindly humor. Women vote for university trustees in Illinois, and as Mr. Abbott is popular with the fair sex his friends apprehend that he will roll up a tremendous majority next November.

W. L. ABBOTT.

ELECTRIC LIGHTING

The Jonesboro (Ark.) Electric Light Company is planning to enlarge its plant.

The city of St. Joseph, Mo., will hold an election soon to decide on the issuing of $325,000 of bonds, $75,000 to be used for a new electric-light plant.

A movement authorizing the city of Chicago to own and operate gas and electric-light plants and to sell gas and electric light to its citizens has been launched in the City Council by Mayor Harrison. The council passed an order, sent in by the mayor, directing the committee on state legislation to prepare a bill providing for municipal ownership of these public utilities. The bill will authorize the city to issue certificates against the properties for the purchase or construction of gas or electric-lighting plants.

The New England Engineering Company of Waterbury, Conn., has been awarded the contract for the installation of an electric-light system and power plant for the Massachusetts Fiberloid Company at Indian Orchard, Mass. The system will be equipped with over 1,000 incandescent lights, and the power station will have a capacity of 1,000 horsepower.

The finance committee of the Chicago City Council has prepared a bond issue of $2,044,200 for permanent improvements. Of this amount $200,000 is specified as for extensions to the electric-lighting system. The extension of the electrical department has been repeatedly recommended by City Electrician Ellicott, but before the bonds became possible the money was not at hand.

A proposition has been made to the city of Austin, Texas, by R. O. Deming of Kansas City, Mo., and J. M. Jacobs of Lansdale, Pa., to rebuild the dam across the Colorado River, destroyed by flood a few years ago, and to repair the waterworks and electric-light plant in return for a 50-year water and light franchise. They offer to assume the bonded indebtedness of the city, amounting to $1,400,000, and expend $500,000 on the dam and plant.

Plans are now being made for building a municipal electric-light plant at Covington, Ky. Citizens voted to issue bonds for this purpose three years ago to the amount of $75,000, but the matter got into the courts and has just been decided in favor of the city by the United States court. It is thought that the people will vote for an additional issue sufficient to install a plant large enough to supply the city and allow current for commercial purposes.

ELECTRIC RAILWAYS

President J. C. Bronston of the Fayette Interurban Railway Company, Lexington, Ky., is making preparations to begin work on the line from that city to Versailles within a few days.

The Fox Point line of the Milwaukee Electric Railway and Light Company has been opened and the cars will be run every hour from 6 in the morning until 11 o'clock at night.

The Springfield and Decatur (Ill.) street-car system will at once be extended from Carlinville, where the extension now is, into Edwardsville by way of Bunker Hill and will reach Fosterburg. From Edwardsville a connection to the new St. Louis line will be made.

President Charles Singer of the New York and Stamford Railway Company, Greenwich, Conn., has inaugurated a parlor trolley service, charging double fare for seats in the parlor car of the company and running it between Port Chester and Rye Beach, Conn. If it proves popular, parlor cars are to be put on the main line.

The Long Island Railroad Company will build a new $40,000 sub-station at Rockaway Beach, to take current from the big power house at Long Island City for operating the Ocean electric line on the Rockaway Peninsula. Another sub-station at Ozone Park will furnish a supply for the line across Jamaica Bay. The entire Long Island railroad system west of Jamaica on the Atlantic Avenue and Rockaway division will be operated by electricity next year.

The elevated railways of Chicago show about the usual gains in passenger traffic for May as compared with the corresponding period last year. The Metropolitan West Side elevated made the best gain, 4.61 per cent., while the South Side elevated gained only 0.55 per cent. The Northwestern gained 3.35 per cent. The daily average of passengers carried by the Metropolitan in May this year was 114,372, as against 109,330 last year. The South Side company averaged 83,342 in May this year and 82,884 last and the Northwestern increased its daily average from 66,990 last year to 69,232 this year.

An unusual wreck occurred recently on the Rockford and Interurban railway. Car No. 101, running between Rockford and Belvidere, Ill., was left standing in front of the car shops, when, from some unknown cause, it got under way without anyone on board to control its speed. It ran north to State Street, thence west on State to Wyman, passing over the girder bridge and also the Chicago and Northwestern railway tracks. It dashed down the hill at a rapid rate and, in turning the corner at Wyman Street, the car left the track, dashed into an electric-light pole, breaking it off at the base, and came very near going through a shoe store. Several persons were injured, and the car was almost a total wreck.

POWER TRANSMISSION.

The Great Northern Power Company of Duluth, Minn., is contemplating installing several large turbines, in order to increase its capacity to 80,000 horsepower.

A waterpower electric plant is contemplated at Griffin, Ga., by W. J. Kincaid, J. P. Nichols, H. B. Neal and others, who have applied for a charter for the Flint River Power Company. They have purchased the Flat Shoals waterpower and 200 acres of land and will develop 5,000 horsepower.

The electric plant of the Highland Power Company on the Boise River 20 miles above Boise, Idaho, has been destroyed by high water, and the loss is estimated at $150,000.

Considerable interest attaches to the electrical supply of the city of Butte, Mont., since it is derived from four sources. Part of the supply is generated locally by a steam plant of 3,000 horsepower and part is obtained from three waterpower plants, of which one of 5,000 horsepower is situated on the Missouri River, 60 miles away; another, of 2,000 horsepower on the Madison River, 67 miles away, while the third plant, which is also of 2,000 horsepower, is situated on the Big Hole River, 20 miles away. Three of these plants are worked together with no more difficulty than if they were situated within the same building. The pressure used on the Missouri River line is 50,000 volts. The wires are placed 78 inches apart, which is said to be amply sufficient to prevent any arcing across. On the Madison River line the conductors are of aluminum, and the voltage is 40,000.

PUBLICATIONS.

The April supplement to the National Electrical Code contains changes and additions adopted at the annual meeting of the National Board of Fire Underwriters last December and also a list of electrical fittings that have been examined and approved by the Underwriters' National Electric Association.

The F. Bissell Company, Toledo, Ohio, has prepared two new additions to its perpetual catalogue, bulletins Nos. 29 and 30, the former devoted to ammeters and voltmeters and the latter to wattmeters. The bulletins contain illustrations and descriptions of the various instruments, with lists of sizes and prices.

The Arnold Electric Power Station Company of Chicago has issued two pamphlets containing reprints of articles in the technical press concerning two installations which were made under the supervision of the company—one the Omaha shops of the Union Pacific Railroad and the other the Baring Cross shops of the St. Louis, Iron Mountain and Southern Railway.

The Star Dynamo Company of Jefferson City, Mo., has issued a catalogue of its dynamos and motors, which range from one-half to 7½-kilowatt capacity. The machines are described in detail and illustrated. They are of the semi-enclosed type, some being supplied with a momentum disk and others with a back-gear attachment. These machines are all plain shunt wound, but will be compounded to any practical percentage if specified.

"Generator-can Telephones" is the title of the latest bulletin issued by the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y. Among the more important things described in the bulletin is the company's No. 4 type of transmitter, which will be its standard in the future. A party-line selective intercommunicating system is also described. Telephone parts are very fully set forth, as are also divided-circuit telephones, the "sure-ring" bridging telephones, portable combination telephones and adjustaphones. The bulletin is carefully prepared and clearly illustrated. It is distinctly a credit to the literary bureau of the company.

A neatly prepared fan-motor booklet comes from the Fort Wayne Electric Works. The illustrations are exceptionally good and show a great many applications of fans, each illustration being accompanied by a short description. The booklet is entitled "Summer Comforts." Bulletin No. 1055 from the same company is also out and is devoted to form C arc lamps with concentric diffusers for interior lighting, especially in textile mills and mercantile establishments, where a uniform distribution of light is essential. The concentric-diffuser equipment consists of a specially designed porcelain shade below and around the inner globe and a porcelain-lined reflector above, designed with special reference to maximum efficiency and distribution of light rays emanating from the arc.

TELEGRAPH.

The Western Union Telegraph Company is about to extend its underground system in Memphis, Tenn. About $20,000 will be put into the improvement.

The final splice in the second cable from Borkum to New York, via the Azores was made off Fayal a few days ago on board the cable steamship Stephan, which sailed from New York on May 10th with 2,100 nautical miles of cable on board. There are now two complete submarine cables between Germany and the United States. The total length of the new cable is 4,200 nautical miles.

SOCIETIES AND SCHOOLS.

Nearly all of the class graduating from the electrical engineering course at the University of Minnesota are located, many of them being already at work. E. J. Cheney, V. E. Goodwin and F. C. Helms enter the engineering apprenticeship course

with the General Electric Company at Schenectady and J. Howatt, F. A. Otto and R. B. Taplin that with the Westinghouse Electric and Manufacturing Company at Pittsburg; L. C. Tomlinson and J. Wicks go with the Automatic Electric Company at Chicago; G. Crabbe with the Otis Elevator Company at Yonkers, and H. G. Morton with the Northwestern Telephone Exchange Company at Minneapolis; B. M. Bouman will enter the telephone field and P. M. Rosok goes with the Missouri River Power Company at Helena.

SPACE TELEGRAPHY.

It is possible that isolated Iceland, cut off from the rest of the world save for slow mails, is to be linked to other countries by means of space-telegraphic connection with the Shetland Islands or the mainland of the United Kingdom, as may seem best. This is to follow the action of the Icelandic Parliament, at its last session, in voting a yearly subsidy of $9,380 for 20 years for that purpose and also for similar means of communication between Reykjavik and the principal towns of Iceland.

A newspaper correspondent at St. Petersburg, Russia, says that Colonel Perky, a Russian officer, in a communication to a technical society on the discovery of a means for utilizing space telegraphy to explode submarine mines, asserts that an apparatus invented by him can change the position of mines already submerged, make mines attached to the bottom rise to the surface and explode, and render fixed mines not connected with a port by wires harmless to friendly vessels and dangerous to hostile ones.

MISCELLANEOUS.

Two of the three scout ships recently authorized by Congress, it is stated, will probably be of the turbine type. The vessels without the turbine are in themselves new departures in American naval construction, and the substitution of the turbines will make them still more unique in the service. The vessels are expected to be among the fastest war vessels ever constructed.

Machinery Hall, unlike the other buildings at the St. Louis World's Fair, is not closed in the evening. It is open until 11 p. m., and visitors in the evening will find at work there, among other objects of interest, the big 5,000-horsepower Allis-Chalmers-Bullock engine and generator producing part of the electric current for the decorative lights which glitter all over the buildings and grounds.

The German government's railroad exhibit, which shows the block system and switch signals now in use in Germany, is attracting attention from visitors to the World's Fair. More than 1,500 feet of track, in the construction of which both iron and wooden ties were used, has been laid. There is a station house, two switch towers and one intermediate block-signal post. One of the switch towers is fitted with mechanical and one with an electric-signal apparatus.

O. H. Ernst, government engineer for the Chicago district, has made his report to the Navy Department on the street-railway tunnels under the Chicago River, in which he recommends that the city be directed to lower the Washington and La Salle Street tunnels and that the traction company be required to lower the Van Buren Street tunnel. He suggests that the city be given until May 1, 1907, to complete the work. Colonel Ernst gives it as his opinion that the Washington and La Salle Street tunnels are the property of the city and these he thinks should be destroyed and new ones built to give a depth to the river of 26 feet. This will allow the river to carry 800,000 cubic feet of water a minute through to the drainage canal, without making too rapid a current for the safety of navigation. On account of legal complications it will be some time before the department can take action. One of the questions to be decided is whether a joint order to the city and the traction companies will be required. The judge advocate is making an examination of the papers.

TRADE NEWS.

Evans, Almirall & Co. have removed their Chicago office from 1205 to 1057 Monadnock Building, securing more commodious quarters to care for increasing business.

The Electrical Recorder and Indicator Company of Chicago was recently incorporated with a capital of $25,000. It is proposed to manufacture electrical measuring devices. The incorporators are T. T. Collins, E. Pearson and J. J. Sheridan.

Sealed proposals will be received at the office of the supervising architect, Washington, D. C., until July 12th for the construction, including heating apparatus, electric wiring and conduits, of the post-office and custom house at Perth Amboy, N. J., in accordance with the drawings and specifications on file at the Treasury Department and with the postmaster at Perth Amboy.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) May 31, 1904.

761,066. Light Accumulator for Continuous and Alternating Electric Currents. August Engelsmann, Stuttgart, Germany. Application filed August 1, 1902.

A parabolic reflector of special design, for arc lamps is described.

761,090. High-tension Electric Condenser. Ignacy Moscicki, Fribourg, Switzerland. Application filed February 17, 1904.

A dielectric thickened at those parts which support the edges of the coatings is the essential feature of the convention.

761,094. Fuse. William McElroy, Brooklyn, N. Y., assignor of two-thirds to George A. McElroy and George Holt Fraser, Brooklyn, N. Y. Application filed April 2, 1900.

A number of cut-outs co-operate with a main switch. Means controlled by the opening of the switch automatically introduce one of the cut-outs into the conductor when a preceding cut-out has operated to break the circuit through the conductor.

761,102. Insulator. Leonard M. Randolph, Newark, N. J. Application filed March 12, 1903.

An insulator support has a base portion and a cap portion between which is a channel for the cable, and projections formed partly in the base portion and partly in the cap portion at each end of the channel through which the channel is extended.

761,111. Production of Tubes from Refractory Material. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed August 28, 1902.

The method of forming tubes or other hollow bodies from a refractory material consists in drawing an electric arc between electrodes within a mass of the material to be acted upon, discontinuing the arc, removing the body thus formed, and subsequently reheating to smooth the exterior.

761,117. Electrical Regulating Mechanism. Allyn B. Walton, Lorain, Ohio, assignor to the National Vapor Stove and Manufacturing Company, Lorain, Ohio. Application filed June 25, 1902.

Combined with an electromagnet having two sets of poles forming two magnetic fields, one of the fields being of markedly greater impedance than the other, is a movable coil connected in series with the magnet coil.

761,132. Perforating Device for Music Rolls. Henry P. Ball, New York, N. Y., assignor of one-half to Samuel Insull, Chicago, Ill. Application filed July 3 1902.

Electrical means control the punches which perforate the rolls.

761,133. Electric Switch. Henry P. Ball, New York, N. Y., assignor to the General Incandescent Arc Light Company, New York, N. Y. Application filed September 30, 1902.

A bracket support projects from the switchboard upon which the switch mechanism is carried. An oil well is mounted under the support, and means support the oil well independently of the support.

761,134. Automatic Short-circuit Alarm for Electrical Gas-lighting or Other Systems. Ferdinand M. Barrell, Brooklyn, N. Y. Application filed June 15, 1903.

An alarm in an auxiliary circuit is rung when the gas jet is turned on.

761,150. Telephone Attachment. George A. Cowgill, Euphemia, Ohio. Application filed July 16, 1903.

An attachment on the telephone stand holds the receiver to the ear when the mouth is in a position to speak into the transmitter.

761,179. Electrical Device for Operating the Keys of Typewriters, etc. Jacob Pilsatneeks, Riga, Russia. Application filed June 17, 1903.

A series of solenoids, each adapted to directly severally engage a key of the typewriter are operated by a source of electricity connected in circuit by the keys of the typewriter.

761,182. Electric Arc Lamp. Joseph A. Rignon, Berlin, Germany. Application filed August 21, 1902.

The lower base plate carries a central tube with a piston working in the closed upper end. The upper carbon holder is carried by the piston and a grip device acts on the upper carbon.

761,198. Heat-actuated Alarm System. Charles E. Buell, Camden, N. J. Application filed May 28, 1903.

Upon the melting of a fusible conducting mass connection is made in a normally open circuit, which rings an alarm.

NO. 761,360. -ELECTROPNEUMATIC BRAKE.

NO. 761,379.—ARC LAMP.

761,199. Apparatus for Producing an Alternating Magnetic Field for Therapeutic Purposes. Ernst Buhtz, Berlin, Germany, assignor of two-thirds to Rudolph Lüthi and Andreas Gurlitt, Berlin, Germany. Application filed January 30, 1904.

In an apparatus for producing an alternating magnetic field for therapeutic purposes is a rotary shaft supported in a bearing at each of its ends, several electromagnets having shoes secured to their ends, the magnets attached to the rotary shaft and rotating with it and between the bearings, means for supplying current to the electromagnets and a motor for rotating the shaft.

761,204. Method of Making Electrical Heating Apparatus. Charles E. Carpenter, New York, N. Y., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Application filed November 20, 1902.

Suitable resistance is placed on vitreous insulating material. The insulating material is heated and pressed while hot between the plates to be heated in the completed apparatus so as to form an intimate contact between the insulating material and the resistance and the insulating material and the plates.

761,205. Electrical Heating Apparatus. Charles E. Carpenter, New York, N. Y., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Application filed January 27, 1904.

A vitreous insulating material is pressed between the plates when hot so as to conform to the shape of the plates and to be in intimate contact therewith. An electrical resistance is sealed by the surrounding insulating material.

761,215. Fan Motor. Augustine R. Everest, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 31, 1901.

An electric fan comprises rotary blades, a motor and a distributing reflector mounted between the blades and the motor.

761,230. Weatherproof Pole Switch. Chester H. Jackson, Portland, Maine. Application filed May 29, 1903.

Electrically connected to one wire of a circuit is a switch socket. A plunger is slidably mounted in the other end of the switch casing and electrically connected to the second wire of the circuit, the plunger being adapted to engage the socket. A dog is pivoted within a slot in the plunger, and a spring within the slot holds the dog normally projected from the slot.

761,250. Electric Heater. Edwin F. Porter, Boston, Mass., assignor to Benjamin F. Peach, Lynn, Mass. Application filed October 17, 1898.

One or more heat-developing electric conductors form an electric heater, while a fan removes or displaces the heat from the heater.

761,256. Wireless Telegraphy. Charles K. Salisbury, Lincoln Township, Blackhawk County, Iowa. Application filed October 30, 1902.

In a space-telegraph instrument is a rotatable wheel having a cam projection on its face and mechanism for adjusting the wheel. A second projection on the face of the wheel makes electrical contact between a vertical wire and a coherer, at a certain determinable point of the revolution of the wheel, for the purpose of receiving signals.

761,258. Wave Receiver. Richard W. Shoemaker and Lawsen H. [illegible] plication filed May 2, 1902.

A wave receiver [illegible] non-conducting [illegible] by the coming an[illegible] for varying the [illegible]

761,267. Magne[illegible] Mass., assign[illegible] Company Applica[illegible]

A [illegible]

testing material, and a burnishing shield of sheet metal fitted over the outer surface.

761,280. Potential Indicator for High-voltage Circuits. Jonathan E. Woodbridge, Albany, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 30, 1902.

Combined with an alternating-current system are several measuring instruments having one terminal of each connected together and to ground. Leads extend from the free terminals of the instruments to mains or conductors of the system, and a device in each lead conveys current by electrostatic induction.

761,284. Reduction of Nitro Compounds. Max Buchner, Mannheim, Germany, assignor to C. F. Boehringer & Soehne, Mannheim-Waldhof, Baden, Germany. Original application filed September 24, 1900. Divided and this application filed December 13, 1902.

The process of reduction consists in introducing the substance to be reduced into a hydrochloric-acid cathode electrolyte and passing an electrolytic current through in the presence of lead, and at the same time stirring and cooling.

761,308. Trolley-wheel Guard. Curtis W. Leslie, Pittsburg, Pa.; Theresa A. Leslie, administratrix of Curtis W. Leslie, deceased, assignor of one-third to William A. Maline and George J. Carew, composing the firm of Maline & Carew, Youngstown, Ohio. Application filed November 5, 1903.

A folding guard to hold the trolley wheel upon the wire is described.

761,345. Storage Battery. Theodore A. Willard, Cleveland, Ohio, assignor to the Willard Storage Battery Company, Cleveland, Ohio. Application filed September 11, 1903.

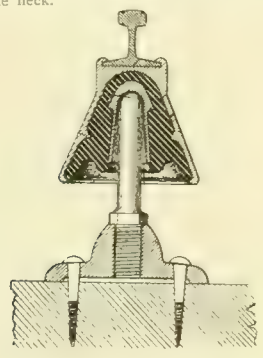
Perforated members or walls exteriorly provided with spacing ribs have side and bottom flanges. The flanges of the walls adjoin each other, a vulcanized binding strip covering the meeting edges of the flanges.

761,360. Electropneumatic Brake. John W. Cloud, London, England, assignor to the Westinghouse Air Brake Company, Pittsburg, Pa. Application filed September 30, 1901.

In a fluid-pressure brake valve is a pneumatically controlled piston and an electrically controlled piston. A slide valve is constructed to be operated by either of the pistons, and has a range of movement greater than that of either of the pistons. (See cut on preceding page.)

761,372. Portable Electric Gas Lighter. Edwin R. Gill, New York, N. Y., assignor to the Electric Contract Company. Application filed January 4, 1902.

Batteries are contained in a small casing and a circuit leading from them out through a long neck may be opened and closed by a push button so as to cause a spark at the end of the neck.



NO. 761,553. THIRD RAIL SUPPORT.

761,379. Electric Arc Lamp. John A. Heany, York, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va. Application filed December 4, 1903.

Two electrodes, each formed of material non-arcing at normal temperatures and each forming a terminal for the current, are combined with means for heating the electrodes to a temperature at which an arc may be formed and maintained between the electrodes during the passage of the current. (See cut on preceding page.)

761,380. Electric Arc Lighting. John A. Heany, York, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va. Original application filed December 4, 1903. Divided and this application filed February 4, 1904.

An improvement in electric-arc lighting consists in first heating the electrodes or terminals of normally non-arcing material to arcing temperature, and then establishing and maintaining an arc between them.

761,417. Safety Apparatus for Use on Railway Cars. Sidney H. Short, London, England, assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed February 11, 1902.

In an electric-railway system is a trolley wire, a trolley base normally insulated therefrom, a local circuit extending from the trolley to ground and containing a fuse, a pivoted weighted arm mechanically connected with the fuse, and a circuit terminal located in the path of movement of the weighted arm, the arm and the terminal being included in a local signaling or alarm circuit.

761,432. Collector for Third-rail Systems. Aldred K. Warren, New York, N. Y. Application filed February 25, 1903.

In a collector for electric railways are a support pivoted to the car, a shoe attached to the end of the support adapted to bear on the conducting rail and a spring bearing on the support to prevent breaking the contact between the shoe and the rail, one end of the spring being disposed to form a buffer for the support.

761,450. System of Telegraphy. John L. Creveling, New York, N. Y. Application filed April 11, 1903.

Means detecting electric waves or oscillations consist of a circuit containing apparatus for detecting changes of resistance in the circuit, combined with apparatus for increasing the resistance of the circuit, under the effect produced by waves, or oscillations. Means in the circuit constantly tend to decrease the resistance in opposition to the effect of the waves or oscillations.

761,454. Manual and Automatic Circuit-controller. William L. Denio, Rochester, N. Y., assignor of one-half to Hobart F. Atkinson, Rochester, N. Y. Application filed January 20, 1904.

A switch arm is adapted to enter a groove in a grooved push when the latter is operated, which entering movement carries the switch arm from one contact to another. A second spring normally holds the push in position to be operated.

761,459. System for Operation of Magnetic Clutches. Arthur C. Eastwood, Cleveland, Ohio. Application filed January 14, 1904.

The device comprises a clutch having a winding, means for controlling the flow of current to the winding and a device mechanically independent of the clutch mechanism for reducing the amount of the current after the controlling means has been operated.

761,465. Electrical Appliance. Philip H. Fielding, New York, N. Y. Application filed August 26, 1903.

A branch block, receptacle or similar electric appliance consists of an elongated body of insulating material having notches formed endwise in its extremities and interior closed passages extending from the notches toward the middle of the body. Caps are adapted to pass endwise over the extremities of the elongated body with means for holding the caps in place.

761,466. Electric Cut-out. Philip H. Fielding, New York, N. Y. Application filed October 10, 1903.

A pivoted circuit-controlling element is provided with two jaws and an operating handle having a portion adapted to play between and engage the jaws to open and close the circuit.

761,490. Safety Device for Electric Interlocking or Block-signaling Apparatus. Frederick T. Hollins, Leytonstone, England. Application filed February 18, 1901.

Associated with an electric locking or similar circuit using the ground as a return conductor is a stray-current arrester for preventing the passage of more than a given amount of current, which current arrester is irresponsive to a weak battery current, but is responsive to foreign currents of a higher power than that normally used on the circuit and which is cut out of the circuit when a current of greater strength is required to be sent.

761,536. Automatic Car Switch. Morris Nuss, Philadelphia, Pa. Application filed September 25, 1903.

Electrical circuits from the switch enter the car through a segment shown as a short rail. The controller handle on the car closes the circuits.

761,549. Electric-railway Crossing. Abraham A. Shobe and William Embley, Jerseyville, Ill. Application filed September 26, 1903.

In an electric railway crossing conductors are arranged in intersecting lines, in a box or casing containing insulating material disposed at the point of intersection.

761,553. Third-rail Support. Louis Steinberger, New York, N. Y. Application filed December 7, 1903.

A third-rail support comprises an outer shell and an inner shell each provided with anchor surfaces, a body of insulating material engaging both of the shells and held firmly by aid of the anchor surfaces, and a member engaging one of the shells and normally supporting it, the other of the shells being provided with a surface for engaging the rail. (See cut.)

761,563. Switch for Electric Lamps. Charles Wagner, New York, N. Y., assignor to E. F. Caldwell & Co., New York, N. Y. Application filed August 22, 1903.

A rotating switch presenting a large surface for contact is described.

761,564. Trolley. John H. Walker, Lexington, Ky. Application filed April 29, 1903.

The wheel is supported between and bears against thrust plates.

761,565. Trolley Mechanism. John H. Walker, Lexington, Ky. Application filed July 29, 1903.

A connecting device between the trolley conductor and motor cable is described.

761,566. Trolley. John H. Walker, Lexington, Ky. Application filed July 29, 1903.

Details are described.

761,567. Trolley. John H. Walker, Lexington, Ky. Application filed December 24, 1903.

Harp prongs hold the trolley wheel on the wire.

761,572. Electric Fire and Burglar Alarm. William C. Barger, Mammoth, W. Va. Application filed March 31, 1904.

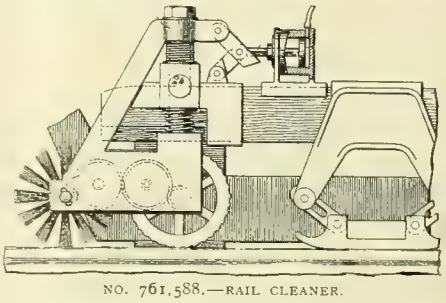
A push button has contacts forming terminals of an electric circuit through a bell and a spring bar has connections for a cord. A screw is connected to the spring bar and arranged in line with the push button to depress it when tension on the spring bar is released.

761,574. Trolley Protector. John H. Best, Jr., Sandusky, Ohio. Application filed January 8, 1904.

Rigid plates on either side of the trolley sheave protect the wheel.

761,588. Rail Cleaner. Paul C. Hunter and William C. Bamber, New York, N. Y. Application filed December 23, 1902.

A contact shoe is carried by the car. A brush mounted in a frame is provided with a gearing operated by contact with a rail, for imparting rotary motion to the brush. Air pressure lifts the frame to raise the brushes from the rail. (See cut.)



NO. 761,588.—RAIL CLEANER.

761,611. Trolley Pole. Charles F. Ritchel, Bridgeport, Conn., assignor to the International Perfect Electrical Supply Company. Application filed September 17, 1903.

The trolley pole is provided with an elastic extension which carries the trolley wheel.

761,616. Selective Party-line Telephone System. Albert J. Springborn, Cleveland, Ohio. Original application filed April 3, 1903. Divided and this application filed June 27, 1903.

The system contains a movable selecting device, a cable having a pair of plugs, the cable being separable intermediate its length, and a pair of conductors in the selecting device. Means within the device connect the conductors and connections are supplied whereby the movement of the selecting device opens the cable and places the sources of power in a circuit with one of the plugs and the selecting device. Other means within the selecting device break the connections after a predetermined time.

761,630. Recorder for Bell Buoys. John A. Fairbanks, Cambridge, Mass., assignor to Henry R. Bradley, Bangor, Maine. Application filed August 30 1901. Renewed October 30, 1903.

An audible signaling mechanism is arranged on the buoy, together with means for electrically actuating the signaling mechanism. Wires lead from the actuating mechanism to an electric generator located at a station distant from the buoy and an automatic circuit-closer and breaker is arranged to intermittingly close and break the circuit to produce signals corresponding with the chart number assigned to the buoy. A recorder located at the station is so electrically connected to the buoy signaling mechanism as to record at the station the proper working of the signaling mechanism on the buoy.

761,636. Auxiliary Fire-alarm System. William L. Denio, Rochester, N. Y., assignor of one-half to Hobart F. Atkinson, Rochester, N. Y. Application filed January 20, 1904.

Magnetic means in the fire-alarm box release separating springs in a normal circuit and close a signal circuit when the circuit controller is actuated.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on June 7, 1904:

364,204. Railway Signal. James H. Armstrong, Houston, Tex.

364,235. Electric Gas-lighting Apparatus. Israel Fisher, Medford, Mass.

364,271. Telegraphy. Louis Maiche, Paris, France.

364,344. Galvanic battery Cell. J. Randolph Hard, New York, N. Y.

364,429. Electric Clock. Gustaf E. Mejer, Providence, R. I.

364,444. Annunciator System. Paul Seiler, San Francisco, Cal.

364,471. Telegraphy. Leo Bock, Jr., New York, N. Y.

364,472. Recording and Reproducing Sound Waves. Leo Bock, Jr., New York, N. Y.

364,475. Telephone Transmitter. James W. Bonta, Philadelphia, Pa.

364,518. Thermostatic Circuit-closer. Warren S. Johnson, Milwaukee, Wis.

364,558, 364,559. Electrical Contact Device for Hose Couplers. William F. Wamsley and Thomas McIntosh, Walla Walla, Wash.

364,619. Relay Instrument. Granville T. Woods, Cincinnati, O.

SPECIAL MENTION.

The International Steam Pump Company of New York city is manufacturing a direct-connected electric pump which possesses the desirable feature of having no gearing, the pump being operated from a crank on the motor shaft.

The Northern Pacific takes pleasure in stating that it can now supply to all who have visited, contemplate visiting or are interested in Yellowstone Park a large panoramic picture of the park. This work of art is 42 inches long by 38 inches wide, and is done in 15 colors. It shows, absolutely, the topography of the park, the location of the hotels, geyser basins, canyons, roads, lakes, mountains and all features of the park. It gives, as nothing else can, a connected idea of the region and is a valuable picture and map combined. Framed, it is ornamental as well as useful, and is specially suited to the school, classroom and library. This panoramic picture will be ready for distribution in tubes about June 15th, and will be sent to any address by A. M. Cleland, general passenger and ticket agent, St. Paul, Minn., upon receipt of 35 cents. Orders will be taken now and may be sent direct to Mr. Cleland or through any of the general or district passenger agents of the Northern Pacific in the larger cities, or through the local agents in Northern Pacific territory.

Much success is met by J. H. Seaman of Chicago in the sale of his Crown cord adjuster. Points of merit attributed to this adjuster are the ease of its attachment to the cord without removal of the socket and its firm hold on the cord, preventing slipping and abrasion.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, JUNE 18, 1904 No. 25

Electrical Features of a Large Manufacturing Plant.

An example of a well-arranged and modern manufacturing plant is that of Pettibone, Mulliken & Co. of Chicago, which is devoted to the manufacture of track switches, frogs and railroad supplies of a similar nature. The plant is situated on the outskirts of the city, with good railroad facilities. It consists of two main buildings, a power house and small office building; the main offices of the company are in the downtown district of the city.

The largest building is 280 by 700 feet and is the machine shop. The next building in size is a blacksmith shop 200 by 280 feet. Electric drive has been adopted throughout, except for the ventilating system, and the installation is one which reflects credit on those who had the work in charge.

Power is generated in a separate power house and is distributed to the various buildings through tunnels, which are also used for the steam piping. The power house is divided into two rooms, the boiler room and generator room. In each, space has been left for just twice the capacity of boilers and generators now installed. Fig. 1 is a picture of the generator room, showing in the foreground the generator unit and the switchboard. The generator is of Crocker-Wheeler make, direct-current, with 16 poles, running at 85 revolutions a minute. It is direct-connected to an Allis-Chalmers 24 by 40 by 48-inch, cross-compound engine. The capacity of the unit is 600 kilowatts, which is more than sufficient for the present needs of the factory, which was but recently put in operation. Later, however, when the plant is running at its full blast, the whole capacity of the generator will be utilized and possibly that of another similar unit, as the plant grows.

Steam is generated in the boiler room adjoining the generator room, an interior view of which is shown in Fig. 2. Three Heine boilers of 500 horsepower each are at present installed, and are now hand fired, though provisions have been made for equipping them with mechanical stokers, when it is deemed necessary to do so. As will be seen by the picture, the boiler breeching is placed on top of the boilers. The breeching is five feet by 10 feet in cross-section and opens into a round brick stack 200 feet high, with an internal diameter of nine feet. Live steam may be admitted to the fireboxes for the purpose of reducing the smoke. To the left of the boilers, as seen in Fig. 2, is a 1,000-horsepower vertical heater. This stands out by itself, instead of being tucked away in some out-of-the-way corner, as is so often the case. In fact, it will be noted that everything about the plant has been given plenty of space, the rooms are lofty and the arrangement of the apparatus in the boiler and generator rooms is such that nothing is crowded.

The gravity system of lubrication is employed, the oil being pumped from storage tanks in the basement up into two tanks near the ceiling of the generator room. From here it flows by gravity down to the bearings of the machinery, and, after circulating there, flows into filters in the basement. The oil, after being filtered, is returned to the storage tanks, ready to be used again. There are two Turner oil filters used, of 150 gallons capacity each.

Having described the generating plant, the method of distribution may now be considered, and the credit for the good workmanship and design of this part of the installation is due to Henry Newgard & Co., electrical contractors of Chicago, who designed and built the switchboard and did the wiring work.

Beginning at the generator, the cables from there are carried through iron-pipe conduits in the basement (see Fig. 3) to a point beneath the back of the switchboard; from this point they are brought up through the floor to two large terminals at the back of the board near the floor. The back of the board as mounted in the shop is shown in Fig. 4.

The main bus bars, shown at the top of the board in Fig. 4, are made up of eight strips of copper, one-fourth by four inches in cross-section and, as now placed, are of sufficient current-carrying capacity to take care of a load twice as great as the output of the present generating system. This is to provide for future extensions. Whenever another generating unit is put in all that then will be necessary is to fill in the instruments on the blank panels, which can be done without disturbing the arrangement at the back of the board. Of course, this means that considerable copper now in, is unnecessary, but it was thought that the interest on the amount invested in the extra copper will be more than overbalanced by the saving which will result in the ease and quickness with which future additions to the switchboard equipment can be made. In a large plant employing hundreds of men a temporary shutdown of only a few minutes means dollars lost, and where there is much tearing out and rearrangement of switchboard apparatus it is next to impossible to avoid more or less serious interruptions to service.

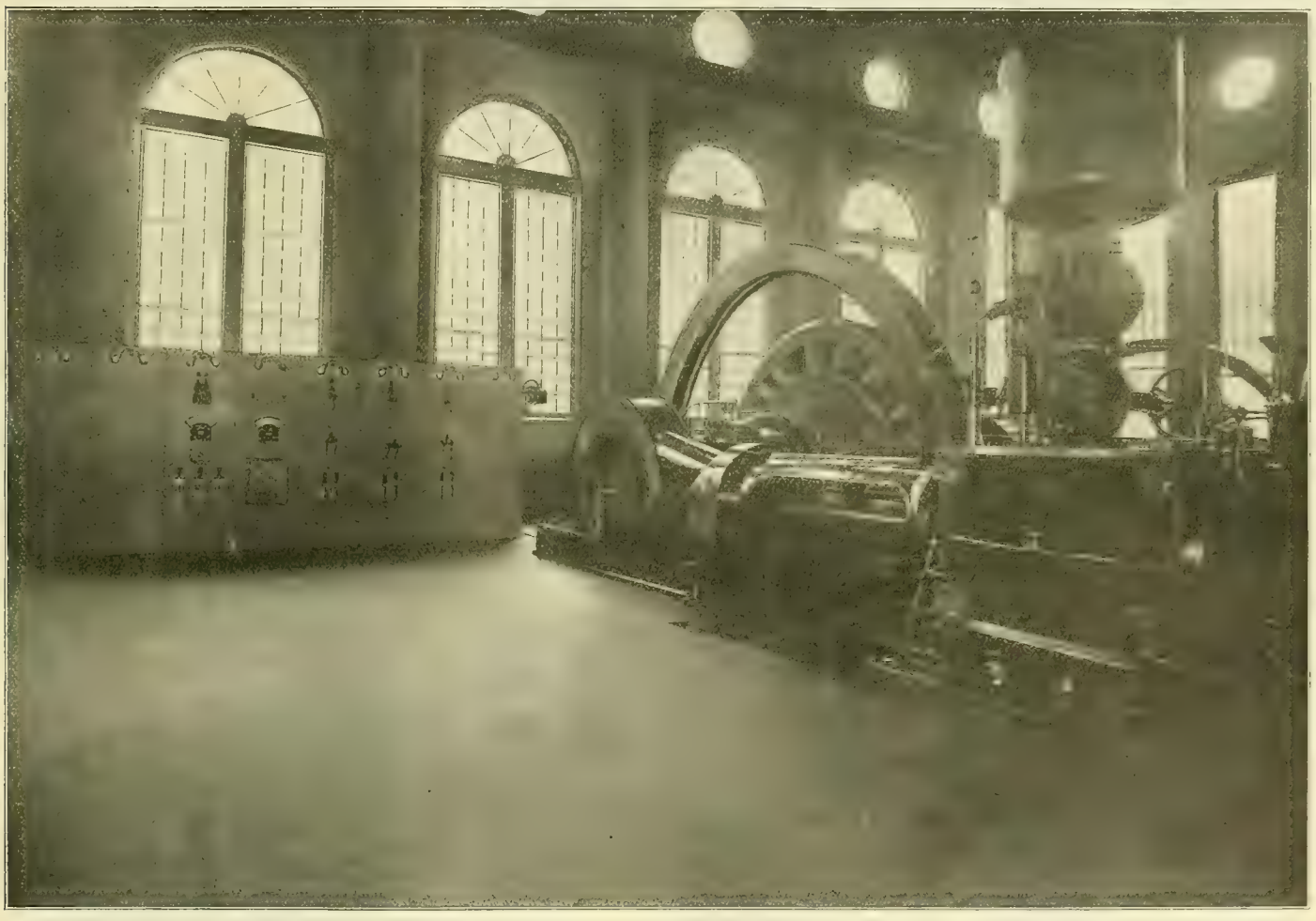


FIG. 1. ELECTRICAL FEATURES OF A LARGE MANUFACTURING PLANT.—VIEW OF GENERATOR AND SWITCHBOARD.

The main bus bars are carried on brackets at the top, seven-eighths of an inch of slate topped by one-half inch of glass giving more than sufficient insulation, the voltage of the system being 250. The conductors to the wattmeter are made up of six strips one-fourth of an inch by six inches in cross-section. They are designed to carry 8,000 amperes, the present maximum operating capacity of the board.

Fig. 1 gives a very good view of the front of the switchboard, which is eight feet high by 20 feet long. There are in all eight panels. Beginning at the right of the board, as seen in Fig. 1, the first panel is a blank feeder panel. The second, third and fourth panels are for feeders, each containing a 1,000 and a 500 amp[illegible] total-output panel. The generator panel is No. 6, and Nos. 7 and 8 are left blank.

The switchboard equipment is composed of I-T-E circuit-breakers, all the heavy circuits having both circuit-breakers and fuses, Weston ammeters and voltmeters, a General Electric wattmeter and Bossert switches. Especial pains have been taken in the construction of this board and the workmanship upon it is of a high [illegible]

is polished and the panels, which are of Tennessee marble, sawed from a single block, are polished not only in the front but in the rear also. The field rheostat, instead of being mounted at the back of the board, is mounted at the ceiling of the basement, shown at the left in Fig. 4. It is operated by a hand wheel at the front of the board, which connects to a shaft and worm gear at the back, the rheostat being operated by a series of levers in the basement. This arrangement was devised by Mr. W. Starr, operating engineer of the plant, and places the rheostat out of the way and in a cool place.

FIG. 2. ELECTRICAL FEATURES OF A LARGE MANUFACTURING PLANT - INTERIOR OF BOILER ROOM SHOWING BOILERS AND HEATER.

From the switchboard the cables return to the basement, and from there are led through a tunnel to the machine shop, a part branching off through a second tunnel to the blacksmith shop. A view down the main tunnel is shown in Fig. 5. This tunnel is six feet by six feet and contains not only the wires but the steam piping as well. As seen in the picture, the cables are supported near the roof. There are 12 800,000-circular-mil cables for power and two 400,000-circular-mil cables for lighting circuits.

From the tunnels the cables are led to distributing centers at various points in the factory buildings. Fig. 6 shows a distributing center located in a corner of the machine shop, which is for the lighting circuits, six in number. From the box the circuits are carried up to near the roof and run out to their respective lamps. This wiring, as well as the power wiring, except the heavy cables in the tunnel, is all run in iron-pipe conduit. Another distributing box, for power wiring in the machine shop, is shown in Fig. 7. This is mounted on the wall, and entering it are four 800,000-circular-mil cables. The buses of this distributing center are made especially heavy, as will be seen by the picture. The boxes for these centers are of a good grade of cabinet work, with glass doors, so that the position of all the switches may be seen at a glance without opening the door. Another box, not shown, in the machine shop, has six 800,000-circular-mil cables, and one in the blacksmith shop has two cables leading into it of 800,000 circular mils each.

The motors about the plant are mostly installed for group drive and were furnished by the Crocker-Wheeler Company. They are mounted overhead and each drives by belt a short shaft for operating a group of machines. From six to 10 machines are run in a group. Four motors are installed for driving individual machines. Three of these are in the blacksmith shop for operating punches and shears and the fourth, one of 90 horsepower, is used to drive a rail saw in a small building near the machine shop. The last-mentioned motor is completely enclosed in an iron housing to protect it from the flying scraps of iron from the saw, which would soon play havoc with the commutator and bearings if some means were not provided for their protection.

In all, 25 motors are installed for various purposes and are rated as follows: One of 90 horsepower, six of 75, two of 50, one of 35, four of 25, two of 20, four of 15 and five of 10 horsepower, or a total of 925 horsepower.

Most of the lighting is done by arcs, of which there are 135 altogether, run two in series. There are only about 500 incandescent lamps all told, which are used principally in the office building and in small quarters, where an arc could not be hung. The shops depend almost entirely for their lighting upon the arcs. Most of the light wiring is run in one-half or three-fourths-inch conduit.

The heating and ventilating system is adequate. The apparatus was furnished by the American Blower Company. The air is first heated, when heat is necessary, by passing over steam pipes in a large enclosed chamber. The steam-driven fans then force the air through galvanized-iron pipes, the cross-section of which is reduced at each outlet, the latter being provided at frequent intervals and placed so as to direct the air downward. The dampers to the outlets are controlled by a thermostatic arrangement.

Compressed air is used largely for various purposes, principally for driving tools and for air hoists. A number of hoists are used in the yard adjacent to the machine shop for handling rails and the heavier work.

A feature which is contemplated and will in all probability be used in the near future is an electric switching locomotive for running freight cars back and forth in the yards and into the shop. To do this with an ordinary locomotive means to fill the building with smoke and noise, and it is thought that an electric locomotive will obviate this nuisance.

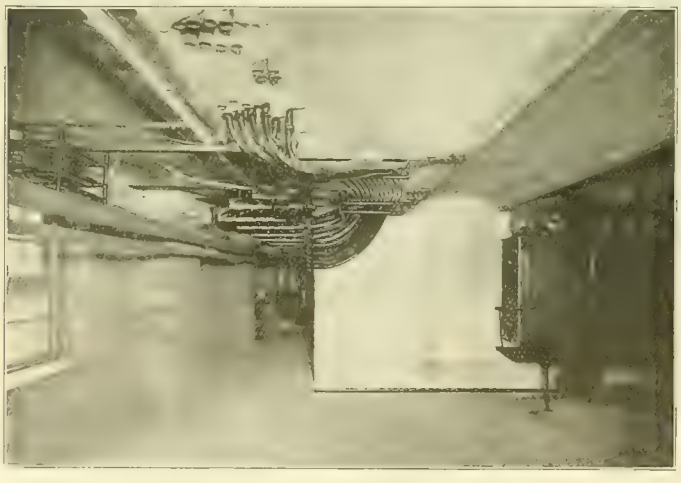


Fig. 3. Cabling to and from Switchboard.

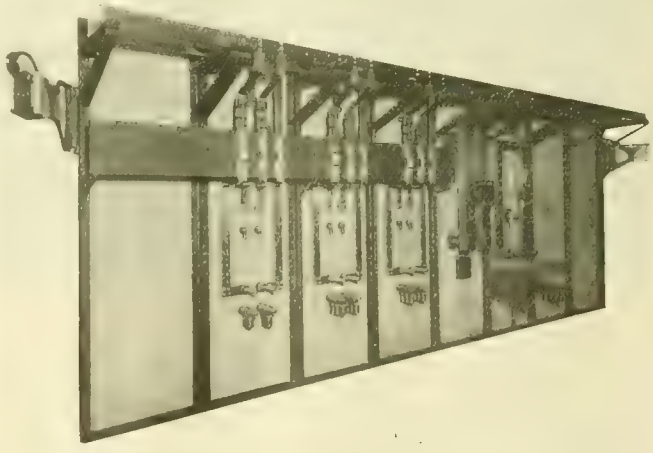


Fig. 4. View of Back of Switchboard.

ELECTRICAL FEATURES OF A LARGE MANUFACTURING PLANT.

High-speed Steam-locomotive Tests in Germany.

A report has been received from United States Consul-general Mason treating on the recent high-speed steam-locomotive tests in Germany following the elaborate experiments in high-speed electrical traction. These carefully prepared trials were conducted to decide the question as to whether, with the existing conditions of climate, distances between large cities, grades, curves and the present standard of track and bridge construction in Germany, the speed of express passenger trains could be safely and economically increased to 70 or 80 miles per hour, and, if so, whether steam or electricity would prove preferable as a motive power. What follows is taken from Mr. Mason's report:

The electric motor trials were completed, as will be remembered, during the autumn of last year, with the net result that the two motor cars obtained speeds of about two miles a minute, without injury to the car or motor, without undue strain upon the track or discomfort to passengers. This upon a straight, nearly level track, 14.5 miles long, and of the heaviest and most solid and careful construction, with inside guard rails to minimize the effect of lateral motion at high velocities. But as the railways of Germany involve all the usual variations of grade and frequent curves of a radius as low as 520 yards, any such pace as 117 miles an hour is and must long remain outside the limits of actual practice. It remained for the new locomotives to demonstrate the efficiency of steam up to 80 or 85 miles an hour, the apparent limit of speed development under existing conditions.

The experiments with steam locomotives began about the end of February and were continued until the middle of April. The tests included engines of four different types, each built by a different German firm or company. In order to make the conditions as nearly as possible those of actual service, the load consisted of six vestibule cars of the standard D type, weighing about 30 tons each, one of which had been equipped with instruments to measure and record speed, oscillation, and the pull exerted by the engine at each part of the run.

The first trials were those of a locomotive built by the Egestorf Machinery Company, at Hanover. It is of the same general model as the "Atlantic" type in the United States. This machine, with a train of six cars, attained an average speed of 111 kilometers (68.97 miles) an hour throughout the run, and with three cars a pace of 79.41 miles an hour. The second machine, of Grafenstadt construction, is a compound locomotive, likewise of the Atlantic type, in which the cylinders are placed far back and the piston head geared by a short connecting rod to the crank pin of the rear driving wheel. This engine made with the full train a run of 118 kilometers (73.32 miles) and with three cars 76.42 miles an hour, and showed good results as to fuel and steam consumption. The third contesting machine was an eight-wheeled compound engine, equipped with Schmidt's device for superheating steam. It was designed by Baurath Garbe and built by the well-known firm of A. Borsig, at Tegel, near Berlin. This engine was not built specially for these trials, but is one of a number of the same type which have been constructed by the same firm and supplied for service to the royal Prussian railway administration. This engine attained with the full train 128 kilome-

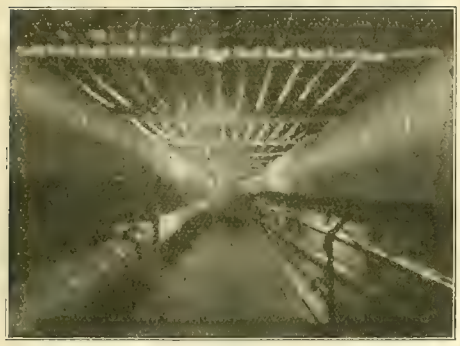


FIG. 5. CABLE AND STEAM-PIPE TUNNEL IN LARGE MANUFACTURING PLANT.

ters (79.53 miles) and with three cars a speed of 84.5 miles an hour, the energy developed being about 2,000 horsepower.

The fourth competitor was an engine of a wholly original type, designed by Chief Engineer Wittfeld of the Prussian Railway Administration, and built by Henschel & Sons of Cassel. Before being brought to Berlin it was tested on one of the state lines near Göttingen, and since the trials were finished it has been dismantled and shipped for exhibition at the World's Fair in St. Louis. Its most striking peculiarities are that it is so built that the engineer stands in front within a glazed cab, like the motorman of an electric car, and both engine and tender are covered with a sheathing of sheet iron with glazed windows and so arranged as to provide a covered passage from front to rear. The engine is carried on 12 wheels—a four-wheel truck in front and rear and between them the two pairs of drivers, coupled in the usual manner. This arrangement is for the purpose of securing a smooth steadiness of motion despite curves or irregularities of track surface. The engine is of the compound type, the high-pressure cylinder being located midway between the side frames, where its piston connects with an inside crank on the forward driving shaft. The low-pressure cylinders, of which there are two of equal diameter, are external and drive two outside cranks set parallel to each other and on the same side of the axle 90° from the inside crank that connects with the high-pressure cylinder. This secures an even balance between the reciprocating parts, from which important results have been expected. The boiler

FIG. 6. ONE OF THE LIGHTING CENTERS IN LARGE MANUFACTURING PLANT.

is, from the European standpoint, enormous, having 2,766 square feet of heating surface, and it is calculated that, with a coal consumption of 2.5 pounds per horsepower-hour, it will develop about 1,775 horsepower. It weighs 76.8 tons and cost $23,800. The tender weighs 47 tons and carries seven tons of coal and 4,400 gallons of water, which it is equipped to take up at speed, as is done on some lines in the United States. At the recent tests this engine slightly surpassed all its competitors, attaining a speed of 128 kilometers (79.53 miles) per hour with six cars and 85.12 miles with half that number. While, therefore, its speed with the full train was the same as that of the Borsig superheater, the Cassel machine did one kilometer (0.62 mile) better with the light load, a difference so slight that it might easily have been influenced by varying conditions of wind.

Among the incidental demonstrations made by the tests was the fact that with the pneumatic brakes now in use on German vestibule cars it required a full minute and a distance of 1,093 yards to stop a train of six cars running at 85 miles an hour. German first-class trains are equipped for a maximum speed of 85 kilometers (52.8 miles) an hour, and their brakes are capable of stopping a train running at that speed on level track within a distance of about 433 yards. If, therefore, any approach to the higher speeds which will be made possible by these new types of locomotives should be adopted, the change will involve important modifications in brakes and signal systems, which are based on present limitations of speed and braking power.

Pending the preparation and issue of the official report, on which the ultimate conclusions will be based, a Berlin engineer, Dr. Reichel, has given some

FIG. 7. POWER-DISTRIBUTING CENTER IN LARGE MANUFACTURING PLANT.

interesting comparisons of cost between steam and electric traction from the standpoint of German practice and illustrated by the recent experiments with both motive forces. A steam train of five cars and a standard locomotive weighs 330 tons, seats 168 passengers, and uses at full speed 1,400 horsepower. The electric train of one motor car and four trail cars weighs 260 tons, seats 180 passengers, and utilizes 1,000 horsepower. Each train and engine costs for initial construction about $100,000. The operating cost of the steam train is fixed by Dr. Reichel at 12½ cents per 100-seat-kilometers, and 11½ cents, or one cent cheaper for the electric train.

International Electrical Congress.

Acceptances of membership in the International Electrical Congress of September 12th-17th in St. Louis, now number 1,702, and over 160 specially invited papers are promised in all. One thousand certificates of membership have been issued to those who have become members by sending in their subscription, and about 100 more certificates are about to be issued.

Efforts are being made to secure the manuscripts of as many of the 160 papers as possible, by the first of July, in order to have them printed in advance and distributed among the congress members at St. Louis. Thus far, six papers have been delivered, and many more are promised by that date.

The programmes scheduled for Sections D and E are here given:

Section D.—"Electrical Transmission Plants in Switzerland," E. Bignami; "Conditions Conducive to Economy in Motor Design," H. M. Hobart; "Transmission of Alternating Currents Over Lines Possessing Capacity," Maurice Leblanc; "Utilization of Hydraulic Powers in Italy," Professor G. Mengarini; "High-potential Long-distance Transmission and Control," Professor F. G. Baum; "The Tower System of Line Construction," P. O. Blackwell; "The Use of Aluminum as an Electrical Conductor," H. W. Buck; "High-tension Insulators," V. G. Converse; "Line Construction and Insulation for High Tensions," M. H. Gerry, Jr.; "Bay Counties Transmission System," L. M. Hancock; "Some Practical Experiences in the Operation of Many Power Houses in Parallel," R. L. Hayward; "Long-distance Power Transmission," J. F. Kelly and A. C. Bunker; "Transmission and Distribution Problems Peculiar to the Single-phase Railway System," P. M. Lincoln; "The Maximum Distance to which Power Can be Economically Transmitted," R. D. Mershon; "Pioneer Work of the Telluride Power Company," P. N. Nunn; "The High-tension Transformer in Long-distance Power Transmission," J. S. Peck; "American Practice in High Tension," Dr. F. A. C Perrine; "Theory of Single-phase Motors," Dr. C P. Steinmetz.

Section E.—"Impregnated Arc-light Carbons," Professor André Blondel; "Single-phase Motors," Max Déri; "Rates for Electricity Supply," E. de Fodor; "Insulating Materials in High-tension Cables," E. Jona; "Upon a Means for Compensating the Series Connection of Induction Motors," Professor W. Kübler; "Storage Batteries," Karl Roderbourg; "Commercial Limits of Electric Transmission, with Special Reference to Lighting Service," Guido Semenza; "The Superiority of the Alternating Current for Distribution in Large Cities," Dr. G. Stern; "Measurements of the Energy of Light and Heat Radiation from Electric-light Sources," Dr. W. Wedding; "Recent Improvements in Electrolytic Meters," Arthur Wright; Subject to be announced, Professor S. P. Thompson; "The Testing of Alternating-current Generators," B. A. Behrend; "Protection and Control of Large High-tension Distribution Systems," George Eastman; "Rotary Converters and Motor Generators in Connection with the Transformation of High-tension Alternating Current to Low-tension Street Current," W. C. L. Eglin; "The Effect of Steam Turbines on Central-station Practice," W. L. R. Emmet; "Underground Electrical Construction," Louis A. Ferguson; "Storage Batteries as an Adjunct to Central-station Equipment," Gerhard Goettling; "American Meter Practice," G. Ross Green; "Metering Efficiency on Customers' Premises," Caryl D. Haskins; "Steam Turbines," Francis Hodgkinson; "Incandescent Lamps," John W. Howell; "Distributing Systems from the Standpoint of Theory and Practice," Philip Torchio; "The Selection of a Distributing System for a Large City," W. F. White.

The Rapid-transit Problem in London.

[From the London correspondent of the Western Electrician.]

The royal commission which was appointed in April, 1903, to inquire into the conditions of traffic in London and to report as to what remedies were desirable to bring the condition of things more into line with modern requirements will have finished taking evidence by the time this is printed. The scope of the terms of reference to the commission has been an exceedingly wide one, and it has necessitated having the views even of the electric-light and gas companies in respect to the breaking up of the streets for the laying of mains and the obstruction to vehicular traffic caused thereby. However, tedious as undoubtedly the proceedings have been at times, the main object of the inquiry, viz., the present backwardness of transportation facilities of all kinds, has brought forward much that is of exceedingly great interest, and the final report of the commission should be a document widely read.

Probably the one great feature of the evidence put before the commissioners has been the number of schemes involving enormous sums of money to be expended upon street widenings and improvements in order to accommodate the new methods of locomotion suggested. A few of them may be mentioned. The London County Council has strongly advocated the universal adoption of shallow subway tunnels within a mile or two of the center of London, communication within which is the most difficult part of the problem which has to be solved. These subways would be more or less after the style of those in Boston and New York, viz., to take tramways only. Again, the mayor of Westminster, which place is one of the London self-governing bodies, put forward a more ambitious scheme of subways, which would accommodate tramways, pedestrians, electric, gas, hydraulic and other mains, as well as sewers. A still more drastic proposal came from two witnesses, and was that double-decked streets should be constructed with tramways on the surface, both above and below, and overhead electric railways spanning the tramways. Then we have had Mr. Behr, the monorail enthusiast, expounding upon the advantages and virtues of his system, where the legs of the spans should be placed in suburban back gardens and the trains should run at the level of the top windows of the houses.

Many of the originators of the schemes referred to above, however, would seem to have worked upon the basis that London is absolutely devoid of any means of getting about and that the ground is perfectly clear for their projects within a reasonable period. From that point of view, therefore, it is to be feared that their projects will not have an importance in the minds of the commission commensurate with the expense and time involved in their preparation in the form of evidence.

It was stated in evidence, and quite truly, that it takes as long to cross London as it did 20 years ago. This has been brought about to a great extent by

ment, having created the existing conditions of things, has now to set it right again. For instance, the introduction of electric tramways into London has been retarded to an extraordinary degree by the conditions attaching to the Tramways Act of 1870, which was framed to meet the conditions which then attached to horse tramways and has not been amended or modified since. Again, the promotion of railways has taken place not with the object of opening up new districts, but merely with the idea of picking out an area where a good population already existed, so that there are short lengths of line here and there, with no really good through routes available without frequent changing and consequent loss of time. It must be said that the tube railways have been faulty in this direction.

Probably the quickest means of short-distance traveling for the general population is by means of electric tramways, and it is in this respect that London is sadly deficient. There are several reasons for this. In the city proper, which is under the control of a body having the supreme voice concerning its own affairs, tramways of any description have never been permitted, perhaps a not unwise decision in view of the very narrow main thoroughfares. Apart from the city, however, the present disgraceful lack of tramway facilities is to be traced to the conservative policy of the various London county councils, no matter what their political constitution may have been. Not that London differs much in this latter respect from the other large towns of the country; but there has been this important difference, viz., that the governing bodies of the large provincial towns, conservative though they may be in other respects, have eagerly taken advantage of the advances of science, whereas in London the policy seems to be always to wait until someone else has proved their value.

Ever since the London County Council came into existence its policy has been to get the complete control of all the tramways within the county. Consequently private enterprise has been completely exterminated, with the result that many promising schemes have had to be abandoned. In this the council's hand has been considerably strengthened by the present state of the law. At present there are three methods by which tramway powers can be secured: (1) By act of Parliament, (2) provisional order granted by the Board of Trade and confirmed by Parliament, (3) light-railway order. In connection with the two former the local authority has an absolute veto, i. e., under standing orders of the Houses of Parliament no tramway scheme can be introduced unless the promoters can produce the consent of the local authority, and it is easy to imagine to what use this power can be put. In London the County Council frankly states it wants no companies, and no amount of bribery will alter that decision. In regard to light-railway procedure, if a tramway were to be promoted by a company in London under the light-railway act (as a matter of fact it never is, as the act was never intended for London) the County Council would at once offer to take similar powers and so secure the preference.

Obviously, therefore, under this system tramway progress cannot possibly go forward uniformly throughout the county with the rapidity that is necessary to the commercial needs, chiefly for the reason that the commitments of the County Council in various directions compel slow movement. An additional factor to this retardation is the weak state of the municipal money market. The last London County Council loan was issued at 95.

But it would appear that nothing that the royal commission might recommend can alter matters in respect to tramways, for the County Council, having gone so far and having electrified a large percentage of the lines besides owning the remainder, would be well left alone to complete the work, which may not be long delayed now. The real fact is that the commission should have been appointed years ago and some drastic recommendations of the nature foreshadowed by some of the witnesses, such as the abolition of the veto, etc., would have had a beneficial effect.

With regard to railway accommodation, apart from the rather revolutionary proposals referred to at the commencement of these notes, a very prevalent feeling was that so far as the covering of districts was concerned, practically all that was necessary had been done. But the mischief was caused by the insufficiency and sluggishness of the services. If one picks up a railway map of London it is difficult to point out any district in the county which is not adequately served by railway lines. What is really needed is that the existing means of communication should be put into the hands of an efficient management, which should consolidate and weld the whole into an harmonious undertaking which would be of the maximum utility to the whole of the community. That this is no light undertaking is fully appreciated, but it should not be impossible, especially if all railway managers are sincere in their declaration of willingness to help in any possible way. Greater intercommunication between one company's system and another is imperative, together with a keener appreciation of the advantages of electric traction.

One must also take into consideration the fact that a considerable mileage of tube railways is at present under construction, in addition to which the inner circle is in process of reconstruction for electric traction. All these things, coupled with the endeavor to work the electrified district railway in conjunction with the electric tramways in the west of London, almost forces upon one the opinion that the royal commission has been called upon to solve a problem which in some ways is almost on the verge of solving itself.

One direction in which much good might result would be the appointment of a special tribunal having the sole care of traffic facilities in the metropolis. This idea is favored by the commission, and the existence of such a body which might examine schemes and modify them before they are submitted to Parliament would be beneficial in several ways. It would save much of the expense at present involved, as well as create a uniformity of procedure. At present there are too many methods by which the same end may be attained.

Communication within the city boundaries will receive special attention in the report, but it is doubtful whether tramways on the surface will be recommended. The choice will lay between shallow subway tramways and deep level tube railways. With regard to the former the opinion has been expressed that a revolution will take place at the instance of the business men, owing to loss of business during construction, if this method were adopted. There is certainly a great prejudice against such subways. However, I will not attempt to anticipate the report of the commission too definitely.

A great deal of time has been devoted to the consideration of the vehicular and pedestrian traffic on the surface and the general forms of obstruction. One fact may be worth mentioning, and that is the part played by Americans in bringing about the appointment of the commission. In 1902 Mr. Morgan and Mr. Yerkes, together with some English promoters, had a big fight for the possession of the Piccadilly-City route for a tube railway. All the other promoters were very quickly put out of the running. Mr. Yerkes got a few short lines, and, practically speaking, Mr. Morgan was left with the main route in conjunction with the London United Tramways Company. Great things were promised the public, the lines being 15 miles in length, by far the largest tube railway ever constructed. But during the parliamentary summer recess Morgan and the tramway company quarreled, with the result that the project fell to the ground. Yerkes very soon afterward captured the tramway company. Great indignation was expressed in Parliament that London railways should be made the shuttlecock of American millionaires, with the result that the government was compelled to appoint a royal commission in order that a little firmer grip might be had upon the manner in which these things have been carried out in the past.

G.

Storage-battery and Booster Plant in Concord, New Hampshire.

The Boston and Maine railway soon after it obtained control of the Concord Street Railway property, erected commodious car barns near its extensive repair shop at Concord, New Hampshire. An auxiliary and emergency transformer, booster and storage-battery plant was installed at these barns a year and a half ago. The operation of this auxiliary plant during the time since it was installed has been entirely satisfactory, and a brief description of it will be interesting.

The battery consists of 264 cells of Chloride accumulator, with 11 plates to the cell, and is of 800-ampere-hours capacity. There have been absolutely no renewals since installation and the weekly record shows an average of 20½ hours service a day. Without the battery the line would show a drop of at least 100 volts at the extremity, where the barns are located.

The battery and booster set are in series in the line circuit. Fig. 1 shows the booster set and switchboard, located at the barns. The battery, as shown in Fig. 2, is in a well lighted and ventilated room. The cells, 24 by 18 by 18 inches, are set on heavy porcelain insulators, and these in turn are set on one-inch glass plates on a floor heavily tarred. The battery shows an efficiency of 90 to 95 per cent.

The battery and booster float upon the load during light service and are of great value for regulation and are also ready at all times to take the whole load for a short period in emergencies or help out the generating plant on heavy loads. In the machine room are located one 300-kilowatt rotary converter, the booster set, switchboard, two oil-cooled transformers for changing three-phase to two-phase current for the rotary converter and a Westinghouse regulator for polyphase currents.

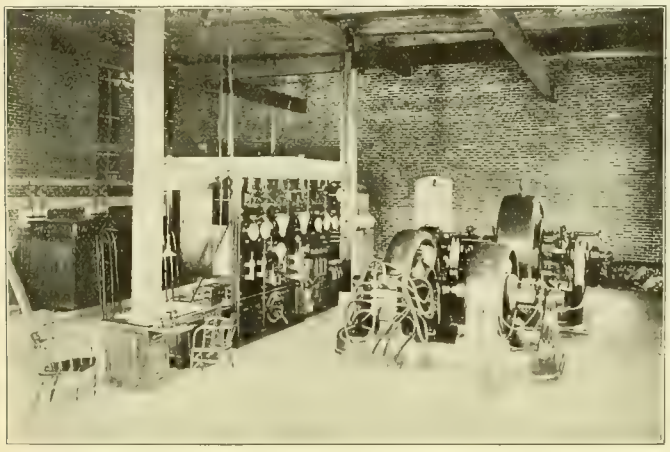


FIG. 1. BOOSTER SET AND SWITCHBOARD AT CONCORD.

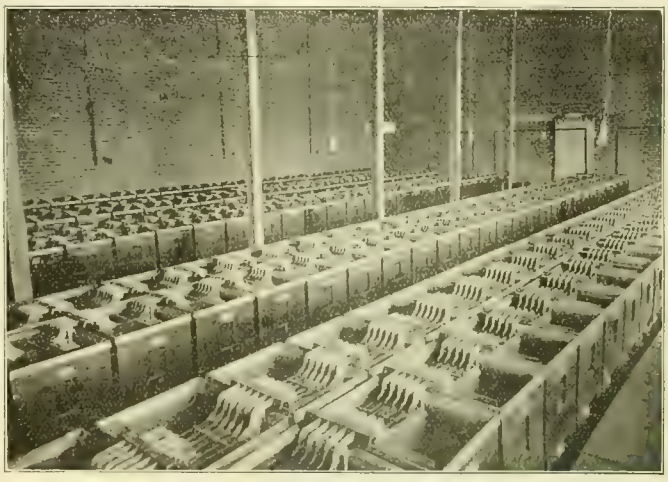


FIG. 2. STORAGE BATTERY IN CARBARNS AT CONCORD.

The switchboard consists of five panels of black marble. Two panels are for the battery and booster set and the other three for line service. Westinghouse and General Electric instruments are used and at the farther end of the board, as shown in Fig. 1, are two instruments hinged so they may be in view from any part of the room. These instruments are a synchroscope and a power-factor meter. Other instruments on the board are I-T-E circuit-breakers, a Bristol recording voltmeter, Thomson ammeter and General Electric differential wattmeter for the battery. Mr. L. E. Chase has had charge of the plant since its installation.

Reuter's Telegraph Company.

Admiral John Hay, presiding at a recent meeting of Reuter's Telegraph Company, gave out some interesting information concerning the distribution of news from the scenes of existing wars. He said that the company had been put to great expense in regard to the Somaliland campaign, without any adequate return, and very great expense was involved in reporting the naval and military operations in the Russo-Japanese war. Interpreters were indispensable, because messages sent over the Japanese field wires must be written in Japanese, which meant that the telegrams must be first translated into the language at the front, and then retranslated into English at the base. The most rigorous censorship was in force on the Russian as well as on the Japanese side, which explained the meagerness of many reports received in other countries. The company had many triumphs to record in the matter of early information concerning military and naval events of the war, and the company's prestige as a distributor of news stood high in Japan and China.

Conventional Signs Used by Foreign Electrical Draftsmen.

By Arthur d'Romtra, E. E.

Blue prints and drawings laid out by German, Austrian and Italian engineers and draftsmen in their designs for wiring of buildings, etc., are generally most elaborate. Every little detail is shown in a most painstaking manner, and the signs here illustrated are universally used in the countries mentioned to designate the material or apparatus to be used for proposed plants.

One readily gets accustomed to them, and I find that in estimating for foreign work that the use of foreign prints with these symbols greatly accelerates the capabilities of the estimate department. The following conventional symbols are used in the three above-named countries:

Fixed incandescent lamp.

Portable incandescent lamp.

Stationary group of incandescent lamps; number of lamps, five.

Portable group of incandescent lamps; number of lamps, three.

Arc lamps of six amperes.

Wall bracket (one lamp).

Standing lamp (one lamp).

Hanging lamps (two lamps).

Electrolier (four lamps).

Wall tube.

Single-pole cutout; if a figure is alongside, it denotes amperes.

Double-pole cutout; if a figure is alongside it denotes amperes.

Three-pole cutout; if a figure is alongside it denotes amperes.

Wall attachment.

Small branch cut-out.

Reversing or pole-changing switch for three amperes.

Single-pole switch for four amperes.

Double-pole switch for four amperes.

Three-pole switch for four amperes.

Single circuit (flexible cord).

Ordinary return circuit.

Three-wire or alternating-current circuit.

Flexible conduit, armored (Greenfield type).

Vertical mains, up and down.

Switchboard, two-wire system.

Switchboard, three-wire system, or alternating.

Rheostat or heating appliance of 10 amperes.

Portable rheostat of six amperes.

Choking coil.

Lightning arrester.

Lightning-rod tip.

Ground.

Accumulators or secondary batteries.

Dynamo or generator, with 10 kilowatts capacity.

Motor, with two kilowatts capacity.

Transformer with capacity of 85 kilowatts.

Two-wire meter, with capacity of five kilowatts.

Three-wire or alternating-current meter with capacity of 10 kilowatts.

Ammeter.

Voltmeter.

Conductors: B.—bare copper; B. E.—bare iron galvanized; G.—seamless rubber insulation; L.—flexible cords; K. B.—bare lead-covered cable; K. A.—lead-covered cable, with asphaltum-taped cover; K. E.—lead-covered cable, armored; g.—conductors on insulators; o.—conductors in iron conduit.

Firms making out plans and drawings to be used in the before-mentioned countries will do well to consider these symbols, and also carefully to add in figures the proposed amperes to be carried on each wire or cable.

Electromechanical Amusement Device.

A new and interesting electromechanical amusement device, known as the "Double Whirl," is now in operation at Chutes Park in Chicago, and is shown by the accompanying cut. It consists of a center vertical shaft, carrying a spider and large annular gear and six horizontal shafts. On the outer ends of the six shafts are "Ferris wheels," 20 feet in diameter, each wheel having six seats, and each seat carrying two persons, making the capacity of the machine 72 persons. On the inner end of each of the six shafts is a 14-inch bevel gear, meshing with a 42-inch stationary bevel gear. The stationary bevel is supported by a 12-inch pipe with channel-iron braces and tie rods. The spider and six horizontal shafts are rotated in a horizontal plane through the large annular gear, and suitable reduction gear, by a 35-horsepower motor.

ELECTROMECHANICAL AMUSEMENT DEVICE.

On account of the comparatively heavy load in starting, an electric motor is found to be the most desirable means of driving. The device is illuminated by 150 16-candlepower incandescent lights. The 35-horsepower motor is furnished by the Guarantee Electric Company. The device is proving a great success, both as a source of amusement and as a money-maker. It was designed by Winn, Milmoe & Porter, electrical and mechanical engineers of Chicago.

Western Union Telegraph Company.

The quarterly report of the Western Union Telegraph Company for the quarter ending June 30, 1904, shows that the net revenues for the quarter, based upon nearly completed returns for April, partial returns for May, and estimating the business for June, will be about $1,850,000. Appropriating $292,550, interest on bonded debt, and $1,217,017.50 required for a dividend of 1¼ per cent. on capital stock issued, leaves a surplus, after paying dividend, of $1,509,567.50.

The following statement exhibits the condition of the company at the close of the quarter ended March 31st:

Surplus January 1, 1904	$14,360,345.97
Net revenues, quarter ended March 31st	1,737,426.57
	$16,097,772.54
Dividend April 15th	$1,217,017.50
Interest on bonded debt	292,550.00
	1,509,567.50
Surplus April 1, 1904	$14,588,205.04

High-tension Convention in Chicago.

Announcement was made in the Western Electrician last week of the high-tension convention of the Institute, to be held in Chicago on June 21st and 22d. Arrangements have been about completed and the meeting bids fair to be an interesting and profitable one. The meeting will be strictly for business and, as indicated by the programme, already printed, there will be some good papers presented. It is expected that a large number of members of the Institute and others, outside of Chicago, will attend the convention, and James Lyman, Monadnock Building, has the matter of hotel accommodations in charge and will see that all are well taken care of. One of the things on the programme which promises to be of much value is the report of the transmission committee on high-tension work. There is much data which might be collected on the subject of high-tension transmission which would be eagerly sought by those interested in the work, and it is probable that this committee report will contain a great deal of valuable data.

Allis-Chalmer's Report.

The third annual report of the Allis-Chalmers Company, being for the year ended April 30th, has been issued and shows a considerable reduction in profits, owing to heavy expenditures during the year. The earnings for the year were equal to 5.86 per cent. on the preferred stock of $16,150,000. The net profits, after deducting depreciation, amounted to $952,624, as compared with $1,653,576 in 1903. The quarterly dividend, due May 1st, was passed, the other three amounted to $853,125, which left a total surplus for the year of $99,499.

Operating expenses for the year amounted to $997,013, and, besides this, the company made heavy expeditures during the year, as follows: Additions to plant, $642,231; new plant, $77,300; terminal railroad at West Allis, $49,060.

Concerning dividends, the report says: "By reason of the contraction in general business and the introduction of several new manufacturing departments that will require some time and expense to properly establish, the directors have deemed it the part of conservatism to postpone the declaration of dividends on the preferred stock until they are fully assured of a return of continuing prosperity for this company."

The necessity which the management was under to enlarge its scope of business to meet competition, it is pointed out, has resulted in the company coming into control of the Nurnberg gas engine, the Escher, Wyss & Co. hydraulic machinery, the Parsons steam turbine and the electric-machinery output of the Bullock Electric Manufacturing Company.

The balance sheet at the close of the year is as follows:

ASSETS.

Plants, good will, etc.	
Bills and accounts receivable	
Merchandise	
Bullock Electric Manufacturing Company	463,000
Cash	1,060,113
Total	

LIABILITIES.

Preferred stock	
Common stock	
Accounts payable	
Mortgage on N[illegible]	
Depreciation reserves	
Surplus	
Total	

In the settlement of several business contracts, entered into prior to March last, the company became the owner of $100,000 of its preferred stock and $180,000 of its common stock, which have been retired.

The electric-light plant at Wimbledon, N. D., which has been [illegible] purchased by Fred [illegible] establish lighting [illegible] and Courtney.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

High-pressure transmission convention of the American Institute of Electrical Engineers, Chicago, June 21st and 22d.

New York State Independent Telephone Association (annual meeting), Genesee Hotel, Buffalo, N. Y., June 23d and 24th.

Indiana Mutual Telephone Association (annual meeting), Lafayette, Ind., June 28th and 29th.

Ohio Electric Light Association (annual convention), Sandusky, Aug. 15th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

National Electrical Contractors' Association (annual convention), St. Louis, September 13th to 16th.

American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

IN FRANCE it is a much more serious offense to insult a functionary than to insult an ordinary individual. This fact has long been recognized, but it is only recently that it has been clearly decided that the "demoiselles de telephone," or telephone girls, are public functionaries, and so protected from the shafts of repartee by the awful majesty of the law. The point came up in a recent case that attracted much attention, wherein a popular Parisian actress was prosecuted in the criminal courts by the telephone administration on the charge of insulting employes. The defendant was acquitted, but nevertheless the fact was established that the French telephone girls are citizens in the public service and therefore must be treated with due circumspection.

MUCH interest will attach to the progress of the Lake Superior Corporation, successor to the Consolidated Lake Superior Company. The new company starts out in life hampered by a series of catastrophes which overtook the original company that would put any ordinary enterprise so completely in the ground that recovery would be impossible. The "Soo" properties are, however, of such magnitude and value that it would seem, with proper financiering as the prime requisite in the reorganization, they might well be placed on an excellent paying basis. Apparently everyone now concerned is satisfied with the situation as far as the conditions will allow, and it is now "up to" the management of the company to prove that the expectations will be satisfied. The steel-rail mill, according to present reports, is likely to be in shape to commence operations by July 15th or August 1st, and ore supplies to the extent of 50,000 tons of Bessemer pig have been purchased on this side of the Canadian boundary for early operations. When the steel-rail mill is once in running order it should have plenty of work to do in connection with the completion of the Algoma Central railroad from its present terminus north, to a point where it may make connection with the Canadian Pacific. With a check of $1,000,000 for working capital, from a strong and reliable trust company, the stockholders were able to meet, elect their officers and proceed at once to business. With such men as Charles D. Warren for president and John T. Terry, Jr., for treasurer, and with a board of directors made up of the heads of some of the largest banking concerns in the country, there is no lack of executive ability for financiering the new enterprise and it starts out upon its career with the good wishes of all

FORTUNATELY, many of the fires and accidents which the public so often and unthinkingly attributes to electrical causes have their origin in entirely different sources. Still it must be confessed that electricity is responsible for a certain proportion of the accidents and fires which do occur, and one of the questions which naturally arises is to what extent the electrical supply companies are responsible for damages by electric current beyond the point of delivery on the customer's premises and to what extent they should carry on inspection of the customer's wiring installation. Some opinions in regard to this matter were expressed in the Question Box of the National Electric Light Association which are worthy of consideration. Opinions of the best lawyers in regard to this question are at variance, judging from the court decisions on cases of injury by electricity, but from the majority of the cases it would appear that the supply company is held liable unless relieved by a specific contract. In one of the answers to the question this statement was made: "If the question is intended to apply to all classes of customers, under ordinary contracts and methods of delivery, my opinion is that the point of delivery would be at the lamp or appliance used. Although a customer may own all the wires and appliances in his building, they become a part of the supply company's system when connected for service, and therefore the supply company is as liable as though it owned the wires and appliances, for the reason that it is not the wires and appliances that do the damage, though they may cause it indirectly, but the energy delivered to them." In order to protect itself the supply company must have recourse to inspection of the customer's wiring installation to see that it complies with the spirit of the underwriters' rules. It is better that the wiring be done safely at first, even at an added expense, than to connect to a system that will soon be liable to cause trouble and increase the already too prevalent opinion that all fires of unknown origin are electrical fires. A thorough and frequent inspection of the system by the supply company, not only as far as the consumer's premises but through the entire interior system, will be of mutual benefit to both. It is not sufficient that this be left to the town or city authorities alone, as has been only too well exemplified in more cases than one.

NATURALLY enough, the Boer war had an adverse effect on the electric-light and power business of the Transvaal, but we note with pleasure, in the annual report of the Rand Central Electric Works of Johannesburg, that there has been a slow but steady recovery since the cessation of hostilities. The war terminated at the end of May, 1902, and on January 1st of that year the company had a deficit of £25,231, brought about by the circumstances of the conflict, which, indeed, almost put an end to the working of the company altogether. After the close of the war matters slowly took an upward turn, and by January 1, 1903, the deficit had been reduced to £22,993. Last year the total income amounted to the respectable figure of £71,820—an increase of £18,856 over 1902. Expenses were heavy, but in face of it all the deficit was reduced to £11,948, and at the annual meeting held on May 31st last Sir Rivers Wilson, the chairman, announced that the estimated profits for the first quarter of this year were about £10,000. At this rate it is hoped that the payment of dividends may be resumed at the annual meeting of next year.

One statement in Sir Rivers' report again illustrates the notorious reluctance of governments the world over to pay war claims: "I am sorry to say that all our efforts to obtain from his majesty's government recognition of our very reasonable claim for damages incurred during the war have not met with that success which we expected, and certainly which we deserved. Fortunately, we had what I may call a little nest egg—a small reserve which we had accumulated in the early period of our history, and we were able to apply that in writing off the claim against the government. The original claim amounted to £4,138. In the year 1902 we wrote off £1,408, and now we have written off the remainder, amounting to £2,729, and there is an end of that." It may be remarked that some of the claims of the British submarine-cable companies against the United States, dating from the war between the United States and Spain, are still pending; and in presenting to our government the claims of its subjects the British government would have placed itself in a better light if it had itself paid this electrical claim—not a very large one—growing out of its own rumpus in South Africa.

At the present time, it is gratifying to observe, the Rand Central Electric Works has contracts for the whole of its available power. In fact, it has been compelled to place an order for a new 400-kilowatt turbo-generator and for boilers of 800 kilowatts capacity, thus providing for another turbine unit, which, it is expected, will soon be required. This evidence of returning prosperity after an exhausting war will be noted with pleasure by electric-light men in the United States and elsewhere, who take an intelligent interest in the progress of their fellow workers all over the world. Rather curiously, the new turbine unit is being obtained from Switzerland. As most of the stock of the Johannesburg company is held in England, it might have been conjectured that the order for the turbo-generator would have been placed in that country. As for the American steam-turbine builders, they are now so busy on domestic orders that it is probable that the date of delivery on a 400-kilowatt order from South Africa would be prohibitive.

The Late William Wallace.

Herewith is presented an excellent likeness of William Wallace, who died in Washington, D. C., last month, as announced in the Western Electrician of May 28th. Mr. Wallace, who passed away at the ripe age of 79 years, was one of the great pioneer inventors in electric lighting in the United States, and it is fitting that the readers of the Western Electrician should have the opportunity of gazing on a picture of his strong yet kindly face. Some additional facts, to supplement the brief sketch of three weeks ago, will also be of interest.

Mr. Wallace, naturally of a mechanical and experimental turn of mind, turned his attention to electricity before the days of electric lighting. He built the largest spark coils that had been made up to that time—one for Stevens Institute of Hoboken, N. J., and another, which he presented to the Sheffield Scientific School of Yale University, in New Haven. He made some Holz influence machines of his own pattern, and, becoming interested in the work of Gramme and other foreigners in magnetos, he designed and built Gramme magnetos. Then he conceived the idea of making the magneto a complete machine, and by diverting a part of the current to excite the field, he made the first dynamo built in this country, if not in the world. About this time Professor Moses G. Farmer became associated with him in his experiments, as he had been working on similar lines, and Mr. Wallace had, through Wallace & Sons of Ansonia, Conn., of which company he was president, superior facilities for carrying on experimental work, and had one of the largest and most complete electrical laboratories in the world, the whole upper floor of his large residence being fitted up as a laboratory.

The factory of Wallace & Sons at Ansonia was the first to use electric lighting for any practical purpose in this country, and at the Centennial Exposition in Philadelphia, Wallace-Farmer machines, manufactured by Wallace & Sons, were the only electric-lighting machines exhibited, excepting a small dynamo built by the students of Cornell University, part of the material for which was supplied by Mr. Wallace.

Ansonia, in the early days of electric lighting, was the Mecca for all electrical people and the only point where they could get some of the necessary material for their experiments in this country. Wallace & Sons, under Mr. Wallace's direction, were the first, and for years the only people in this country to make carbons for electric lighting, and William Wallace devised the necessary machinery and processes. Such men as Hiram Maxim, Edward Weston, Sawyer, Charles F. Brush and Thomas A. Edison were visitors at Mr. Wallace's laboratory in the early days of electric light, along in the 70's, and received the benefit of his experiences. It is particularly notable that Mr. Edison first saw the electric light at Ansonia, Professor Barker of the University of Pennsylvania having induced him to go to Ansonia to spend a Sunday with him at Mr. Wallace's house with a view of taking up electric-lighting work. A New York Sun reporter followed them, and the Sun gave up a large part of its first page to a description of this visit and of the wonders of the new light as shown to Mr. Edison. The result of this visit was that Mr. Edison bought several dynamos for experimental purposes and devoted himself to the art, and it is of interest that a piece of platinum wire fastened in the shape of a horseshoe to the poles of the first dynamo ever built in this country and heated to incandescence at once convinced Mr. Edison that the future of electric lighting lay in the incandescent rather than in the arc light, and he said then that he would never be satisfied until he had made that method of electric lighting practical.

Mr. Wallace was the first to run arc lights in series, and it is characteristic of the man that in the early or experimental days of the industry he would not apply for any patents that he felt would retard the development of the art he was so much interested in, and his research and the result of his experiments were not carefully guarded secrets, but available to other workers in the same field.

William Wallace was a very kindly and hospitable man, plain and unassuming, a good listener but a poor talker, except when very much interested, when he had a faculty of expressing himself with remarkable clearness and brevity.

It is proper to say that many of the facts in the above all-too-brief sketch of a useful career were obtained from Mr. J. B. Wallace of Chicago, a nephew of William Wallace, who, as a youth, was associated with his uncle in many of the latter's most interesting experiments. It is to be hoped that at some future time Mr. J. B. Wallace will lay before the public an authoritative account of the work of his distinguished kinsman.

Underground Construction.

By W. P. Hancock.

Part III.

If the manholes are shelved to receive the cables, as shown in Figs. 4, 5 and 6, the cable contractor should be required to form all of the lines into their respective shelves in a neat and workmanlike manner, taking special care that joints are so located in different lines that when shelved they will not lie directly one over the other, and also he should be careful that joints are so placed, if possible, as to avoid being trod on by workmen—careless workmen is the proper phrase—when climbing about a manhole for any purpose. If the manhole is plain (without shelves), then the cables should be racked in a neat manner, as shown in Fig. 7; and if a transformer is in a manhole (see Fig. 8) or a catch-box (see Fig. 9), great care should be taken with the bending of the cables to meet these terminals, so that the radii of the bends will not be too great, and yet be as great as possible, and not interfere with future installations of cables, transformers or boxes.

Electrolysis.—If your installation is in the ground near a street-railway system, where the rails are bonded and the return conductor is not fairly proportioned on account of a probable cost of copper to make it of proper proportions, and more especially if the ground is wet and what is usually termed "made land," then the lead sheaths on your cables will be liable to carry stray currents and, if they do, damage will occur sooner or later, which will result in the drawing out of a faulty cable and the

WILLIAM WALLACE.

replacing of same with a new one of like size and length. There does not seem to be anything left to do in such matters as this except to protect yourself at a cost which, in the end, will be far less than the cost of replacing lengths of paper cable whose sheaths have been eaten through by the electrolytic action, for such action will take place when the current leaves the sheath to the ground, and if you know this in time, as perhaps by actual experience you do, you should—on the new installation—decide to circulate through your duct system in the railway district a bare copper wire of, perhaps, 200,000-circular-mil cross-section, and have one end of it attached to the return conductor of the railway system, at a point as near the railway power house as it is practical to get it, and with as good electrical connection as is possible to have; and from each sheath in each manhole connect a small bare copper wire, say No. 20, by making several wraps around the sheath, and attach the other end to the copper conductor first mentioned, being careful to make the best electrical connection possible between the sheath and the large copper. The result will be that the sheaths will discharge their currents to the large copper, which will in turn discharge its current into the return conductor of the railway system and electrolytic action on the lead sheaths will be avoided.

In case you intend to use cable mains on your underground system, the handholes for distribution from same can occur in any part of the duct line where needed and space is available. The handholes are built over the line, and so that the top row of ducts will enter either side of it (see Fig. 10), and inside of the handhole there is placed on steel supports, made of light steel T-iron, what is termed a cross, or service box, which is made in either a two or a three-wire type or form, as required, and from the catch box in the manhole (see Fig. 11), the main cables leave and are extended through the top layer of ducts to the handhole. They are then picked up, and extended through the terminals of the service box, which has a water-tight stuffing box for each cable in the main, and cut at the proper length to take a lug, which is, when soldered on the cable, bent down and connected to the bar terminals in the box. This is a very convenient way of installing mains and services; there are methods less expensive, but not better, for here you have a water and gas-tight box, a first-class opportunity to extend services to either side of the street, and, above all, the best of methods by which in time of line trouble to test from house to house, and from manhole to manhole, without rejointing any cable or keeping any customers out of service but a very short time. The same thing can be done from the manhole itself, but if the distances between manholes are long and your services are heavy, and require separate service wires or cables for each building, your manholes will become crowded and the chances of encountering obstructions in installing services are greater. In either case the service wires would lead from manhole or handhole, through a three-inch iron pipe to the customer's premises, and terminate on a service switch. Fig. 8 shows pipes of this description, one going to a street lamp, and showing a connection from pole line to manhole.

Care of Cables.—Cables once installed should be looked after carefully, and it should not be assumed that a manhole does not need inspection, or cleaning. On the other hand, they should be inspected regularly, and kept clean. The sewer connection should be known to be open to the sewer, and not be liable to flood, and the cables should be tagged in every manhole, and in case concentric, or other cables of more than one conductor, burning out, a provision should be made to protect other cables near by from having their respective sheaths burned by wrapping them with asbestos ribbon, and thereby avoid trouble on several lines at one time. Care should be taken, also, to caution employes about treading on cables and cable joints at all times, and especially in manholes, where usually the conditions are of the best to destroy cable if the slightest opening occurs in the sheath. If the cover of a manhole is a perforated one, and such I would prefer, unless the manhole contains transformers, it should be looked after as regularly as the manhole is inspected, and let the duct system get all the ventilation it can from that source; and if the manhole is built, and is required to be watertight, then the cover and joint should be regularly inspected and kept tight, and save the apparatus therein from receiving water, after an expensive manhole has been built to prevent that identical occurrence.

Manhole Boxes.—Like boxes for mains, the feeders in the system may terminate in some suitable receptacle, placed in a convenient position in the manhole, and being capable of being made watertight (these, of course, are applicable to direct-current lines only), and may have fuses and bus bars either straight or circular.

There are types which fit to the wall of the manhole which are of large capacity, convenient to operate and watertight. There are other types which may be hung from the roof of the manhole, and operated from the surface of the street. In winter weather, the box in the manhole is in a better place to operate than the one which opens at the surface, and, all matters considered, I had rather have the box in the former location; and, as a matter of fact, I am of the opinion that it is the safest location, if well installed and cared for.

I do not lose sight of the fact, however, that there are many instances where, in manholes, there is not room for a box, and in such cases one must use that which is available.

From Overhead to Underground.—Fig. 8 shows what the central-station man can do when his conduit line is complete, his boxes installed, or transformers, if may be, and his cables drawn in and connected to their terminals, whether it is for one block along the line, or more, both in the case of his series arc lamps in the street, and his overhead low-tension mains or his primary and secondary lines. I believe the items are shown fairly complete, so far as the construction needed applies, and with the lines open at the station end, and fuses off in the boxes in the manhole, it would not be difficult to make the transfer, and when the section overhead, as shown, has been connected to the new section of underground, the work of removing wires and poles could begin and be carried on from time to time as new sections of underground were installed and conditions would permit. I have in this type of underground system included necessary construction for transferring present overhead lines to underground, involving only such capacities as were contained in the overhead lines, the only other stipulation being that, in building your conduit line, don't fail to determine what you need for future development as far forth as possible, and if the city of town is a large one, or a small but growing one don't guess on the minimum side for the size of the conduit, and have to open the same street or streets twice, pay a contractor to get his outfit there and away twice, and pay for the paving more than once. If you don't fail on these points, the abutters and your customers will congratulate you on your foresight, especially if they are stockholders, and you will congratulate yourself on the second line you build (and think it too large) when in an incredibly short space of time you find your ducts are filled; and, besides, there are concerns who have [illegible] paid, [illegible] for the [illegible] rent. Therefore, consider the matter well, before

you decide that you cannot afford to build an 18-duct line, instead of a 15, while you have the ground open. Lay out the cross-section of an 18 duct line and figure it; your manholes will not cost you any more, your stock and labor will be in a very large degree less than it would cost to open the same ground again, and if your present 15-duct line is to have its capacity taken, or nearly so, and a new enterprise of some sort comes into existence,

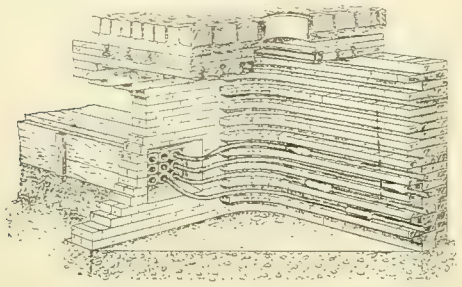


FIG. 4. UNDERGROUND CONSTRUCTION.—CORNER OF SHELVED MANHOLE.

which you had not the remotest idea would ever exist, and the concern expresses a wish to become your customer in the near future or not at all, then, as you have duct space, you are ready for a heavy customer, except, perhaps for cable, and that can be obtained from stock if it is not in too large size, and you are then in a position to take on the new customer, while perhaps the competing company or companies in your town, in your line, who have been more cautious in the matter of conduit installation, will be unable to accommodate prospective business.

I have covered the conduit system in a manner which I hope will enable the central-station man to see his way clear to put his conductors into that type of system, and without difficulty. There is, however, another type of underground system, which is the well-known Edison tube system, and, under certain conditions, such as those where lines which

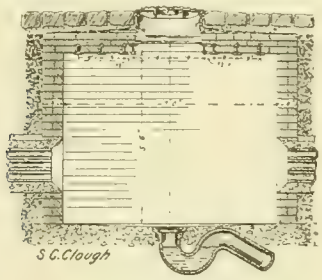


FIG. 5. UNDERGROUND CONSTRUCTION.—ELEVATION OF SHELVED MANHOLE.

are not too long are required, and where the load for the line will be fairly heavy, in amperes, and the volts needed do not as a rule exceed 300, it is a good system to use. It will compare favorably as to cost with the conduit system for short distances; but while the cost of installation under these conditions may be favorable, the cost of operation favors the conduit system to a large degree.

If the central-station man should wish to use the Edison tube underground system, it would be necessary for him to follow in general the same method of procedure with reference to survey, right-of-way and placing of contract, also with reference to the bonds for faithful performance of work, accidents, and the maintenance of street surfaces for a period of time conforming with the requirements of the city in which the system is to be installed;

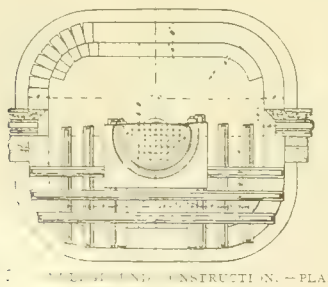


FIG. 7. UNDERGROUND CONSTRUCTION.—PLAN OF SHELVED MANHOLE.

and when these conditions have been met, and properly taken care of, the work may proceed.

If the city is one of medium size, and the business portion especially is not scattered, we can assume that the location of the feeder terminals has been fixed at such points as have in the survey indicated the heaviest loads. If the station is to be near the water front, and the distance is not made greater by reason of such location, we can use one street only for some distance, to carry along, say, 10 feeders; or, in other words, 10 Edison tubes, having in each three coppers. Two of these are used for the positive and negative, each having a diameter of one inch, and the third wire is used for the neutral and has a diameter of 0.59 inch, and the three coppers, taken together with the pressure wire, represent one No. 1,000 feeder of an Edison three-wire system.

We want to lay them all in one street if we can, for the reasons following:

It will be cheaper, as the trench need not ordinarily be lower than 30 inches from the surface; locations can be secured much easier than with the conduit system; the material which is heavy will be handled cheaper; the labor can be superintended for less cost, and the resurfacing can be done with greater facility. Assuming we are ready to start the work, with the necessary foreman and subforeman at hand, we start in and get the blocks out, then get the men in with the picks and shovels, and as soon as the trench is bottomed out for 30 feet in length we can begin to drop the tube in place and get the jointers at work on the connections, and as the excavation progresses we can get in more tubes and connect them. In the meantime the compound kettles have been heated, the clamps and the coupling boxes have been placed under and over the connections between each end of the connected tubes, and have been bolted together and are ready to have the hot insulating compound poured in them.

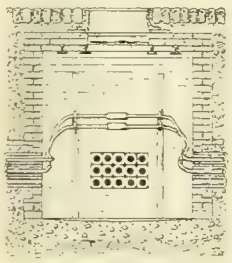


Fig. 6. Cables in Plain Manhole.

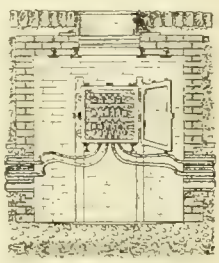


Fig. 9. Transformer in Catchbox.

UNDERGROUND CONSTRUCTION.

The boxes may not be filled too fast, nor too near full at first, for it will be better, if they are filled two-thirds full, to let any steam which may generate from the contact between hot compound and cold iron have an opportunity to dry out, and later on fill the boxes completely, and then screw the plugs in the pouring holes. Perhaps at this time we have reached a point on the same street on which we started, where a feeder ends, and if so, we need a six-way or a 10-way, 1,000-ampere catch box or junction box; that is, an underground device of 1,000 amperes capacity and having six or 10 stubs projecting from its base, two of which are for feeder connections, the others being for the purpose of connecting the mains, of which we shall speak later. (See Fig. 12.) Therefore we excavate for our catch box, set it and cut a piece of tube of the proper length for the space intervening between the end of the last length of tube, laid for the particular feeder, and connect it to the line and also to one of the feeder stubs of the catch-box, and we may then call that particular feeder connected except at the station end. Such portions of the

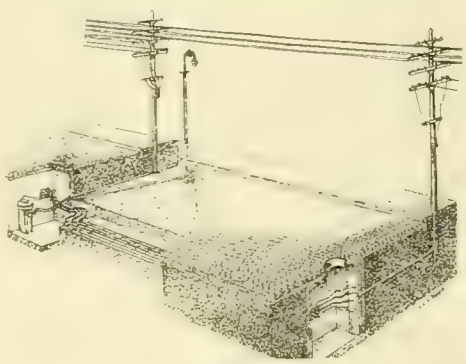


FIG. 8. UNDERGROUND CONSTRUCTION.—TRANSFORMER IN MANHOLE.

lines as have been connected and completed may have a length of plank laid on each and the trench may be backfilled. We may also assume that, from the point where we set the first catch-box, which would naturally be at the junction of two or more streets, the balance of our group of feeders would begin to lead in three different directions at least in order to have them arrive at the points indicated on the plans as feeder terminals; but as the method of getting them there and making the terminal has already been described on one feeder, we will consider that description sufficient for the balance of the group, or the other nine feeders. We have not, however, said anything yet about providing for such an emergency as having one of these feeders out of service, or how we would keep the pressure in the district fed by that tube at standard.

There is a device that can be and is used to cover such cases, called a feeder box, which differs from what I have described as a catch box in that it is used for manipulating feeders, in case of accident to one or more of the group.

For instance, if we install a four, six or eight-stub feeder box in a group of feeders, and enter the group from one side of the box, and connect them to the cables of the box on that side, the current will then be carried in and through the box to the other side, and out to the other portions of the lines; and if one feeder of the group becomes faulty, we can, by means of a set of cable jumpers, so called, connect the good portion of the faulty feeder to some one of the group of remaining feeders that are perfect, and, if the faulty feeder is burned out on the station side of the box, you can still deliver some current from the good lines through the jumper cables to the terminal of the faulty feeder. If the feeder is burned out on the feeder terminal

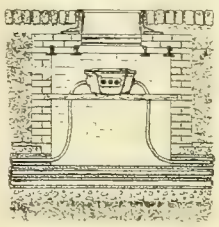


Fig. 10. Type of Handhole.

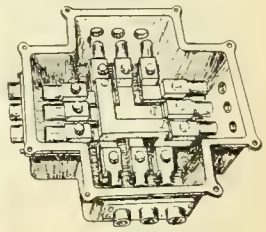


Fig. 11. Type of Catchbox.

UNDERGROUND CONSTRUCTION.

side of the box, you can still use the cable jumpers, and send all the current you can to the several terminals of the good feeders, and thereby increase the circulation of current from their respective terminals and keep the pressure as near standard as possible at the terminal of the dead feeder. In fact, a feeder box is an extremely useful piece of apparatus, and if I intended to install a complete tube system, I should by all means install a number of these boxes at points where three or more feeders were located in any one street. Fig. 13 will show the feeder box and the use of the jumper cables.

Not only for uses already described are the feeder boxes available, but they are valuable indeed when grounds or crosses occur on the feeder system, for it is then possible to cut the feeders into sections and test in either direction for the difficulty.

If the central-station man has had his system installed for some years, and feels the need of a small sub-station from which he can extend a few feeders in the direction of a growing business district, and his system is, as first installed, a purely low-tension system, then he will probably need one or two tie or trunk lines. These are lines which leave the bus in the power station and extend, exclusive of any connection with the underground system of mains, to the bus in the sub-station; and, if so, these lines will necessarily be operated at a higher voltage than his feeder lines, for it will also be necessary to obtain, in order to use the same voltage lamps throughout, a bus voltage at the sub-station which is practically the same as the feeder bus voltage at the power station, although that depends entirely upon the amount of load and the length of the feeder from the sub-station. When such lines are installed, if they are tube lines, as we now assume they will be, the type of feeder box before spoken of should be installed not further apart than 1,000 feet, for the cost of the installation of the boxes, in case they were not used and repairs were needed, would in a short time be overshadowed by the cost of making openings in the street from which to make tests, not to speak of the time saved in the interruption of service and the vexations attendant thereto.

We can utilize still further these tie or trunk lines,

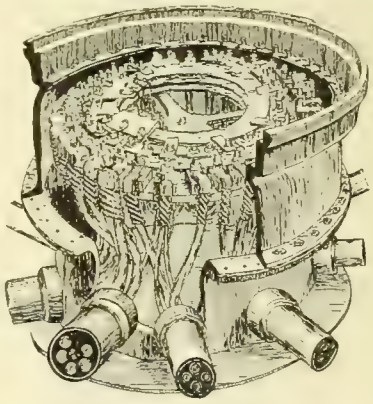


FIG. 12. UNDERGROUND CONSTRUCTION.—UNDERGROUND JUNCTION BOX.

for, if we wish, as a matter of insurance, we can connect these lines to the catch boxes through the medium of an underground switch box, a device which can be operated electrically from the switchboard in the power house; and when you have a feeder, which is heavily loaded, develop an open circuit, you can, by operating the switch box, throw the current from the tie line into the system of mains—having first opened the switches in the sub-station on that particular line—and put the switches in the power station from a bus of high voltage required for a tie line to a bus of lower voltage as required for the district which you intend to feed.

In the matter of mains, or the line from which

you will tap service lines for your customers, do not make the serious mistake of having the first installation of these lines go underground with the copper just large enough for present use, or with a very small margin for future use. When you install them you may say you have enough copper in the ground to cover the business for a number of years, but don't forget at that time that if your guess is erratic you are bound to have an overload which will mean a higher amount of energy lost, excessive cost for repairs, interruption of service, and arguments from customers who may, perhaps justly, complain of unsatisfactory service.

Lay the mains on both sides of the streets in the business section if you can possibly afford it. It costs you a certain amount of money for plans, etc., to prepare to lay any line, and the men, tools and stock must get to the spot before you can begin, and when you have them there don't make the mistake of not having the stock and keeping them there long enough to lay an amount of line sufficient for use as far into the future as careful judgment will dictate, for the amount of money you can spend in making a second preparation will pay the interest on quite an amount of investment in copper for future use, not to speak of having yourself in position to take on a large customer on short notice, and thereby perhaps save the business to yourself instead of seeing it go elsewhere. All of the coppers in Edison main tube are usually of the same size, and nothing smaller than 200,000 circular mils area for each copper should be considered in any installation, that is, in a growing city, and you may decide that 350,000 or 500,000 would be more to your advantage in the end, after you consider interest charges, maintenance, and the value of being able to take on business in fairly large items. The reliability of this type of main to carry its rated load is not to be questioned, and the repairs are not as a rule excessive on a well installed system. Of course, they are not as easily gotten at to repair as cable mains, but, on the other hand, they cost a good deal less to install than a drawing-in system with handholes at convenient locations.

The installing of mains should contemplate the setting of a junction or catch box at every street corner, or at least on one corner of every junction of streets, so that when your total system is installed and line difficulties occur you will be enabled to open catch boxes, take off fuses, make dead any one section of your system of mains that will be most convenient for your purpose, find your trouble easily, and inconvenience only such customers as are on that particular section.

Just a word about the boxes of all kinds which you have in the system. It will pay you, after you have them well installed, to inspect them regularly and know that the fuses or catches are intact on every copper which has its lead from the box, and keep them clean. Do not assume, when the box is once in the ground and sealed, that so long as you have no line trouble they are O. K. You may have a customer who complains of poor light and notices that his neighbor across the street has a much better one, and in such a case, if the two customers are feeding off different mains from the same box, you may find on opening the box that the cause of poor light to the complaining customer is the fact that the current is feeding to him from one source only, on account of a blown fuse. Take care of the system; it pays in the end, and has been so proven by experience. Service lines we must also have, and 100,000 circular mils is small enough to install underground, for you cannot afford to do the work, or at least incur the expense of service installation, for a less capacity than that of the service above named, which is 100 amperes for each conductor. A three-conductor cable insulated with rubber, jute and asphaltum, and with a steel ribbon armor outside, is good for the purpose, for it is small, flexible, easy to work, handy to connect, reasonable in price and durable.

If service lines are being installed at the same time mains are being laid, of course, much expense is avoided; but it is necessarily true that many services must be installed after the main line is complete, and in the latter case the ground can be opened over a coupling box in the main, and then a very small trench extended from that point to the customer's premises where entry is made, a service switch installed, with the necessary fuses and the cable connected thereto. Before backfilling the trench, kyanized plank should be used to cover the cable, to prevent the picks in hands of other workmen from injuring the cable in the future. The line need not be made dead for the purpose of installing this type of service if you have what we term a good "live-wire man" for a jointer; but in case you need a larger service which is, for instance, the same size as the main itself, the line would be made dead long enough to put in the proper connection with a tee box, to replace the straight coupling box, before used at that point. In case of customers who have heavy and important load demands on the system, the main itself is sometimes led into the building and out again in the form of a loop, so that when this service is connected complete to the loop-service switchboard, current will be taken from the main in either or both directions from two junction boxes, and if the main on one side of the loop becomes faulty, the other side is still available. Do not make the mistake of installing services on a too cheap basis. Make your terminal switch substantial, and have the cable leads which are connected to its terminals put up in a thoroughly substantial and workmanlike manner, well insulated, and, in fact, in such shape that it will reflect credit on your method of doing business with customers.

And, now, as to the difference in cost of the two systems, I can say that the tube-feeder line is cheapest but not best. I have in mind one trunk line laid in conduit in 1899, which was 4,255 feet long and which was drawn into a new conduit. General Electric, rubber-insulated, lead-covered cable was used as follows: Two 1,000,000-circular-mil cables for positive and negative, and one three-conductor pressure cable. We did not draw in a 350,000-circular-mil cable for the neutral, but if we had it would have cost 48 cents per foot, drawn in and jointed, and that would have made the total cost of one foot of the line, including ducts, cables, and every item to make the feeder ready to go into service, $4.044. This with the price of copper at 19 cents. If we had used for the same line No. 1000 Edison tube, with a junction box installed at its terminal, the cost per foot of line would have been $3.27, or about 19 per cent. less than the line in the conduit system; but, on the other hand, even though we had cut the tube line in sections by reason of installing the feeder boxes I have previously spoken of for testing purposes, no doubt we should have paid to date on the tube line a very large percentage for repairs and renewals, more than we have for the cable line, and the excess of its cost over tubes. On mains it is the same; the installation cost is greater, but with cable mains properly installed, and not allowed to be overloaded, repairs can be made quickly and without opening ground, when with the tube mains you must open the street, be it winter or summer, and at much expense. On services, as on mains, it is equally true, for with handholes and cross boxes, as before

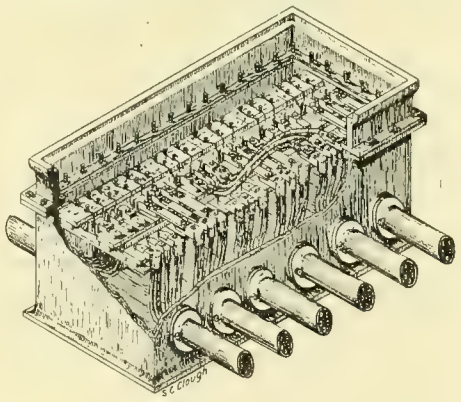


FIG. 13. UNDERGROUND CONSTRUCTION.—JUNCTION BOX SHOWING JUMPER CABLES.

referred to, repairs may be made quickly and safely, at small expense, and with no detriment to other customers on the line.

To sum the matter up, the advantage appears to exist in the conduit system undoubtedly.

One word about the number of cables in a single duct. Don't crowd them too much. You may at times have to do such things as that, when, after your conduit is complete, in due course of time you find that you are short of duct room; but, if so, on the next occasion of duct installation add a few more than you may need, at least 25 per cent., for in your past experience you may have found that it would have been cheaper to have had some spare ducts, with the investment for the same lying idle for a while, rather than have paid for the repair or renewal of cables upon which no expense would have been incurred provided you had not been obliged to crowd ducts with more cable than they should contain. In this connection, also, do not let the value of a conduit location pass in a disinterested way. Bear in mind that in these days everyone wants wires to go underground, and a location for a conduit should be considered a valuable acquisition, and the most careful use should be made of it, to utilize to your utmost ability something which you have for your own use at present, but at the same time something which all central-station men are looking for all of the time, and which, if the business is growing, they will utilize probably to your detriment, if you do not exercise good judgment and fill the location for your present and future uses.

About ducts, of which there are many types and many makes, use a good clay duct, from a responsible concern. Make it single or multiple, according to the conditions which surround the installation of your system. Look up the different types in a thorough manner. Ask people who have used ducts, and get their experience, and find out that which seems after investigation to be the best.

On the question of manholes, don't scrimp on them. A badly shaped manhole, too small, with not the proper space to install cables, not to mention the fact that your men have got to work in them, to make repairs at any time in 24 hours, perhaps, may be the means of adding more expense than several times the amount it would have cost you for stock and labor to have built them right.

When you have got your duct and cable systems properly installed, and you look at the cost of maintenance each month as compared with your previous cost of maintenance of overhead lines or tube system, you will feel a sense of satisfaction that you did not before experience, and in case of trouble in the streets, by reason of fire and the many other difficulties which tend to make overhead lines the bane of a central-station man's life, you may rest content, for then the system will be to a greater degree under your control only than ever before.

Concluding, I will say that it has been my intention to include in this paper such information as would be in compliance with the request of the secretary, and all of the detail has been taken into consideration that seems necessary to enable anyone in the central-station business to proceed with the installation of a new and complete underground system, or to change from an overhead to an underground system, without serious difficulty.

[*The end.*]

Cable Repairing on the Amazon.

An interesting account of the experience of the steamer Viking during the repair of one of the cables in the Amazon River is told in the Electrical Review of London. It seems that a fault had been located at a spot where the cable was laid in one of the numerous side streams out of the strong current of the main river and the Viking proceeded to its repair. After grappling for some time without success, she moved about a mile down stream. Here the channel passed close under a fringe of high trees which seemed a favorable position for hooking the cable. The first drag proved the surmise to be correct, and the bight having been duly lifted and cut, one end was buoyed, and picking up commenced toward the fault. Half a mile or so had been recovered when the cable left the open water and led right into the coarse grass, called capim, which everywhere fringes the low-lying banks of the Amazon, and which frequently floats in immense masses on the surface of deep water, reminding one very much of the "sud" on the Upper Nile.

In this instance there was 12 feet of water alongside it, and picking up was continued in the hopes of being able to pull the ship through to the other side, distant about a mile. The situation was certainly novel, and soon difficulties arose. The circulating pumps got choked with grass, and, to make matters worse, water had to be supplied to the boilers, to enable the picking-up machine to be worked, by means of a suction hose put over the side and connected to a hand pump. Gradually, as the vessel proceeded, the grass in front became more and more compact until the cable led up and down, and it was obviously necessary to cut away the obstruction. A couple of hours' work by all available hands armed with knives, choppers and other cutting implements cleared a way for the cable and the bow of the ship, and the machinery was again started. Before long, however, the neighborhood of suspicious-looking young trees was reached, and the ship became stationary. On making a hole through the grass and pushing down a pole, nine feet of water was found and this being one foot less than the ship could float in, the cable was accordingly cut, just above the surface of the grass. The end remained sticking up, and appeared to have no inclination to retire from view.

Over half a mile had been picked up, and but for the shoal water doubtless the whole length would have been recovered, and a somewhat bold proceeding justified by complete success.

Pulling a ship along by means of a good strong cable is one thing; warping her back, stern first, by running out kedge anchors, is quite another. Grass had closed up behind, leaving only a narrow channel barely sufficient to permit the passage of a boat. The first kedge anchor promptly came home without the ship showing any signs of moving. A heavy grapnel was next banked behind the anchor, but these two proved insufficient, and matters began to look serious. As another resource grapnels were now run out over the bow, carried along the grass to the stern of the ship, and hooked deeply into the impeding mass, which was then hauled forward with the winch. The excitement of falling into holes was varied by a snake hunt and the killing of a fine specimen about eight feet long. After a few of these novel drags had been made and the stern cleared, the ship began to move, and gradually left behind a compact mass of grass and weed, which appeared almost solid, and which had extended from the bow to about amidships. By this time it was dusk, and work had to be abandoned. Myriads of young mosquitos now appeared, giving a pretty good idea of what the experience would have been had the season been a little more advanced, and their biting powers fully developed. In the early morning, the engineers having made the necessary alterations, and cleared the propellors of grass, the ship was worked out, using the high-pressure cylinders only; and, the choked pumps having been cleared, cable work was resumed and the repair duly completed. A considerable length of cable had to be abandoned. The channel has completely changed, and, where four or five years ago 14 feet of water existed, is now an island with fair-sized trees. Under this the cable goes, and it is too deeply buried to be recovered.

The village of Alexis, Ill., has voted to buy the electric-light plant of the town and operate it as a municipal plant.

The Mechanical Stoker and the Human Operator.[1]

By Edwin Yawger.

It is a matter of common observation that there is frequently a considerable variation in draft in different furnaces where a number are connected to the same stack.

When the furnace is hand-fired, all the losses due to the improper manipulation of the air supply are rendered much greater. An indication of this can be obtained by noting, by means of a gauge, the variation of draft in the fire chamber during a cycle of firing.

I believe it is the practice of boiler manufacturers to establish a fixed arrangement of baffles. The furnace specialist goes further than this, and arranges the baffles to conform to the nature of the service, and the amount of draft in the particular case.

Accessibility is a prime requisite, and that stoker will give the best service in which the condition of the fire can be seen, and obstructing clinkers dislodged without the opening of doors.

In view of the prevailing tendency toward the use of large boilers, stoker design must permit of a corresponding expansion of grate surface. In many cases 500-horsepower or 600-horsepower boilers, instead of being fitted with the proper amount of grate area, as determined by the draft and weight of coal to be burned, are expected to give results on a restricted grate, simply because the design does not permit the proper area.

The data at hand on the question of durability offer, if possible, a wider range than above indicated for boiler trials in general.

The peculiar thing about reports of stoker repairs is that records cover only the two extremes of experience, in a few plants the small cost of repairs being a matter of pride, a segregated record is kept of stoker repairs. In other plants, more unfortunate in design and operation, excessive repairs are often reported. The range in this respect varies from half a cent or less per ton of coal fired, to 12 cents in extraordinary cases. In the large majority of plants between these extremes there is no record available.

It should be noted that the life of a boiler and a furnace should be logically reckoned, not by the year, but by the gallons of water evaporated and the number of tons of coal consumed.

The foregoing requirements are generally understood and accepted.

Other questions of furnace design no doubt have two sides, with advocates for each. A number of makers construct furnaces calculated to reject the refuse continuously and automatically, the argument being that this reduces the labor required and adds to the effectiveness of the operation. On the other hand, it is claimed that continuous discharge will carry over a considerable amount of combustible when fires are forced, while with light firing there will be a thin zone in the fire near the discharge point that will admit an excess of air; also that large clinkers will occasionally fail to pass through an otherwise automatic discharge.

The extent of the firebrick arch over the fire in furnaces operating with progressive feed is sometimes subject to discussion. The presence of an arch sufficient to reflect heat on the fuel until it is well coked is always recommended. It is argued, however, that the external fire chamber, with its full-length arch, throws back all of the radiant heat upon the fire, thereby increasing the rapidity of combustion and insuring its completeness. Other authorities state that it is better to expose the heating surface promptly to the highest possible temperature, to this end making use of a large proportion of direct radiation. Rankine states that about one-half of the total heat from the combustion of coal is given up in radiation. The open fire, therefore, would project a greater quantity of heat against the first row of tubes, with a tendency to intensify evaporation at that point. Experiments made by the Northern Railway Company of France showed that evaporation around the firebox of a locomotive boiler averaged seven times as great per square foot of heating surface as the rate in the flues.

There is no increased danger to boiler tubes by reason of high temperatures. The rupture of a tube is invariably due to some cause within itself, either a flaw in material or the presence of scale sufficient to interfere with the releasing of steam. With these facts in mind, and with a view to reduce as far as possible the loss by external radiation and air leakage, it seems the logical thing to design an arch deep enough to insure the absence of combustible gases in the flues, at the same time permitting a liberal amount of direct radiation.

Judging from the number of 60-foot stacks in use, especially in steelworks, there would appear to be a wide difference of opinion on the subject of draft. If I were asked to specify a single improvement in furnaces that would net a greater saving than any other, the reply would be "double the height of all the stacks now in use." Intensified draft will work wonders.

First—It will permit the burning of more coal per square foot of grate, thereby increasing furnace temperature. The burning of more fuel per square foot of grate surface, and the consequent high temperature, is in itself an element of economy, illustrating one of the fundamental laws of thermodynamics, which states that efficiency is dependent on the range of temperature in the working medium.

Second—It will make combustion complete at a point nearer the coal; that is, the flame will be shorter, and the excess of air will be less. This condition is due to the fact that a strong draft rushes among the fuel at high velocity, causing a more intimate mixture of air with the inflammable gases.

Third—The same volume of gas at the same temperature will give up more of its heat when passed rapidly than when passed slowly over the same heating area. Many experiments have been made to determine a law governing the effect of speed on the liberation of heat from gases, but the results are variable. All agree, however, that the effect is important.

It is plain from this that the stack or draft apparatus has a function not usually accorded to it; namely, that of overcoming friction in gas passages induced by high speed of gases. It is considered by many a point of good management to reduce as much as possible the internal friction in furnaces, but if this is done at the expense of speed of gases, the result will be a reduced capacity and a higher stack temperature.

It is common experience that no part of a power plant is subject to so much neglect as are the boilers. The reason for this lies in two inevitable weaknesses of human nature.

First—A reluctance to perform a dirty and disagreeable task.

Second—A reluctance to perform any task when its results are not apparent to the observation.

An engine operator may build up a reputation by giving such attention to his engines that they will not offend the eye or the ear of the observer. The chances are that if his engine looks clean and runs quietly, it is in fact in good order; but the external cleanliness of a boiler would argue little as to the absence of scaled tubes, soot-choked passages or broken-down baffles.

Some years ago I became partly responsible for the operation of a large mechanically fired plant in Pittsburg. There were 16 boilers in the plant, and I was asked to determine why it seemed impossible to secure sufficient steam for the engines. I made a brief examination of the boilers, and found that the stack draft in the different batteries ranged from 0.45 inch to 0.7 inch of water, and that stack temperatures varied from 450 degrees to above 700 degrees. The general condition inside the furnaces seemed obvious. I agreed with the management to pick out a man who would enter their employ and have full charge of the boiler plant, with the expectation that a change would soon be apparent. An inspection by this man showed that in some cases soot had accumulated in such quantities as to choke the gas passages. This explained the low draft and temperature in some of the stacks. In other cases the baffles were broken down and displaced to such an extent that the gases made practically one pass through the tubes and escaped at high temperature. This gave the key to the other extreme stack condition. It was found, by a little close observation, that the attendants reported the external cleaning of the tubes without going through the formality of doing the work. A short period of personal supervision served to put the plant in such condition that steam was easily supplied by 14 boilers instead of 16. This happened in a stoker-fired plant; it would have been worse in a hand-fired one, because the same human nature would have been there, only more of it. It is evident that such delinquencies on the part of attendants work equally disastrous results, whether the plant is stoked by hand or by machine.

There is another phase of human nature that has an important bearing on the comparison of hand versus machine firing, which probably furnishes the stoker manufacturer with his strongest argument in favor of the superior fuel economy of the mechanical stoker. It is the well-known fact that there is a wide variation in the efficiency of individual firemen in the actual manipulation of the fires. I am told by the superintendent of motive power of one of our greatest railroads that his company has for a long time maintained a system of rewards, based on the economy in coal obtained by the different locomotive firemen. Basing observations upon the records of a large number of firemen, who had been under the system long enough to establish a personal average, it is found that certain individuals maintain a higher average of rewards than others throughout a long period of service. If, therefore, the company could secure a force of firemen, each one of whom could equal the best average, there would be a saving in fuel amounting to many times the sum required for premiums.

During the World's Fair I was called upon by the judges to conduct some comparative economy tests on traction engines. The tests were for the purpose of determining the fuel economy of boilers and engines combined, when running at constant load, furnaces being fired by the manufacturers' expert firemen. In five engines tested there was a variation in results of about 15 per cent. The steam distribution and the furnace and boiler design were quite similar in all five engines, and it would be safe to assume that their inherent efficiencies would not vary more than five per cent. The further difference, therefore, of 10 per cent. should be charged to the variation between expert firemen.

One universal result of the substitution of mechanical for manual methods consists in a greater uniformity of product, and from the nature of the operation it is possible to maintain a stoker at or near its highest efficiency. To obtain this very desirable condition it will be necessary to start right by making a competent engineer responsible, not only for the selection of the machine, but for the unity of design of the entire furnace from ash pit to top of chimney. This responsibility is often assumed by stoker builders, and some of them refuse to make an installation unless full and satisfactory information is furnished covering all the essentials of the furnace.

To maintain a boiler plant at its highest efficiency is not a complex problem, but enough has been said to show that it requires constant and intelligent supervision. It is its capability of responding to intelligent supervision that renders mechanical stoking superior to the human kind. The functions of the machine are varied, when necessary, by positive adjustments, and changes in adjustments can be governed by definite rules easily within the comprehension of the dullest operator. I should say, in general, that any chief engineer of a station, who himself is capable of operating successfully a mechanical furnace, can, with a reasonable amount of attention, secure uniformly good results throughout a large plant.

A daily inspection of the fires will assist as much as anything, remembering that a white-hot fire is an indication of all-around economy.

Recording instruments of various kinds will be found useful, especially in mechanically fired plants. Probably the most useful record obtainable in connection with furnace operation is a record of the amount of air supplied. With the uniform conditions due to mechanical stoking, such a record gives a fair indication of the degree of efficiency of the furnace. This record is obtained in many plants by an apparatus for the continuous analysis of flue gases. The use of a draft gauge, attached permanently and showing the draft in the fire chamber, will give an approximate idea of the amount of air consumed. A diminution in draft at this point indicates air holes and an excess of air, while a great increase will indicate too great a thickness of fire and the probable presence of CO in the flue.

It will be noticed that an expert stoker fireman, in running a test, will keep his fire gauge at that point which indicates the proper thickness of fire.

Many reports find their way into print condemning wholesale the use of stokers, and many reports get circulated of expensive installations being placed on the scrap pile. It is just possible that in some of these latter cases the mistake occurred, not in the purchase, but in the discarding without making sure that a correction in some other part of the system would not have removed the difficulty. Misfit installations are fortunately decreasing in number, and there are now millions of horsepower of boilers machine-fired in the United States.

Discussion.

C. H. Parker, Boston: The main point seems to me to be the question of fire temperature. The higher the temperature of the fire the better the fire efficiency. It is shown clearly in all flue-gas analyses that with low fire temperature and a low number of tons of coal burned per square foot of grate surface that you will have a large excess of free oxygen. When your fire is run up to 40 or 45 pounds per square foot of grate, the excess air is brought down to something like 30 to 40 per cent. above the theoretical requirements, and the fire is a dead white. In our practice we find that the heating surface, however, of the boilers as ordinarily installed will not take up the heat as given off by this fire, and that the most economical point to work in is somewhere in the neighborhood of 25 per cent. above the boiler rating. Where it is possible, with an even-load condition, the maximum economy should come by reducing the grate area, working a greater number of pounds per square foot of heating surface, and working the heating surface at about 25 per cent. above the rating.

R. S. Hale, Boston (written discussion): Mr. Yawger's paper is very interesting, but there is one point on which I should like to advance a contrary view, and that is in regard to the saving by increased draft. I have made and analyzed a great many boiler tests, and it is my firm conviction that, other things being equal, the less draft that is used the higher will be the efficiency. If it is a question of getting a greater capacity, of course, a greater draft must be supplied. If it is a question of burning more coal per square foot of surface and getting the same capacity as before, which, of course, means cutting down the grate surface, then, of course, more draft must be supplied, but, other things being equal, the less draft used the better will be the efficiency of evaporation.

The point advanced by Mr. Yawger, in regard to the saving made by increased draft, that the same volume of gas at the same temperature will give up more of its heat when passed rapidly than when passed slowly over the same heating area, is a fallacy in so far as it applies to this question. If the conditions, i. e., the output of steam, are to remain the same, then the amount of coal and amount of gas must be reduced in order to gain any better efficiency and the gas must pass more slowly over the heating surface. If increasing the draft must cause the gas to pass more rapidly, it could have none other than a bad effect.

The reason that the best efficiencies are gained with a small draft is that this makes it necessary to fire more carefully in order to keep up the capac-

[1] Abstracted from a paper read before the National Electric Light Association, at Boston, Mass., May [illegible].

ity, and hence reduces the amount of air used, reducing the loss by the heat of the waste gases and also causing the gases to pass more slowly over the heating surface, giving them more time to give up their heat.

I will repeat that there are, of course, many cases where an improvement in the plant as a whole is made by increasing the draft, but that, other things being equal, the highest efficiency will be gained by the smallest draft.

Economy in Minor Station Supplies.[1]

By Edgar B. Greene.

Under this subject I propose to treat of stations of moderate size, or the small station rather than the large. Stations of moderate size, of necessity, do not have the number of people employed to separate the branches of work into classes, as can be done in the larger stations. Hence it is necessary to educate help to cover wider ranges of work than would be the case with the larger plants.

We have used, with very good results, a course of training that starts the young man as an apprentice, either in the steam side of the plant or in the electrical side, giving him a thorough training through all branches of the work. Instead of the course covering a certain period of years, it covers the time necessary to develop the natural ability in the apprentice, that is, promoting the apprentice as fast as his ability will warrant the promotion, with the distinct understanding that each person must earn the promotion, and must have the ability to warrant promotion, or be required to stand aside for the next man; in other words, that each position in connection with the plant is filled by a person trained through all parts, and at no time is a man brought in from another plant located elsewhere and given a position over the men who have gone through the apprentice course. This plan, we have found, works very successfully, as it creates a feeling of assurance on the part of each employe that so long as he gives his best efforts to produce results he will not be required to stand aside for some other man who has not grown up with the plant. This does not mean that we exclude entirely, and will not bring in, new blood or new material, but it does mean that the new material is from time to time employed on some special parts of the work, but not retained and promoted; used rather to bring out a wider field or range of ideas.

We have had a number of our employes leave our employment after having finshed the course and, having been with us several years, spend two or three years with other concerns, and come back to our employment again. This has a tendency to bring in any good ideas being worked out elsewhere, and we are able to criticise our own methods by the experience thus gained, as well as to get in our employment again a man thoroughly trained in and familiar with our methods of work; and in every instance of this kind we have found very satisfactory results.

We have had a number of our apprentices take a course with the well-known correspondence schools, and we can most heartily recommend this method of education.

With regard to station supplies, one item that we have found to be of value has been to standardize the fittings, valves and nipples of each diameter of pipe used in the plant; as an example, two-inch pipe would have two lengths of nipples, one a standard nipple, and the other a short nipple. A standard two-inch nipple would always be 15 inches long; if it were required to use a very short nipple, the short nipple of two-inch pipe would be four inches long; in three-inch pipe the standard nipple would be 18 inches long, and the short nipple six inches long. By just a little care in laying out the work it is easily arranged to follow out this system; then, when repairs become necessary, any nipple in stock will fit any place needed. The same is true in valves. We standardize by being careful to adopt a make of valve for the several sizes and do not buy anything else. This does not necessitate carrying so many extra parts, and if you have one extra valve for each diameter you have a spare valve that will fit any place.

We have found that, by putting Greenfield tubing inside of the steam hose (used for blowing off the soot in boiler tubes), the life of the steam hose is increased fourfold.

We have a home-made arrangement for bending tubes, such as are used in Stirling boilers, making segments that would be about two inches in thickness, and fitting about half of the circle of the diameter of the tube. These are made of cast iron and are bolted fast to a wide plank. We are able to heat and bend a straight tube to replace any tube that is defective. In the necessary repairs to Stirling boilers we do this by heating the tube in the fire under the boiler, which is kept quiet and clean at the time of heating; that is, the damper is closed on the particular boiler the tube is being heated in, and the fire burned down until it is perfectly clear on the top and has no green coal on.

For repairing the valve stems on engines, the valve stems in gate valves, and the renewal of the pins in engine governors, pumps and like machinery, we use standard cold-rolled steel shafting of the required size, cutting and threading this on the lathe in our little shop; this method makes our repairs to engines and other machinery very simple and requires having the engines out of service but a very short time. For the renewal of the bushings in engine governors we get bronze tubing in standard size; then it is only necessary in most cases to cut a piece off the tubing to make a bushing; we use the same method for the valve motion for pumps and the different kinds of machinery in use, if the holes are not bushed. The first time repairs are necessary we ream these out to a standard size and bush with the above-described method. When next this part comes to be repaired it is a matter of only a few moments to renew the bushing and necessary pin.

It will be noticed that there is a strong disposition to follow up very carefully the details of all parts that have occasioned repairs and make a standard method fitting the several cases, so that in future repairs the work is very much simplified.

In a growing town there is a demand for ashes and cinders, for use in buildings and in building permanent sidewalks. We have found it economical to arrange the ash pile so as to make it convenient for teamsters to load easily, thereby encouraging the carting away of the greatest amount possible of the ashes at no expense to the station. At some periods of the year there is no building of any account going on, therefore, no demand for ashes. We have devised a very economical elevator for loading the ashes then on cars, and they are taken away by the railroad company, free of any additional cost; they use the ashes for repairing sidings.

We find economy in buying strips of hard-rolled copper, three-fourths inch wide, 12 inches long and 0.01 inch in thickness; we solder four of these strips together, making brushes for our arc machines. We find that this makes a very good brush, and they are very economical. For the stiffener we use a phosphor bronze 0.026 inch in thickness of the same width and eight inches long.

We find very good results from an arrangement for draining all of the oil from engines by gravity directly to the oil house, where it goes through the filters automatically without any handling except drawing off the water in the first tank. The filtering system in use is a very simple one; the oil coming from the engines goes directly to the bottom of a tank for the purpose of separating from the oil any water that may be in it; from the top of this tank it goes to the bottom of the second or settling tank; from the top of the settling tank it flows by gravity to the filters, two of which are kept in service. The oil flowing from the second or settling tank constantly and slowly is being filtered as fast as used; from there it goes to an underground tank, and is pumped from this underground tank to an overhead tank for gravity distribution to the engines. The filtering material in use is simply a Turkish towel, supported by fine brass woven wire. This, we find, gives us as good results as any method we have seen, and is very inexpensive, and very easily taken care of. The care necessary is simply shutting the oil during light-load period from one filter, allowing it to drain, then renewing or washing the towel. This room is kept at a temperature of over 95 degrees and is practically underground, and the ventilation is just sufficient to allow such work as is necessary in the room.

We rewind all defective coils for both multiple and series arc lamps, and all field coils for Thomson recording wattmeters, and rewind all transformers.

It will be noticed that by doing the repair work as above described, one man is able to cover a wide field. While the person in this particular branch of work does not necessarily become an expert on each part, yet we find it profitable, taking all of these lines, to keep a man for the necessary repairing as above described, which covers also the machinist's work necessary.

In enclosed-arc lamps, both multiple and series, the inner globes are brought to the station and washed with a revolving brush in a tank of water, rinsed in an adjoining apartment of the tank in clear water, kept approximately at 90 degrees, and dried in racks which support the globes from the inside, keeping each end free. They are then tested on a ground-steel plate for accuracy at the end for the enclosing cap, when they are fitted to their holders and the lower holder trimmed in the station. They are finally put in baskets arranged with a compartment for each inner globe and carried to their destination. We find it profitable to carry at least three days' use of inner globes in the wash room in course of cleaning and drying; that is, globes that are washed on the 10th of the month would not be used prior to the 13th of the month. This allows globes to have 24 hours for drying and keeps two days' supply of globes fitted to the lower holder and supplied with the lower carbon; in any emergency this permits of sending out the second man trimming a circuit at once, instead of first preparing the inner globes before going out. Starting a new man trimming enclosed lamps, handling inner globes with the necessary care and attention, it will be found that the average life of the inner globe would be about 800 lamp-hours for the first month; with careful training the average life on the second month will be found to be between 1,400 and 1,500 hours, and the arc-lamp-hour per carbon will be found to be about 10 per cent. shorter with a new man on the first month than the results which will follow after that period. This method we find gives us very satisfactory results with over 500 lamps in service. It is an exception rather than a rule to be called upon to send a repair man during the evening or night on account of a lamp out; and we find also an increased number of lamp-hours per trim. Carbons and globes are checked each day from the stock room for the day's trim, and rechecked at the end of the month for the number gone out of stock; this gives an accurate account of the total amount, and is sure to include those carbons and globes which have been used in the repair room.

In maintaining the system of poles, wires and fixtures, we use a low wagon, wheels of about 32 and 34 inches high, with a flat top running out over the wheels; this gives a platform or bed (without sideboards) of about 6.5 feet wide and 20 feet long, and with this method two men can load a pole and such necessary tools for transporting to any part of the town.

We have found it very profitable to analyze carefully the orders for repairs, and where we find repairs necessary we aim to follow out the detail as carefully as possible, and where our workmanship is not as it should be, to improve it. Where any line of supplies used, either on the pole line or in the customers' premises, gives trouble sufficient to call attention to, we have found it very satisfactory to quit using such lines of material as give trouble on pole lines, and have the use of such material on inside work discontinued. We have been able in the last 10 years, by carefully following the details, to reduce our repair work about 80 per cent. and give customers very satisfactory service.

In reading meters we find it works well in practice not to use one man, but to use several men from the several different classes of work. We do not send one man on the same route two months in succession, thereby making each man familiar with the locations of the meters on each of the several routes, and in the event of sickness we are never handicapped on account of meter-reading.

[1] A paper read before the National Electric Light Association at Boston, Mass., May 25, 1904.

Cost of Electricity in Columbus.

Superintendent M. S. Hopkins of the Columbus Railway and Light Company recently submitted figures to the City Council of Columbus, Ohio, relating to the cost of production and distribution of electric current during the year 1903, as shown by the records of the Columbus Railway and Light Company. The figures included the price paid by the city for street lighting, and when this contract is taken away the average cost of production and distribution per kilowatt-hour will be materially increased. According to the report, the cost of distribution per kilowatt was 2.7 cents and the cost of manufacture 1.243 cents; 10 per cent. depreciation on the actual amount invested represents 2.734 cents a kilowatt, and interest at five per cent. was 1.57 cents. The total cost of current furnished over the pole lines only, was 7.937 cents a kilowatt, while the average rate received, including street lighting, was 7.27 cents. Mr. Hopkins asked that the price schedule recently fixed by Cincinnati be adopted in Columbus. The Cincinnati ordinance fixes a maximum price of 11 cents a kilowatt, with a minimum charge of $1 per month. It also provides for a system of discounts based on 16-candlepower lamps or their equivalent, ranging from five per cent. on 2,000 or 3,000 watt-hours to 40 per cent. on 9,000 or over. He said the company is now expending $365,000 in remodeling its machinery and extending its service and that in a short time there would be no part of the city without light.

BOOK TABLE.

Ready Reference Tables. By Carl Hering, M. E. New York: John Wiley & Sons. 1903. Pp. (4 by 6¾ inches), 196. Price, $2.50.

This is a book for everyone. In its closely printed pages are tables of almost every kind, from the units of the c. g. s. to those made use of in biblical times. Conversion tables are to be found for the reduction of units and quantities of every description to their equivalents expressed in the terms used in foreign countries. Though of a general nature, the book will be found especially useful to engineers and those doing work of a scientific nature. Students will find it of great value as a time-saver in their work. Not only tables are given but also much data and many definitions of a scientific nature, which may be turned to readily. A new feature has been added to most of the tables in the shape of approximate values carried to two decimal places, which are correct to one per cent., and will oftentimes be found sufficient for practical purposes. Most of the conversion tables have also been compounded, which will save a great deal of calculation. The table of physical quantities, approved by the International Electrical Congress at Chicago, has been added. Accuracy, completeness and convenience for ready reference were the chief aims in the preparation of the tables, and the author seems to have arrived at a remarkably good result. The book is of pocket size and bound in morocco.

Major Black, head of the engineering department of the Panama Canal, expects to leave Panama soon. All the laborers and mechanics applying for work at Culebra have been employed. The work is organized in a style different from that of the French company, and [illegible] maximum amount of work.

Indiana Independent Telephone Convention.

The Indiana Independent telephone convention, which is to be held in Lafayette, Ind., on June 28th and 29th, will have headquarters in the Hotel Lahr. Besides a good programme of papers and discussions, there will be entertainment for all, including a street-car ride, vaudeville performance at Tecumseh Trail summer garden, inspection of Purdue University, a boat ride and a banquet at German National Park. As Lafayette is the home of the Sterling Electric Company, of which W. E. Doolittle is president, that company will furnish the entertainment planned, and in this the company expects to have the hearty co-operation of all telephone manufacturers and supply men, all of whom are assured every courtesy in the display of their wares. A hearty invitation is extended to all and the association suggests that early reservation of rooms be made. Rome C. Stephenson of Rochester is president of the association. The other officers are C. M. Zion, vice-president, and Harry B. Gates, secretary and treasurer.

Telephone News From The Northwest.

The St. Paul City Council has decided that no more telephone or telegraph poles shall be put up in any part of the city.

The Fulda Telephone Company will install a rural system at Dundee, Minn.

The Benson County Telephone Company will install a local circuit at Esmond, N. D.

The Clarkfield (Minn.) Telephone Company has been incorporated with $3,000 capital.

The LeRoy (Minn.) Telephone Company has made arrangements with the Northwestern Telephone Exchange Company for long-distance connection.

The Drayton (N. D.) telephone exchange will build a line to Bowesmont.

Local business men at Fairfax, Minn., have bought the local exchange of the Minnesota Central Telephone Company and will make improvements to the system at once.

The Twin City Telephone Company has been granted a franchise through Litchfield, Minn. Connections will be made with the local company.

The Dassel-Collinwood Telephone Exchange Company has been incorporated, with headquarters at Dassel, Minn. The capital stock is $25,000.

The Merchants' and Farmers' Telephone Company of Shakopee, Minn., has been formed with $10,000 capital stock.

The Burlington (Iowa) and Augusta Telephone Company has changed its name to the Burlington Rural Telephone Company and increased its capital to $25,000. R.

Ohio Telephone Notes.

Probate Judge Nippert of Hamilton County has filed the decree fixing the mode of using the streets in Cincinnati by the Queen City Telephone Company, so that the appeal may be taken to higher courts at once and a decision secured as early as possible. The case will be taken up both upon appeal and error. The city will attack the decree of the Probate Court on the ground that the law authorizing the court to act in such cases is invalid.

The Queen City Telephone Company has made application for a franchise to operate a system in Pleasant Ridge, a suburb of Cincinnati. The application has been referred to a committee for investigation.

The City Council of Middletown has passed an ordinance granting the Home Telephone Company of Dayton a franchise to build and operate a plant in that city. However, it is specified that all lines shall run through conduits within the fire district, and C. H. Bosler, representative of the company, thinks that the erection and installation of a system under those conditions would be too expensive.

The Wellston, Mineral and Athens Telephone Company has increased its capital stock from $2,000 to $10,000.

The United Farmers' Telephone Company of Westminster has notified the secretary of state of an increase from $10,000 to $20,000 in capital stock.

Securities of the Youngstown Telephone Company have been listed on the Cleveland Stock Exchange.

A loan of $150,000 has been made by the United States Telephone Company, to be used for extensions and increasing the capacity of the plant in such a manner that the business offered may be handled.

The Cuyahoga Telephone Company now has 12,000 telephones in use and at least 400 more have been contracted. For the last month contracts at the rate of 200 a week have been made. C.

Indiana Telephone Items.

The following telephone companies were incorporated during the week: The Boone Township Telephone Company of Summitville; capital stock, $1,000. The company will build an exchange in Summitville and extend its lines throughout Madison County. The Farmers' Co-operative Telephone Company of Jay County, with principal office in Portland. The capital stock is $15,000. It is the purpose to do a general long-distance and local business. W. H. Harkins and E. W. Polly are among the incorporators.

The citizens, and especially the business men, of Jasper, Ind., are said to be tired of the double-telephone system in that place, and in consequence there is some speculation as to how the people will relieve themselves of maintaining two telephones.

The Central Union Telephone Company is putting forth an effort to put in a local telephone system at Crawfordsville. The business men generally insist that there is not room for two systems in the city. The rates of the Independent company now occupying the field are fixed by ordinance at $12 for residences and not more than $27 for business telephones. The Central Union has maintained a toll station there for some time.

The Delaware and Madison County Telephone Company contemplates making extensive improvements in the Muncie field. General Manager Bromley announces that he is in the market for a large amount of new material.

The City Council of Evansville has decided to postpone action on the telephone question. A report recommending that the franchise asked for by the Citizens' Telephone Company be referred back to the Board of Public Works until that body had taken some action on the franchise of the Home Telephone Company was unanimously adopted. It is understood that the Citizens' Telephone Company is desirous of giving way to the Home Telephone Company.

The Merchants' Mutual Telephone Company of Michigan City announces that it will reconstruct and improve its local system this summer. The estimated cost of the contemplated improvement is $15,000.

The Home Telephone Company of Elkhart is extending its lines to connect with the exchanges at Pulman's Corners, Union and Bristol.

At a recent meeting of the directors of the Central States Telephone Association at Muncie, the following-named officers were elected: President, F. M. Boyd of Rockville; secretary, A. J. Heitz of Vincennes; treasurer, C. R. Duffin of Terre Haute. This association was organized nearly a year ago by the Independent companies of Indiana and Illinois for the purpose of compiling a rate and route book. The headquarters of the association will remain in Terre Haute. F.

The Telephone in Kansas.

The Greenwood Telephone Company of Eureka has been chartered for $3,000 to build an exchange and rural lines in Greenwood County.

The Missouri and Kansas Telephone Company and the Southwestern Telephone Company have consolidated offices at Harper, Kan., and Enid, Okla. This gives the Bell interests control of all the toll lines in this teritory while the exchanges still are the same.

The Sheridan County Telephone Company of Hoxie has been chartered with $2,000 capital stock. This company proposes to connect up the farmers of Sheridan County with Hoxie.

A charter has been granted to the Barnard Telephone Company of Barnard to build an exchange and rural lines.

The Albano Telephone Company of St. Johns has been chartered for $840 capital to build rural lines.

The Iola Telephone Company of Iola is rebuilding its exchange at a cost of $4,000. All lines will be made copper metallic. Over 2½ miles of cable will be strung.

A charter has been granted to the Mahaska Telephone Association of Mahaska to build rural lines. The capital stock is $3,500.

The Chapman Mutual Telephone Company of Chapman has been organized and chartered with a capital stock of $5,000. K.

New England Telephone News.

Stockholders of the New England Telephone and Telegraph Company will be entitled to subscribe at par for 30,881 shares of new stock, one for every seven held. One-half is to be paid August 6, 1904, and the balance February 16, 1905.

The directors of the Southern New England Telephone Company are preparing to issue $500,000 additional stock, bringing the total up to $4,500,000. The ratio will probably be one share for each eight shares held, and the plan is to issue in July for August delivery. Elaborate improvements and extensions of the service are in progress, and the new stock issue is to defray the expense. B.

EXTENSIONS AND IMPROVEMENTS.

The Winnebago County Telephone Company is extending its lines in Rockford, Ill.

The Southern Bell Telephone and Telegraph Company is seeking a franchise to construct a telephone system in Bluefield, W. Va.

The Central Union Telephone Company is doing considerable toll-line work in the vicinity of Winnebago, Pecatonica and Oregon, Ill.

A. L. Hill, formerly manager of the telephone company at Smithville, Texas, will install a telephone system at Honey Grove, Texas.

About $15,000 will be expended by the Gainsboro Telephone Company of Sparta, Ky., in improvements. One hundred miles of new line will be built.

The Florida Co-operative Telephone and Telegraph Company, Orlando, Fla., will establish a telephone system connecting Jacksonville, Tampa, St. Petersburg and Punta Gorda. John M. Oliver of Atlanta, Ga., is president of the company.

The local telephone exchange at Spirit Lake, Iowa, is being rebuilt by the Western Electric Company. An up-to-date exchange is being installed and will be in operation within 90 days.

It is announced that the Southern Bell Telephone Company will build a long-distance line from Chattanooga, Tenn., to Gadsden, Ala., at a cost of $50,000. The material has been ordered for the building of the new line.

At a recent meeting held by the stockholders of the Eastern Wisconsin Telephone Company at Kiel, Wis., it was decided to build a telephone exchange for the villages of Hilbert and Brillion. The company has franchises at both places. Work will begin by July 1st. The company also decided to build various farmers' lines in the near future.

The International Telephone Manufacturing Company of Chicago reports recent Indiana installations of express boards at Daleville, Summitville, Medford and Frankton. All of the foregoing include complete telephone equipment, consisting of series exchange and four-party-line selective instruments. New express-type switchboards have also been installed at Nappanee for the Nappanee Telephone Company; at Hamlet for the Winchester Telephone Company, Winchester; also a fully equipped 200-capacity addition to the board already installed, together with complete flash-light trunking apparatus for the Home Telephone Company, Crawfordsville, Ind.

NEW COMPANIES.

J. L. Hawks, C. E. Krieg and M. D. Piez are the incorporators of the Duvall Mutual Telephone Company of Shelbyville, Ill. They propose to operate a telephone system in Duvall.

G. W. Isaacs and John Riddle have incorporated the Woodstock (Ga.) Telephone Company with a capital stock of $1,000, to operate a telephone line between Eubank, Pulaski County, and Mt. Vernon, Rockcastle County.

The Schulenburg Telephone Company has been organized at Schulenburg, Texas, with a capital stock of $5,000 for the purpose of establishing at Schulenburg a telephone system. William E. Pertitz is one of the incorporators.

The Standard Telephone and Telegraph Company, with headquarters at Troy, Ala., has been incorporated by Charles Henderson, W. C. Cameron and L. Enzer. The capitalization is $25,000, and it is proposed to operate a telephone and telegraph system.

GENERAL TELEPHONE NEWS.

H. I. Crawford has taken charge of the Wausau (Wis.) Telephone Company's exchange.

C. H. Russell has been promoted to be business manager of the People's Telephone Company at Stewartville, Minn., succeeding B. W. Moore, resigned.

J. T. Quinlan, manager of the Wisconsin Telephone Company, at La Crosse, Wis., has been promoted to a responsible position in the office of the company at Milwaukee. W. S. Smith succeeds him.

The annual meeting of the New York State Independent Telephone Association will be held at the Genesee Hotel, Buffalo, N. Y., on June 23d and 24th. A number of prominent speakers will be present and an interesting programme has been prepared. From present indications, the attendance will be large.

The Union Telephone Company of St. Johns, Mich., will arrange to furnish the subscribers along its rural line with the government weather reports and any other important news of the day. Signals will be rung each morning on all farm lines, and all who desire may get this report. There are about 100 farmers who will be served in this manner.

Through the agency of a direct telephone service Rev. Dr. Russell H. Conwell recently preached to all the patients in the Samaritan Hospital in Philadelphia and at the same time to an audience that filled the auditorium of the Baptist Temple. More than 50 patients, in the various wards of the hospital, with telephone receivers at their ears, heard Dr. Conwell tell his audience in the Temple, nearly two miles away, of the developments in science, art, literature and religion that have been born of sickness. The telephone connection with the hospital will be improved and made permanent.

A telephone war is said to be on in the village of Catskill, N. Y., between the Hudson River Telephone Company and the West Shore Telephone Company, and each company is said to have indulged in obstructing the progress of the other. The Hudson River company in 1884 purchased the wires and poles of the Catskill Telephone Exchange, and for years has enjoyed a monopoly of business there. Two years ago the West Shore Telephone Company secured a franchise to erect poles and string wires in the village of Catskill. Since then rate cutting has been in progress and has led up to an attempt at wire cutting, it is said. Both the managers are taking legal measures to protect their property.

Cord Circuit for New St. Petersburg Exchange.

St. Petersburg, Russia, is soon to have a new and thoroughly up-to-date telephone exchange, the ultimate capacity of which is to be 40,000 subscribers. The exchange will be installed by the Western Electric Company of Chicago and the board will be of the divided-multiple type, which is necessary, of course, in accommodating so large a number of subscribers in a single exchange. It is probable that when the board is first put in the divided-multiple feature will not be made use of, and only when the number of subscribers becomes large enough to warrant it will this method of operation be used. However, everything is to be installed first so as to allow of the divided method being used, and one of the features which is practically new in this system is the circuit which has recently been patented by Edwin H. Smythe of Freeport, Ill., which will be described.

The board will be divided into two sections of 20,000 lines each. Every subscriber's line will have an answering jack in each section of the board, but half the lines will have multiple jacks in one section and half in the other. Heretofore, with an arrangement of this nature, each subscriber's telephone has been provided with two buttons, say, A and B, corresponding to the A and B sections at the exchange. After each number in the directory appears the letter A or B, denoting in which section of the board that particular line is multipled. When calling a certain number the A or B button is pushed, as the case may be, which signals the operator in that section of the board, where the multiple jack of the line called is located. No means of retracting a signal once given were provided, however, and it was found that many times the calling subscriber would push the wrong button, and, having no means of retracting the signal, would be put to the inconvenience of waiting till the operator came in on the line and notified him that the call was made in the wrong section of the board. This caused much delay at the exchange and was not satisfactory to the subscriber. The invention of Mr. Smythe has, however, obviated this difficulty. The general arrangement of the circuits is the same as before, but some changes have been added, which allow of the subscriber, once having given the wrong signal, to put out the lamp at the exchange and call the right section without waiting for the operator to come in on the line.

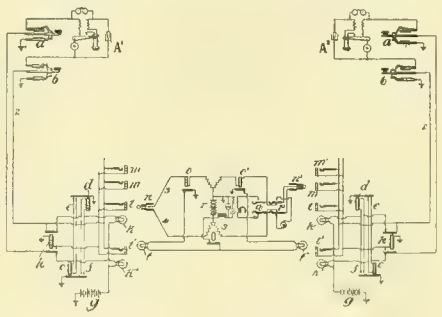
The circuits of two lines to the exchange are shown in the accompanying diagram.

The circuits and apparatus are so arranged that a subscriber having caused the display of his line signal at one division by operating one of his signal keys may, by operating another, efface the signal first displayed and bring about the display of his signal at another division. Replacing the telephone on the hook acts to efface whichever signal is at the time displayed. These results are attained by including a relay in each side of the line which, when actuated in response to the control of its associated key at the sub-station, operates to close a locking circuit for itself controlled by the telephone switch at the sub-station, to light a lamp at one of the switchboards, and to short-circuit or shunt the relay included in the other side of the line.

The telephone station (A′) is provided with the usual apparatus. On depressing either key the limb to which it belongs is closed to ground, opening the line at the sub-station. On being released (the telephone being off the hook) the key completes the circuit before opening the ground connection. The relays (c) and (d) are provided in the circuits of limbs of the line. It will be observed that when either of the relays is operated the corresponding circuit will be closed and grounded by the armature of the relay that is operated.

Assume that the subscriber at station (A′) has by his directory ascertained that the subscriber wanted at station (A^2) belongs to the same division as does his own line, or "division A." Subscriber (A′) will remove his telephone from its hook and depress his key (a), which will operate the line signal (k) at division A. The armature of relay (c) will be attracted and will close the contacts of the circuit (f) to ground. The key (a) having been released and the telephone being removed from the switch, the circuit of limb (1) will be transferred from ground at station (A′), through station (A′) by the telephone switch to limb (2), thence to the central office, and thence to one of the wires of the circuit (f), to the armature of relay (c), and thence to ground—that is to say, the first impulse of the battery (g) will be to ground. Keys (a) and (b) are so constructed that one circuit to ground is completed before the other is broken, in order to prevent any intermission of the flow of current through the line relay which has been actuated. It should be remarked that the resistance of the circuit including individual-line signal (k′), is so great as to prevent the operation of the signal. The line signal (k) at division A, however, is included in a local circuit, formed by the closing of the armature of relay (c). Hence line signal (k) will be disclosed immediately on depressing key (a) and will remain disclosed as long as the telephone at station (A′) is removed from the switch, or until the call is answered by inserting the plug in the answering jack (l), or until key (b) is pressed to display signal (k′). When relay (c) draws up its armature in completing circuit (f), it short-circuits relay (d), so that it is not excited by current flowing in limb (2) of the line. When plug (n) is inserted in response to the disclosure of signal (k), current from battery (r) is directed over wire (4) through relay (h), thus cutting off the signaling apparatus of the line, and the armature of repeating coil (s) is closed, connecting battery with the circuit of supervisory signals (t t′). Lamp (t), however, will not light, since its circuit will be open at the contact of relay (o), the battery circuit being closed through the relay (o) over limb (2), through sub-station (A′) and back over limb (1). Supervisory signal lamp (t′) will, however, be included in a circuit extending from the free pole of the battery (r) through the armature and front contact of the repeating coil and the armature and back contact of relay (o′) to earth. The lamp (t′) will then light. The operator ascertaining that subscriber (A^2) is called for, proceeds to test the line, make the connection, and signal subscriber (A^2) in the usual manner.

Having described the manner of connecting and disconnecting lines of stations (A′) and (A^2) upon division A of the multiple switchboard, let it be now assumed that subscriber (A′) wishes connection



CORD CIRCUIT FOR NEW ST. PETERSBURG EXCHANGE.

with some subscriber of the other division, the one at which his line signal (k′) and answering jack (l′) are placed. Subscriber (A′), having ascertained that the subscriber wanted is of division B, will take down his telephone and depress key (b). Circuit from battery will now be completed through signal (k) and limb (2) to ground at the signal key (b). The resistance of the circuit is so great that signal (k) will not be operated; but the relay (d) will be operated and the circuit (e) closed. The closure of this circuit completes the circuit of signal lamp (k′) directly to earth and illuminates it and closes a short-circuit of relay (c) in the other limb of the line, thus rendering it inert to current returning over limb (1) of the line when key (b) is released. Releasing key (b) completes the locking circuit of relay (d) through both limbs of the line and the switches at sub-station (A′) to earth at the central office by way of conductor (e), controlled in contacts of relay (d). The continued display of signal (k′) after the momentary depression of key (b) is thus effected. If after the signal (k′) has been displayed the subscriber should desire for any reason to withdraw signal (k′) and display signal (k) in its stead, he has merely to press key (a). The depression of key (a) opens the locking circuit of relay (d), permitting the relay to release its armature, upon which relay (c) is actuated to light lamp (k) and short-circuit relay (d), as already described, or, if the subscriber after having caused the display of one of the signals desires to withdraw the call, he may do so by replacing his telephone on its hook, which breaks the locking circuit operating to effect the continued display of the signal.

Stephen Vail, writing from Washington, D. C., to a New York daily paper, makes a lengthy but convincingly worded claim on behalf of his father, the late Alfred Vail, as the constructor of the first practical telegraph instrument.

Automatic Lamp Shade.

Few using electric incandescent lamps have not experienced the awkward and tiresome method of attaching a shade to an incandescent-lamp shade-holder over an office desk or beside an easy chair at home. The General Incandescent Arc Light Company is offering an automatic lamp shade, illustrated herewith, which is light, ornamental and yet durable. The holder attached to the shade is the special feature of the device. It can be instantly put on or removed from any size of electric lamp

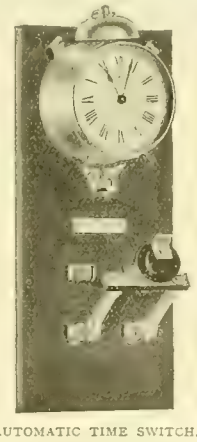
AUTOMATIC LAMP SHADE.

from four to 24-candlepower, without removing the lamp from its socket. It adjusts itself to the lamp automatically, and the maker asserts that it is the only shade with which this can be done.

This shade can be used on an upright lamp equally well, by simply bending the arms up to right angles and adjusting from inside the holder. The quantity of light thrown down by the lamp is increased by using the shade and much time and annoyance are saved in adjustment.

Automatic Time Switch.

Show-window lighting is one of the advertiser's opportunities. It should not be curtailed by losing the evenings after the store is closed. Nor is it convenient to make a special trip to shut off the lights. An automatic switch stops the consumption of the current when it no longer pays to use lights. Without one, lights must burn all night, or be turned out by hand, or else the evening's advertising, which is valuable, must be lost. The accompanying



AUTOMATIC TIME SWITCH.

illustration shows the Security automatic time switch manufactured by the F. Bissell Company of Toledo, Ohio. To set for operation, detach clock, wind both sides and set the alarm on the dial to the time desired to cut off the lights, replace the clock and close the switch. The switch is held by a spring catch connected with the alarm, which releases automatically when alarm rings. The outfits are built for hard service, are neat, compact and fireproof, made for both two and three-wire circuits.

Electric Light Association for Michigan.

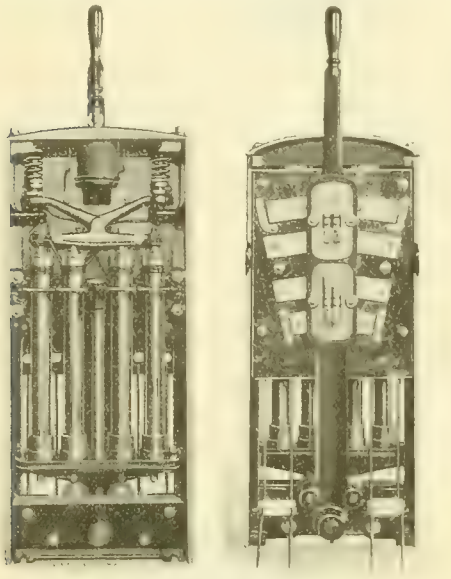
An organization was formed in Detroit, Mich., last week by a number of managers of electric-lighting plants in Michigan cities. The association is to be known as the Michigan Association of Electric Light Managers. E. F. Phillips, assistant manager of the Edison Illuminating Company of Detroit, was elected president and F. S. Hubbell of Milford was chosen secretary. Committees were appointed to perfect plans for a permanent association, and nothing further will be done until these committees have reported. Those present were E. F. Phillips of Detroit, J. B. Foote of Jackson, R. W. Hemphill of Ann Arbor, S. E. Padfield of St. Clair, A. R. McKennon of Cheboygan, F. L. Prindle of Gladwin, A. L. Pond of Coldwater, J. H. Kingsley of Manchester, G. K. Krause of Rockford, F. R. Gallop of Pontiac and F. S. Hubbell of Milford.

New Carbon Controller.

Users of rheostats and other electric-current controlling devices will be interested in the new Allen-Bradley Controller, manufactured by the American Electric Fuse Company of Chicago. This machine is claimed to be absolutely free from sparking, welding or arcing, and to require no repairs or renewals of its parts whatever, except when accidentally injured from external causes.

The Allen-Bradley Controller is a carbon-resistance machine. The resistance medium is a column or pile of carbon buttons or discs placed inside a non-combustible, insulating tube, which in turn is enclosed within an external tube or shield. The resistance of such a column of carbon, made up of a number of discs, resting upon each other with no other pressure than that of their own weight, is naturally very great.

When an electrical connection is made between the top and bottom carbons of the column the flow of current through all of the intervening carbons will meet with a very high resistance, due to imperfect contacts between the several carbon discs. To reduce this resistance a compression lever, operating in connection with springs, is employed to press the carbon discs together, thereby making the contacts between them perfect. This compression is gradually applied, affording a great gradation of the resistance. When



FIGS. 1 AND 2. REAR AND FRONT VIEW OF CARBON RHEOSTAT.

the compression is released from the column of carbon, the carbons, with their own natural elasticity, expand to their normal condition and the resistance of the column of carbon again becomes very great, the contacts between the carbon discs no longer being perfect.

Any desired resistance may be had by increasing the number of tubes or columns employed in the controller. A simple mechanical adjustment of the operating parts equalizes the compression upon all the tubes in the controller, as shown in Fig. 1, a view of the back. Fig. 2 is a front view of the rheostat before starting.

Among the points of merit pointed out by the makers of the Allen-Bradley Controller are the following: It has no steps or contact points, therefore the current is not regulated by jerks, and the controller itself is absolutely free from sparking, welding and arcing. There is no limit to the control of the current flow, and the motor can be driven as fast or as slow as desired with perfect control and infinite gradation of resistance, and without the least danger of injury either to the motor itself or to the controller. Not only are controllers electrically correct in principle, but they are also mechanically strong. They are specially made to stand the hardest usage and work under the most difficult conditions without breaking down.

The compactness of the controller is a point in its favor. Controllers up to 40 horsepower do not exceed 10 inches in width.

A point of special interest to the practical operator of electric cranes is the ease with which the controller is operated. It is fool proof. There is nothing delicate about it, nothing complicated, nothing dangerous to handle. The carbons are protected from injury or destruction through heat by being excluded from the air. The manufacturers state positively that there is no change in their resistance after once having been heated. The controllers are made to operate with any standard motor and are built in all standard sizes.

The Kings County Lighting Company of Brooklyn, N. Y., has been incorporated with capital of $2,000,000 by Ashley T. Cole, Charles T. Larck of Manhattan and others. It is the intention of the company to engage in the gas-lighting and electricity business in Kings and Queens counties.

CORRESPONDENCE.

Great Britain.

London, June 1.—Conflict between private enterprise and municipal authorities has increased in keenness during the last few years, and endeavors to purchase electric-lighting and tramway companies with the object of clearing the ground for municipal trading has not always proved beneficial to the local authorities. A case in point is the Marylebone electric-lighting purchase. A similar case, but not quite of such magnitude, is now in process of settlement by means of arbitration. The town involved is Bournemouth, a fashionable south coast watering place. For some years a tramway company has been carrying on operations on the outskirts of the town, but a bitter feeling has always been entertained toward it by the local authority. Although having an avowed antipathy to electric tramways, the corporation has been forced to construct them simply on account of the forceful tactics of the company, which has made many endeavors to secure powers to do it within the town itself. In 1902 the corporation, in order to get rid of the company once and for all time, came to an agreement to purchase its undertaking at fair market value. The agreement was signed, but when terms came to be considered the corporation very quickly found that it would not be an easy matter. The company had a lease of 35 years from 1899, and consequently had some 30 years to run. In addition the undertaking at the end of the 35 years had to be purchased as a going concern and not upon the much criticised terms of the Tramways Act, viz., at the value then with no allowance for good will or compulsory purchase. Consequently the company has set a high value upon its undertaking, which amounts to $2,250,000, and the Bournemouth taxpayers may not find the attitude taken up by the corporation a profitable one to them.

Complaint is being continually made that electrical legislation is not sufficiently elastic to give private enterprise sufficient encouragement, and distinctions are being frequently drawn between ordinary parliamentary procedure and that under the Light Railways Act so far as tramways are concerned. The latter gives much greater freedom to a tramway promoter, and, as if to emphasize the opinions of the Board of Trade, which is the confirming authority under this act, a new rule has been put into force. This is to the effect that modifications may be made in an application after it has been made. If such a thing were to be suggested in connection with a tramway bill in Parliament it would be deemed a gross breach of procedure.

Loans for electric-lighting and other purposes are not granted to municipalities nowadays by the Local Government Board with that freedom which has existed in the past. Instances of failure to make electric-lighting undertakings profitable in the hands of local authorities have been so numerous that the inspectors sent round to hold the necessary local inquiry, requiring very minute details of the proposals. A few years ago these local inquiries were looked upon as formal affairs, but now this is not so. A few months ago Stowbridge applied for a loan, but the sanction was deferred, as the inspector was not satisfied that a supply could be given cheaper than was offered by a large power company, and for the same reason an inquiry at Wood Green (London) was postponed. This attitude is a desirable one in many respects.

Last Christmas it may be remembered that I referred to a fire that took place at the Bristol electricity works. A report has now been made as to the repairs which are being carried out. The fire destroyed the whole of the high-tension switch gear and did damage to other portions of the plant and buildings. Now a suitable space has been provided for two fireproof switchboard chambers, the apparatus for which has been ordered from Siemens & Bros. Two 750-kilowatt Parsons turbo-alternators have been installed as additional plants, owing to the increasing demands.

At one time it looked as if there would be a big fight in Parliament with regard to the compulsory running powers which were granted to the Tyneside Tramways Company over the Newcastle corporation lines. But at present it looks as if the corporation is disinclined to go to any further expense in the matter, and an effort is being made to come to an amicable arrangement with the company. G.

New York.

New York, June 11.—The latest plans for the improvement of the Manhattan terminal of Brooklyn Bridge present some interesting features. They provide for a temporary extension across Centre Street at an estimated cost of $500,000, and a permanent construction covering a considerable part of five irregular blocks adjacent to the existing terminal. The new terminal building will be 550 by 150 feet, and the total assessed value of the property needed for its construction is placed at $3,094,000. Including the cost of the structure the total amount needed by Commissioner Best for this scheme would be about $8,500,000. Controller Grout on Friday objected to the expenditure of more than $250,000 for the temporary terminal.

The Interborough Rapid Transit Company, the owner of the new subway system in this city, has declared a first dividend of two per cent., although the tunnels will not be open for traffic before September. The money is, of course, derived from the surplus earnings of the Manhattan surface lines, which this year exceeded the statutory limit of seven per cent. The first completed station of the new subway—at Twenty-eighth Street and Fourth Avenue—has been open to free public inspection this week. Most visitors have been loud in praise of the arrangements, though a few have complained that the tunnel traffic promises to be extremely noisy.

During the storm on Tuesday morning lightning struck some of the wires of the Brooklyn Rapid Transit Company, and, burning through some of the feed wires, caused the traffic to be suspended practically all over the borough for three hours.

A temporary breakdown at the Edison Company's power house at Conev Island on Monday evening plunged all the pleasure resorts into darkness for about 25 minutes. At one of the shows the lions were performing at the time when the current was cut off, but the animals were kept under control until lanterns were procured.

Police Commissioner McAdoo refuses to accede to the application to restore the telephones and telegraph apparatus seized by the police in recent raids upon New York poolrooms and has referred the applicants to Corporation Counsel Delaney.

The New York and Long Island Traction Company for the quarter ended March 31st has filed a statement which shows that its gross earnings for that period were $10,152, as compared with $6,669 for the corresponding period in 1903. There was, however, a net deficit of $3,393, the operating expenses having been $13,265.

The Remy Electric Company and the Electric Launch Company are both represented in the membership of the newly organized National Association of Engine and Boat Manufacturers which held its first meeting at the Manhattan Hotel, New York, on Monday evening.

The Automatic Fire Alarm Company has installed alarm boxes at 40-42 Vesey Street and at 26-32 Barclay Street, with the approval of the fire department.

The New York Electrical Society and the officers of the Electrical Testing Laboratories are extending invitations to be present at the visit of the society to the laboratories, Eightieth Street and East End Avenue, New York, on the evening of June 15th. The visitors will be welcomed by John W. Lieb, Jr., president of the laboratories, and addresses will be given by Wilson S. Howell, manager, and Dr. Clayton H. Sharp, test officer. After an inspection of the various departments of the laboratories a collation will be served. D. W. W.

New England.

Boston, June 11.—The Western Massachusetts Street Railway Company incorporation bill, on account of the unusual privileges contained in its provisions, was killed in the House after safely running the Senate gauntlet. There was decided opposition from the newspapers throughout the state, with very few exceptions, and the Massachusetts State Board of Trade entered a strong protest against the bill.

The Haverhill and Boxford Street Railway Company has secured the authority it sought to extend the road into the portion of Haverhill on the north side of the Merrimac River, crossing that stream by means of a new bridge to be constructed.

The Lynn Gas and Electric Light Company has prepared plans for the placing of the wires in that city in underground conduits, and eventually the overhead system, with its poles and supports, will be supplanted by the essentials of a modern electric-lighting system.

The Middleboro, Wareham and Buzzard's Bay Street Railway Company has arranged to obtain power from the New Bedford and Onset Company, and resume operations. It has been tied up for several months, and is under the control of receivers, recently appointed. Superintendent Fred S. Smith last Saturday was notified to begin operating the road at once.

The Hartford Electric Light Company has leased a tract of land on the Connecticut River front and will have a large new power plant at what is known as Dutch Point, superseding the present plant on Pearl Street, which is some distance from the river. Saving in transportation, water supply and other factors in the operation of the plant will be effected. Much of the old plant's outfit will be transferred to the new site. B.

Texas and Mexico.

Austin, Texas, June 9.—The Sherman Gas and Electric Company has been organized at Sherman, Texas, with a capital stock of $200,000 for the purpose of establishing an electric-light and power plant in that city. The incorporators of the company are J. F. Strickland, W. R. Brents and C. N. Roberts of Sherman, R. B. Sticher of Cleburne, Osie Goodwin, M. B. Templeton and J. L. Penn of Waxahachie, Texas.

An effort is being made toward the establishment of an electric power plant on the Colorado River at Columbus, Texas.

The survey for the proposed interurban electric railway between McKinney and Bonham, Texas, by way of Blue Ridge and Denton, has been commenced.

R. Woodson of St. Louis, Mo., and Jesse Shain of McKinney, Texas, are among those interested.

Juan Martinez Negrete has been appointed manager of the street-railway system of Guadalajara, Mexico, and important extensions and improvements are to be made under his direction.

Dr. Carlos Fenelon, Dr. Benjamin W. Wallace and associates, who recently purchased the Barranca del Oro mines situated south of Ixtlan, Mexico, will install an electric power plant and electric tramway at the mines.

The City Council of Puebla, Mexico, has renewed its contract on behalf of the city with the local electric-light and power company for furnishing that city with lights for a period of 25 years.

Governor Luis Terrazas of the state of Chihuahua, Mexico, has granted a concession for the construction and operation of a telephone line from Las Cuevas to Roncesvalles and from Morris to Socorro and other points in the state.

The Mexican government and the City Council of the City of Mexico have extended for a further period of six months the concession held by Jose Sitzenstaller for the construction of a telephone system in the City of Mexico. It is stated that Mr. Sitzenstaller for the construction of a telephone sys which will be a strong competitor of the system of the Mexican Telephone Company, now in operation there. H.

Indiana.

Indianapolis, June 13.—The Tipton, Frankfort and Attica Traction Company has filed amended articles of incorporation which enable the company to sell electricity for light, heat, power and other purposes in the cities and towns along its line.

The last arch on the car sheds of the new station of the Indianapolis Traction and Terminal Company was put in place Saturday. The work of completing one of the finest and most modern buildings of the kind in the country will be pushed with all possible speed. The main part of the station, which fronts on Illinois Street, will be used as waiting rooms, baggage rooms, restaurant, etc., and the seven floors above will be rented for offices. The car sheds, which are to be used by the 10 interurban roads entering the city, will be a great aid and convenience to the travelers. September 1st is the time set to open the new station. At the annual meeting of the stockholders last week the old board of directors and the old officers were re-elected. Hugh J. McGowan was continued as president and was made general manager.

The Indianapolis and Northwestern Traction Company has received five new limited cars, built by the Latona Car Works. The company now has 20 passenger coaches, besides two fast freight and express cars. The Crawfordsville branch will be put in operation in a few days.

The managers of interurban lines, who have thus far held aloof from Sunday excursions and excursion rates, have yielded to the popular demand. The patronage last Sunday was immense, especially to Lafayette and to Spring Lake.

Samuel E. Raugh and J. F. Wild, president and secretary, respectively, of the Home Heating and Lighting Company of Indianapolis, now in the hands of a receiver, have decided upon a reorganization. The officials say the plant cost far more than was expected, and the supplying of hot-water heating from a central station was more experimental than had been supposed. The officers say experience has fully demonstrated that the company cannot continue at the present ordinance rate for heating. The plan of reorganization is on the co-operative basis, calling for a new ordinance which will provide for an earlier and later service and authorizing a charge sufficiently high to sustain the business. F.

Michigan.

Detroit, June 11.—A new electric railway has been projected from Grand Rapids to Gladwin, running through West Branch and Alpena. This road may also run to Standish, paralleling the Michigan Central railroad from that town to West Branch. It is understood that the company will immediately proceed with the building of the road.

The Bay City Board of Trade has been called together to consider giving a new electric line a franchise in that city. The project is to build a road from Bay City to Caro and Bad Axe. No financial assistance is asked.

The name of the Oceana Telephone Company of Hart has been changed to the Lake Shore Telephone Company and its capital has been increased from $50,000 to $200,000. The Wolverine Motor Company of Grand Rapids also filed notice of an increase of capital stock from $50,000 to $100,000.

The employes of the Saginaw Street Railway Company have asked for 20 cents an hour wages; they are now getting 19 cents.

The Detroit United Railway threatens to cut off all transfers on workingmen's tickets, owing to the pressure brought by the Common Council to make them interchangeable on all lines. Assistant General Manager Brooks of the street railway states that the passage of the ordinance would effect such a tremendous change in the trend of traffic that the company would be greatly embarrassed thereby, without any material effect to the public. The street-railway company will be given another hearing before the committee. C. G. W.

Ohio.

Cleveland, June 11.—It is said that the city officials of Cleveland and the officers of the railway company are figuring on plans for a new franchise. Some outside parties have suggested that if a reduction is made, a good plan would be to fix a three-cent fare for each ride and give no transfers.

It is said that a plan is on foot to establish a municipal light plant at Toledo. The city lighting has been done for some time by the Toledo Railways and Light Company. Some years ago Toledo built a natural-gas plant, operated it at a loss and sold it at a low figure.

The Dayton and Muncie Traction Company has completed construction work to within a few miles of Muncie, and it is thought will build into the town by fall. The road is in operation to Greenfield, with a power house at Winchester. Several sub-stations are almost ready for use.

The Incandescent Supply Company of Cincinnati has been incorporated with a capital stock of $10,000. F. L. Dawson and others are interested.

At the annual meeting of the stockholders of the Mansfield Railway, Light and Power Company the number of directors was changed from 11 to five and the following were elected: Leopold Cleybolte, Rudolph Cleybolte and W. D. Breed of Cincinnati, and H. M. Byllesby and A. S. Huey of Chicago. Mr. Byllesby was elected president, Mr. Huey, vice-president, and Mr. Breed, secretary and treasurer.

A rumor is current that the Hirsch-Clouse syndicate has taken the contract for building the Toledo and Indiana line. Instead of cash, it is said, the company will take over that portion of the road that is in operation as far as Wauseon. This syndicate is now building the Toledo, Ann Arbor and Detroit road.

The Springfield and Xenia Railway Company of Springfield has been incorporated by Harrison B. McGraw, J. H. Van Dever, A. T. Hills, G. D. Reed and M. Haas. These men are interested in the legal controversy, in which the Springfield and Xenia Traction Company is now engaged, and this is the first step toward a reorganization, it is believed. However, there are yet a number of details to be worked out before the road can be taken over.

George B. Kerper, president of the Toledo, Bowling Green and Southern electric railway will shortly apply for an independent franchise for an entrance to Toledo. The directors of this company have elected the following-named officers: President, George B. Kerper; vice-president, John Kilgour; secretary, J. A. Bope; assistant secretary and treasurer, A. J. Becht.

The Steubenville and Canton Railway Company of Steubenville has been organized by the election of the following-named officers: President, E. E. Franey, Toronto; vice-president, J. C. Bigger, Steubenville; secretary and treasurer, H. H. Smith, Toronto. Thomas H. Loomis of New York and S. B. Pyle of Richmond will be chief engineer and general manager, respectively. The capital stock is placed at $10,000 for the present.

Harry Williams, a machinist at Akron, has invented an electric clutch that is said to be better than anything yet produced. A company to manufacture the device will be incorporated within a short time. O. M. C.

Southeastern States.

Charlotte, N. C., June 11.—It is said that the Chesapeake and Ohio railroad will investigate the matter of establishing an electric plant at Richmond, Va., for the purpose of supplying light and power for its buildings in Richmond. The road has a successful plant in operation at Newport News, Va.

President Arkwright of the Georgia Railway and Power Company in Atlanta has donated $5,000 for the Grant Park Zoo. The amount is payable $1,000 in cash and a similar amount each year for four years.

The new Jim Crow car law of Mississippi went into effect on June 1st. It provides separate compartments in street cars for negroes.

The Delta Electric Light and Power Company of Delta, Miss., announces that it will immediately begin the work of extending its electric lines to take in all parts of the city. The rails, etc., have already arrived.

The development of the immense waterpower at Bull Sluice Shoals, near Atlanta, Ga., has advanced to the point where the water has been turned into the new electric power dam.

The power plant and adjacent out houses on the estate of Edwin O. Meyer, near the University of Virginia, were burned recently. The loss is $8,000. A gasoline engine exploded, causing the fire.

The town of Batesburg, S. C., has voted a sum not to exceed $20,000 for water and light plants and other public improvements. W. H. Timmerman is on the committee having in hand the issuing of the new bonds.

The Town Council of Newberry, S. C., has in hand the question of investing about $5,000 in improving the city lighting plant.

The Columbia (Tenn.) Water and Light Company will add new equipment for supplying a day current.

The Citizens' Rapid Transit Company has completed all details for building a new trolley line in Richmond, Va., from Brook Avenue to Fulton, and the contracts have been let for the material and work. The new road complete will represent an outlay, it is said, of over $500,000. The new company has been organized by Richmond and northern capitalists and is most substantially backed. L.

Northwestern States.

Minneapolis, June 11.—The Boone (Iowa) council is considering putting in a municipal electric-lighting plant.

Plans have been prepared for a new power house at Thief River Falls, Minn., to cost about $4,000.

The Groton (S. D.) Light, Heat and Power Company has been organized with H. C. Miles as president and J. D. Jones, secretary. The new plant will be put up at once.

J. F. Hill and others have formed an electric-light company at Iowa City, Iowa, and a new plant will be built.

The Cedar Rapids (Iowa) and Marion City Railway Company will make extensive improvements and extensions on its system this summer. A 3,500-kilowatt generator is being installed in the power plant.

The Meyers Construction Company has sublet the contract for the new car barns at Dubuque, Iowa, for the Union Electric Company, to C. Burdt & Sons.

Work has been commenced on the new interurban electric railway to be built from Appleton, Wis., to Seymour.

The reorganization of the Consolidated Lake Superior Company has been completed. Speyer & Co. have been paid what was due them and the property has been turned over to the Canadian Improvement Company.

The general offices of the Twin City Rapid Transit Company have been moved into the new office and power building at Hennepin Avenue and Eleventh Street, Minneapolis. The work of transferring the machinery into the new building is also under way R.

Dominion of Canada.

Winnipeg, Man., June 10.—The Earnest S. Harrison Company of Winnipeg has been awarded the contract for the electrical work on the new Union Bank Building, which is the largest contract of the kind ever given in Winnipeg. This company also has the contract for the installation of an electric-light plant at Moosejaw.

Several extensions are about to be made to the telegraph and telephone lines in the region of Edmonton, N. W. T. The most important of the new lines to be constructed is the telegraph line to Athabasca Landing. The line will follow the present trail and will be about 108 miles in length. Another extension of the government system will be a short line from Andrew, the nearest point on the present line, to Victoria. From Edmonton a telephone line will be run west along the base line to the Indian agency at Stony Plain, a distance of about 14 miles.

An order in the council of Dawson City, Yukon, has been passed granting free right-of-way to the White Pass railway, for building a telephone line from White Horse to Dawson. The Dominion government reserves the right to use this line free of charge for official business.

William Sinclair has been awarded the contract for the construction of the subway under the Canadian Pacific railway on Portage Avenue, Winnipeg, Man., for the Winnipeg Street Railway Company. Through cars for St. Charles will probably be running on July 1st. H.

Ottawa, Ont., June 10.—The City Council of Ottawa has decided to give the Ottawa Electric Company a 10-year contract for lighting the city streets at the rate of $52 per lamp per year. This sets aside the idea of establishing a municipal lighting plant.

The Canadian Pacific Telegraph Company has secured direct connection from the Montreal office with the new cable just completed between the United States and Germany.

The City Council of Kingston, Ont., is applying to the courts for leave to pay $170,000, the price awarded by the arbitrators, in the taking over of the plant of the Kingston Heat, Light and Power Company. The company and debenture holders are opposing the application.

The special committee appointed by the City Council has resolved to recommend that a municipal telephone system be established in Brantford, Ont. The idea most favored is to have some company establish a plant and the city take it over and operate it.

The principal conditions of the newly drafted telephone agreement in Toronto provides for a franchise for five years, the city to have the right then to renew, purchase or appropriate by arbitration, and the company to have no claim for loss of franchise. The service is to be underground except where otherwise allowed by the city engineer.

At a meeting of the City Council of Peterboro, Ont., held a few days ago, a franchise was granted to the Canadian Machine Telephone Company of Toronto, of which F. D. McKay is general manager, to erect poles and string wires necessary for the operation of the system. The rate for business tele-

Pacific Slope.

San Francisco, June 10.—Dealers in electrical supplies in San Francisco state that business is very dull at present, especially in the line of heavy transactions. The out-of-town trade is fairly good, especially in fan motors, the warm season having set in. One large house having branches in both Seattle and Los Angeles, states that the latter place is sending in the most satisfactory orders at present, due to the great amount of electric-railway work now being carried on.

Frank O. Woodward, who has for a number of years been the engineer of the Mt. Whitney Power Company, at the sub-station at Tulare, Cal., has been promoted to a position in the new main power house on the Kaweah River. Ray Holmes takes his place in the sub-station.

Sealed proposals are invited by the committee of electricity in San Francisco for furnishing battery material, hardware, chemicals, electric fittings, tools, miscellaneous articles, conduits, insulators, pins, cross-arms, poles, braces, etc., for the coming fiscal year.

The Central California Electric Company has been incorporated at Stockton, Cal., with a capital stock of $500,000. It is the intention of the company to operate solely in Tuolumne County, as the field is sufficiently large there to use up all the power that the company can generate, a large amount having already been contracted for by various mining companies.

The Co-operative Light and Power Company, which asked for a franchise recently in Santa Cruz, will be ready to turn on its power on May 28th.

In 10 days Bay City, Cal., will have communication by electric trolley with Los Angeles, Cal., and in the course of about two weeks the cars of the Huntington railway system will be operated to and from Anaheim Landing. By July 15th, according to General Manager Schlindler, these same cars will be running to Newport Beach, a distance of 38 miles. When the Pacific electric railway is in operation to and from Anaheim Landing the company will be running cars a greater distance than those of any other electric line in California or the Pacific Coast.

The Southern Electrical Company has been incorporated at San Diego, Cal., with a capital stock of $10,000, by S. A. Wright, J. B. Osborn and others.

Many of the residents of Green Valley, near Santa Rosa, Cal., have decided to join with the Santa Rosa and Mark West Telephone Company for the construction of a telephone line to connect both places. Manager N. L. Jones states that other sections of the valley are considering the matter of constructing rural telephone lines to connect with Santa Rosa. A.

PERSONAL.

Clarence Mackay of the Atlantic cable system, and Mrs. Mackay, left New York for Europe on the Deutschland on June 2d.

Charles R. Guertler of the Engineering Company of America is making an examination of the route for the proposed Roanoke and Mt. Airy electric railroad.

E. B. Ellicott, chief electrical and mechanical engineer of the Louisiana Purchase Exposition, will address the Electrical Section of the Western Society of Engineers on Friday evening, June 24th, upon "Some Electrical Features of the Exposition."

A. D. Bowen, assistant to the president of the Petaluma and Santa Rosa (Cal.) Electric Railway Company, has resigned to attend to other business interests demanding his attention. He will be succeeded by E. L. V. Naillen, engineer of the new road.

George F. McCulloch, president and general manager of the Indiana Union Traction Company, has resigned the position, to give his attention to his newspapers. This announcement caused considerable surprise at Anderson, Ind., where the general offices of the company are situated. A meeting of the board of directors was held in Philadelphia on June 10th, but no successor to Mr. McCulloch was selected.

John V. Clark, a prominent civil engineer of New York, died on June 9th at the age of 45 years. Mr. Clark was especially interested in the construction of waterworks systems throughout the United States. He was one of the organizers of the Le Valley Vitæ Carbon Brush Company of New York city, and he was also interested to some extent in railroads. Of late years Mr. Clark had resided at White Plains, N. Y.

President Samuel Insull of the Chicago Edison Company has returned from Europe and began his official duties by attending the stockholders' meeting at the company's general office, on June 13th. All the directors were re-elected and Henry A. Blair was chosen a director to succeed the late Jesse Spalding. The directors will meet in the near future, when officers will be elected and other matters will be discussed.

Harry H. Hornsby, chief electrical inspector of the city of Chicago, is about to give up his work for the city to accept a position as sales representative of the Sprague Electric Company of New York city. Mr. Hornsby has had a position open for him with the Sprague company for some time. His position as inspector will be filled by the civil-service commission, which will conduct an examination on July 26th. The salary is $1,800 a year.

E. A. Graham of St. Joseph, Mich., died at his home on June 3d, at the age of 64 years. Mr. Graham was one of the owners of the St. Joseph and Benton Harbor (Mich.) Street Railway Company. He was also one of the organizers of the Graham & Morton Transportation Company, which operates boats on the Great Lakes.

ELECTRIC LIGHTING.

A franchise has been granted for an electric-light plant in Osborne, Kan.

The Matthews City (Texas) Lighting Company has been incorporated with a capital of $20,000.

The Electric Light and Ice Company has been incorporated at Leonard, Texas, with $15,000 capital.

The Hopkinsville Gas and Lighting Company of Hopkinsville, Ky., will rebuild its electric-light plant, recently destroyed at a loss of $30,000.

The Colfax (Iowa) electric-light plant has been disposed of at sheriff's sale for $4,300. Mr. McElroy of the Bank of Colfax was the purchaser.

W. B. Moore of Yorkville, S. C., is preparing plans for an electric-light plant and system of waterworks to be constructed at Fort Mill, S. C.

Bonds to the amount of $45,000 have been voted by the city of Carrollton, Ga., for establishing the proposed electric-light plant and waterworks.

The question of issuing $45,000 worth of municipal bonds by the city of Carrollton, Ga., for waterworks, sewerage and electric lights was approved by the voters.

The city of Jacksonville, Fla., has awarded the contract for furnishing a 500-kilowatt turbine generator for the electric-light plant, the price being $20,200.

During a storm a few nights ago fire broke out in the electric-light plant at Pauls Valley, I. T., almost totally destroying the plant. The loss is covered by insurance.

An ordinance is to be introduced in the council of Kissimee, Fla., in regard to bonding the town in the sum of $17,000, $7,000 of which is for enlarging the capacity of the electric-light plant.

ELECTRIC RAILWAYS.

The Buffalo and Williamsville (N. Y.) Electric Railroad Company has been authorized to extend its line from Williamsville to Rochester and to increase its capital stock from $75,000 to $3,500,000.

The daily average of passengers on the main line of the Chicago and Oak Park elevated in May was 41,379, a decrease of 1,187 as compared with 1903. Including transfers, the daily average was 42,833, a decrease of 1,183.

J. J. Freundlich of Paducah, Ky., states that arrangements are about complete for constructing the proposed road of the Kentucky and Ohio River Electric Railway Company, recently incorporated at Paducah. The line is to be built from Paducah to East Cairo, Ky., thence possibly across the river to Cairo, Ill., and is expected to connect many towns and villages with Paducah by trolley line. It is capitalized for half a million dollars, and the survey was made a year or two ago.

The Seattle (Wash.) Electric Company is said to have been robbed of hundreds of dollars during the last two months by certain employes who conceived a plan to steal car tickets that had been used from the headquarters of the railway, and use them again as substitutes for cash fares. Tickets are rung up on the indicators in street cars the same as cash fares and only those conductors whose punches made large holes in tickets were in the scheme, and they took only tickets with small holes from the box. The new holes were punched over the old ones, making detection almost impossible.

The Ottawa (Ont.) Electric Railway Company has a bill before the private bills committee of the House of Commons asking for power to increase its capital stock from $1,000,000 to $1,500,000 and also to permit the company buying up stock in other electric companies. There are two electric-light companies doing business in Ottawa, the Ottawa Electric Street Railway and Electric Company and the Consumers' Company, and the citizens are somewhat alarmed that the new powers asked for by the Ottawa company means the amalgamation of it with the Consumers' Company. Mayor Ellis of Ottawa and Mayor Lighthall of Westmount opposed the increased power, but were defeated.

A newspaper correspondent at Eldora, Iowa, writes that it has been proved by actual experience that the farm lands by which the interurban-railway lines pass have greatly increased in value in Polk and other Southern Iowa counties. On the line of the Colfax and Mitchellville interurban railway a farm of 200 acres near Altoona was purchased at $85 an acre just before the building of the line. Soon after the road was placed in operation across the farm, 20 acres of it sold at $105 per acre. Other sales were made from the original farm of 200 acres until it has all been disposed of at a profit of over $7,000 to the man who bought it just before the construction of the interurban.

While in Boston last week Charles T. Yerkes of the London underground street-railway conferred with the Boston interests in the company. He said: "The work is progressing very well. We should have the Metropolitan line opened for business by January 1st. Our power house is entirely finished, and the only thing to be done there is to get the machinery in place."

PUBLICATIONS.

The L. B. Allen Company of New York city has issued a little booklet entitled "If You Use Solder," which it will be pleased to mail to those who make application for it. It will explain to them all the good qualities of the Allen soldering compounds and if they use solder it will be valuable to them.

Columbia crystal lamps with metal reflectors and Prismo glass shades, manufactured by the Columbia Incandescent Lamp Company of St. Louis, are brought to the attention of the public through a bulletin just issued. Many tasteful designs are illustrated, especially those with the Prismo glass shades.

A striking wall calendar adorned by a beautiful girl in a handsome bright red decollete gown is being sent out by the Morris Electric Company of Wilmington, Del. It is very artistic and serves well the purpose of attracting attention to the company's things electrical, particularly fiber specialties and fiber wiring cleats.

The Marconigram, a monthly periodical devoted to news items and the advocacy of the Marconi system of space telegraphy, has now completed its first year of publication. The first number of the second volume is much larger than any of its predecessors, and contains quite a number of photographs of the men associated with the Marconi system in the United States and Canada.

The Jeffrey Manufacturing Company of Columbus, Ohio, manufactures an extensive line of electric locomotives for mining work. Gathering locomotives are one of its specialties, and a bulletin has been issued by the company describing this type of apparatus. The bulletin illustrates and describes very thoroughly the "electric mule" and lays down many advantages to be derived by its use.

Information of a practical nature concerning Nernst lamps is contained in a booklet issued by the Nernst Lamp Company entitled the "Value and Utility of the Nernst Lamp to the Central Station." It contains a lot of good information concerning the Nernst lamp and its possibilities that will be of much interest to central-station men. It embodies some suggestions of new applications for the lamp which it would be well for them to consider.

Motors of the round type for individual drive are the subject of the Sprague Electric Company's latest bulletin. The bulletin first takes up the motor itself and describes it in detail, after which numerous applications of it are illustrated. Among the machines upon which it may be used to advantage are die presses, exhaust fans, machinery in printing establishments, hoists, etc. The motor has a single field coil, which surrounds and energizes both pole pieces simultaneously.

"Graphite as a Lubricant," a pamphlet issued by the Joseph Dixon Crucible Company of Jersey City, N. J., contains many facts about graphite as a lubricant well worth knowing. There are several chapters setting forth the principles of friction and lubrication which are good. The pamphlet is well illustrated and the matter it contains is interesting to read. The same company is also sending out a mailing card on "Axle Lubrication" setting forth the good qualities of Dixon's graphite axle grease.

MISCELLANEOUS.

The new steamship Turbinia, which left Tyne recently on her maiden voyage to Canada, has the distinction of being the first turbine merchant vessel to cross the Atlantic and is the pioneer turbine steamer for general traffic. The Turbinia is of 1,000 tons burden and fitted with turbine engines with three propellors, two forward and one reverse.

The first supplement to the tariff of Finland fixes the import duty on all cables and insulated wire for electrochemical purposes, and also on accumulators and galvanic batteries and accessories of batteries at $2.75 per 100 kilograms, net weight. The duty on imported calcium carbide has been fixed at $1.11 per 100 kilograms, while carbons for batteries are dutiable at $2.75 per 100 kilograms, net weight.

The development of electrical energy from waterpower in France is receiving considerable attention. Besides the new water supply from the Lignon and electric power works belonging to the municipality of St. Etienne, which are now being constructed, there is another project being studied as a private enterprise which concerns the distribution of electric power and light, not only to St. Etienne, but to all the principal towns of the Department of the

Loire. M. Mallet, civil engineer at St. Etienne, is the promoter of this scheme, and has great hopes of seeing it realized. Authorization to commence operations has been applied for from the French Chamber, and if the necessary sanction is given the use of electricity will be largely substituted for steam in this part of the country.

TRADE NEWS.

The National Battery Company of Buffalo, N. Y., has been incorporated and will manufacture electrical batteries. The capital is $500,000 and the incorporators are R. L. Coleman, W. H. Miller and W. L. Hodges.

Robert Mc F. Doble of San Francisco, consulting engineer, has become identified with the Abner Doble Company of San Francisco, engineer and manufacturer of tangential waterwheels with needle regulating nozzles.

An electrical construction and supply business will be conducted by C. B. Davis, R. E. Davis and C. E. Whitney, who have been incorporated as the Davis Electric Company of Alton, Ill. The capital of the company is $2,000.

The C. J. Toerring Company of Philadelphia announces the removal of its offices and factory to 2318 Noble Street.

F. J. Kane, J. D. Kane and E. J. Kane of Houston, Texas, have incorporated as the J. D. Kane Company and will manufacture plumbing and electrical supplies at Houston.

The Central Electric Company of Battle Creek, Mich., has been organized and is located at No. 68 East Main Street. The company will carry in stock all kinds of electrical supplies and do contract work. The officers of the new company are: President, Sylvester W. Greusel; secretary, Frank W. Greusel; general manager, W. O. McFadden.

In the Western Electrician of June 4th in the article upon the "Electrical Installation for the New Minnesota State Capitol" it was stated incorrectly that the switches were built by the Electric Engineering Company, whereas they were built by the Electric Machinery Company of Minneapolis. The speed of the Corliss engines is 125 revolutions per minute instead of 175, as stated erroneously in the article.

The Chicago office of the General Incandescent Arc Light Company has been removed from 1218-1219 to 1412-1413 Marquette Building, to secure larger quarters.

The Fowler Telephone Company of Pella, Iowa, is interested in the organization of a new electric company to absorb the telephone and electric-light plants in that city. W. H. Fowler states that the old apparatus will be discarded and that the company is in the market for a new engine, dynamo and auxiliary apparatus.

BUSINESS.

The Central Electric Company, Chicago, announces the fact that it is prepared to furnish D. & W. fuses and blocks, up to 800 amperes in both 250 and 500-volt types. The company is also authority for the statement that the demand for D. & W. material is still increasing and that a customer who tries D. & W. fuses is sure to continue using them.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) June 7, 1904.

761,637. Trolley Guard. Linwood B. Aikens, Rockledge, Fla. Application filed March 24, 1904.

A conical guard is mounted concentrically on the trolley-wheel shaft on each side of the wheel. As the cones rotate they direct the trolley wire on to the wheel.

761,641. Exciting Fluid for Electrical Batteries. George F. Atwood, Wakefield, Mass., assignor to the Primary Power Company, Wakefield, Mass. Application filed October 3, 1903.

The fluid consists of ammonium carbonate 1½ pounds, carbonate of sodium 10 ounces, bisulphate of mercury 10 ounces and sufficient sulphuric acid to make the specific gravity of 30 gallons of water 1.2.

761,642. Exciting Fluid for Electrical Batteries. George F. Atwood, Wakefield, Mass., assignor to the Primary Power Company, Wakefield, Mass. Application filed October 3, 1903.

A composition for use in the cell of electrical batteries in which the positive element is immersed, consists of nitrate of sodium seven pounds, nitric acid 142 pounds, and sufficient sulphuric acid to make the specific gravity of 14 gallons of water 1.2.

761,671. Transmitter Arm. Harry J. Guttman Chicago, Ill. Application filed December 30, 1901.

A combined transmitter arm and casing comprises two longitudinal members and a part forming the cap of the transmitter adapted to be secured to the transmitter casing to hold the members together.

761,675. Electric Cut-out. William J. Hartwig, Detroit, Mich. Application filed February 29, 1904.

A tubular housing of fireproof insulating material contains a fuse holder comprising a split tube of insulating material having heads of insulating substances and a flat fusible strip extending through the housing.

761,694. Electric-railway System. Charles H. Murphy, Scranton, Pa., assignor of two-thirds to David B. Hand and George F. Garrity, Scranton, Pa. Application filed September 1, 1903.

An electromagnetic switch for railway systems includes a casing, fixed and movable switch elements therein, an electromagnet whose armature is provided with supporting rods carrying the movable switch element, guides for the rods, and combined buffers and retracting springs carried by the casing and disposed to be engaged by the armature. (See cut.)

761,698. Telephone Switchboard Apparatus. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed November 24, 1902.

A connection switch is supplied for each line. The local switchboard circuit has two branches, one of the branches including a line signal and means for controlling the branch through the agency of the sub-station telephone switch, and the other branch arranged to be completed by the connection switch. The circuit includes a supervisory signal, and a repeating coil permanently associated with each line, one winding of the coil being included in the line circuit and another winding included in the undivided portion of the local switchboard circuit.

761,743. Electric Switch for High Potentials. Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed September 24, 1903.

A movable switch member carries pivoted contacts. Stationary contacts are also supplied. Both sets of contacts have flat bearing surfaces and extensions inclined thereto, and means for pressing the flat surfaces together when the switch is closed and for bringing the inclined extensions into contact as the switch is being opened.

761,744. Switch Contact. Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed October 14, 1903.

A movable switch member having flat bearing surfaces parallel to the plane of its motion cooperates with a completely self-alining main contact adapted to engage one of the surfaces. A pivoted spring-actuated auxiliary contact engages the other surface.

761,745. Switch for Electric Circuits. Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed December 30, 1903.

Stationary contacts are submerged in an oil tank. A longitudinally reciprocating rod is supported above the tank, a member is submerged in the tank and supported from the rod, and self-alining contacts are secured to the member.

761,748. Circuit-breaker. John R. Anderson, Jr., Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed September 12, 1903.

A trip magnet, a movable trip armature, and a setting device for the armature adapted to vary the pull of the magnet on the armature by equal amounts in accordance with equal angular movements of the setting device, are the essential features of the device.

761,760. Insulator. Cummings C. Chesney, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed August 8, 1903.

Several outwardly extending petticoats are arranged one above another, one of the petticoats having an upper surface formed in a concave curve, and having a maximum diameter approximately half the sum of the maximum diameter of the upper adjacent petticoat and the diameter of the lower adjacent petticoat, measured in the plane of the edge of the first petticoat.

761,776. Circuit-breaker. William J. Lloyd, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed August 19, 1903.

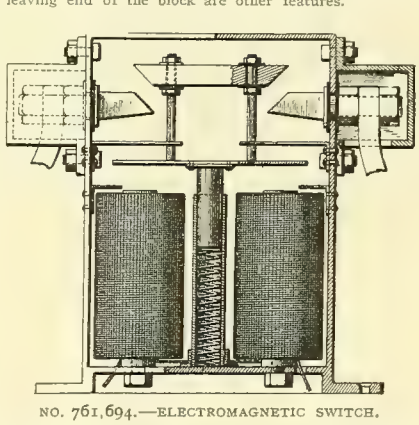
In a circuit-breaker is a solenoid, a balanced armature, a retractile spring for the armature so disposed that the component of spring tension opposing the attraction of the solenoid on the armature diminishes as the armature is attracted by the solenoid, and a switch adapted to be operated by the movement of the armature.

761,814. Combined Insulator and Fuse Box. Aaron Bearse, Syracuse, N. Y. Application filed August 26, 1903.

An insulator base has a removable cap, one of the parts having a recess intervening between the base and cap. A fuse is placed in the recess.

761,848. Trolley Signal. Charles H. Morse, Cambridge, Mass. Application filed June 27, 1901.

A block or section of signal wire has a main danger signal at each end with means operated at either end of the block for setting the main danger signal at the opposite end of the block. An auxiliary signal, also at each end of the block, and automatic means controlled by the signal circuit for setting the auxiliary signal at the leaving end of the block are other features.



NO. 761,694.—ELECTROMAGNETIC SWITCH.

761,852. Apparatus for Telephone Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed August 17, 1895.

A signal bell is located at the sub-station and a secondary source of ringing current is permanently included in the line at the central office. A branch circuit is adapted when completed to form a continuation of the telephonic circuit of the line. A connection switch connects the branch with the line at a point between the secondary source of ringing current and the sub-station.

761,853. Electric-railway Signal. Robert J. Sheehy, New York, N. Y. Application filed September 9, 1902.

A continuous conductor for the car-propelling current is paralleled by a separate sectional conductor. A circuit wire leads from each section to an open terminal alongside the road. A car carrying two contact shoes electrically connected together and bearing upon the respective conductors, is supplied with a signal circuit and means whereby the signal circuit will connect with the open terminals beside the road.

761,875. Overhead Electric Carrier. Charles M. Clark, South Orange, N. J. Application filed November 24, 1902.

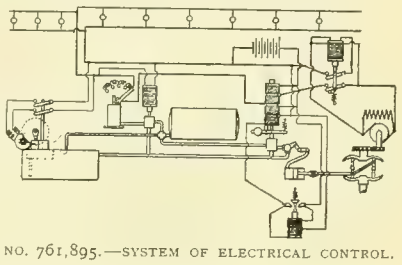
In an overhead electric carrier are combined an electric motor, a dumping bucket, means for reversing the motor and releasing the bucket, and electrical connections whereby the motor may be reversed and the bucket dumped at any predetermined point.

761,876. Means for Reversing Electric Motors. Charles M. Clark, South Orange, N. J. Application filed December 10, 1902.

An electric motor having a reversing switch is provided with means operated by breaking the circuit through the motor for reversing the switch, and means operated by the renewal of the current to place the parts in position to again reverse the motor.

761,877. Insulating Block for Electric Conductors. Charles M. Clark, South Orange, N. J. Application filed July 7, 1903.

An insulating block for conductors having the conducting wires attached to the ends is provided with an auxiliary wire, and means for energizing the wire when the trolley is passing in one direction only.



NO. 761,895.—SYSTEM OF ELECTRICAL CONTROL.

761,888. Telephone Selecting Device. William M. James, New Brighton, Minn. Application filed June 25, 1903.

An electromagnet with means for successively energizing it with current impulses of opposite polarity, is included in the apparatus. A polarized armature lever, a spring attached to the armature for holding its ends equidistant from the pole-faces, means for adjusting the stiffness of the spring and the position of the armature, a pawl carried by an arm of the armature, and a disk adapted to be rotated step by step thereby, are other features.

761,895. System of Electrical Distribution and Control. Lamar Lyndon, New York, N. Y., assignor to the Electric Car Lighting Company, Jersey City, N. J. Original application filed July 18, 1903. Divided and this application filed December 15, 1903.

Means to regulate the electromotive force of a generator include power-transmitting devices arranged for complete disconnection, translating devices in circuit with the generator, an electromagnetic device in circuit with the generator and intermediate mechanism to control the regulating means and the transmitting devices, whereby the electromotive force of the generator may be reduced and the transmitting devices completely disconnected. (See cut.)

761,916. Protective Device for Telephone Circuits. Malcolm C. Rorty, Boston, and George K. Thompson, Newton, Mass., assignors to the American Telephone and Telegraph Company, New York, N. Y. Application filed December 15, 1902.

A non-conducting support contains a rigid terminal attachment mounted thereon, a resilient terminal attachment, also mounted thereon, and a fuse link connecting the attachments, the support and the parts being movable as a whole and being pro[illegible] nection with the terminals of an electrical conductor.

761,917. Telegraph Transmitter. Willis J. Russel, New Orleans, La., assignor of one-eighth to Alphonse King, Chicago, Ill. Application filed February 11, 1903.

Combined with a [illegible] connected with [illegible] heads in the periphery is a contact normally bearing upon the periphery [illegible] the other [illegible]

761,920. Electric Furnace. Charles P. E. Schneider, Le Creusot, France. Application filed October 12, 1903.

A chamber for [illegible] one or more pipes [illegible]

constructed as to permit circulation of molten metal. An iron core encircles the pipe or pipes, with means for producing lines of force in the core.

761,928. Means for Movably Contacting Electrical Conductors. Frederick G. Walker, Cleveland, Ohio, assignor of one-half to Kenneth Reeve Taylor, Cleveland, Ohio. Application filed August 12, 1903.

An electric trolley is described having two trolley wheels set at an angle.

761,971. Apparatus for Generating Electricity. Andrew C. Kloman, Pittsburg, Pa. Application filed September 18, 1903.

The inventor's idea embodies a metallic element, a set of gas-burners, a set of air-jets for each of the portions, pipes conveying gas to the burners and air to the jets, and valves in the pipes so constructed that gas and air may be directed so as to simultaneously heat and cool the different portions, and to reverse the gas and air so as to simultaneously cool the heated portion and heat the cooled portion to generate an electric current.

761,985. Rocker Ring for Electrical Machines. Edson R. Norris, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company. Application filed September 16, 1903.

The ring is divided at one side and has an inclined surface adjacent to the division.

761,987. Railway-track Current Controller. Alfred Oesterreicher, Vienna, Austria-Hungary, assignor of one-half to Lorenz Menelka, Vienna, Austria-Hungary. Application filed May 28, 1903.

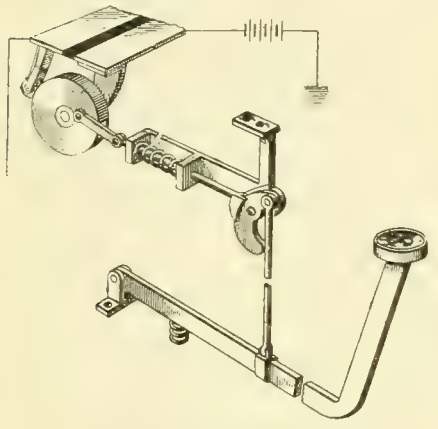
In the device is a track rail, a contact-making or breaking mechanism, a lateral sliding rail arranged beside the track rail and a guide for the last-named rail carried by the track rails.

761,995. Apparatus for Reducing Attenuation of Electrical Waves. Michael I. Pupin, New York, N. Y., assignor to the American Bell Telephone Company, Boston, Mass. Application filed February 6, 1903.

An inductance coil consists of an iron core, forming a closed magnetic circuit and a winding which is distributed over the core uniformly and symmetrically. The core and winding are adjusted in such a way as to give the coil for a predetermined frequency and current strength a predetermined inductance and resistance.

762,009. Automatic Block-signaling System. Herbert B. Taylor, Newark, N. J. Application filed October 14, 1903.

Details are described.



NO. 761,917.—TELEGRAPH TRANSMITTER.

762,030. Incandescent Lamp. Samuel E. Doane, Cleveland, Ohio, assignor to the National Electric Lamp Company, Cleveland, Ohio. Application filed December 12, 1903.

The lead-in wire has a metallic core and a non-oxidizable metallic coating, both ends of the wire being sealed by fusion.

762,034. Electric Switch for Motor Carriages. Henry C. Folger, West Somerville, Mass., assignor to the American Coil Company, Boston, Mass. Application filed December 18, 1903.

The switch comprises a stud having an annular recess, a handle having a notch to enter the recess and embrace the stud, the handle having a path formed about the recess, and a locking device mounted to move in the path across the handle recess to removably lock the handle in place.

762,040. Electrical Contact Means for Ships' Compasses. Bernhard Freese, Delmenhorst, Germany. Application filed February 21, 1903.

The position of the needle is electrically indicated at a distant point through electrical circuits made by a pointer on the needle dipping in various cups of mercury.

762,074. Brush Holder. Emil S. Lueth, Baraboo, and Charles D. Knight, Milwaukee, Wis., assignors to the National Electric Company, Milwaukee, Wis. Application filed March 21, 1904.

Combined with the body of the holder in which the brush is movable endwise and which is formed with semicircular ears, is a pin journaled in the ears concentric with their curved edges. A tension spring is attached at one end to the pin between the ears, a bail-shaped arm engages with the ends of the pin, and a friction grip is eccentrically pivoted between the branches of the arm parallel with the pin.

762,083. Electrical Musical Instrument. Emil A. Petching, Lymansville, R. I. Application filed September 15, 1903.

The device is for scenic effects. Different objects on the stage are supplied each with an electric bell of different tone, which are thrown in circuit by the operator.

762,105. Electric Semaphore Signaling Mechanism. Bruno O. Wagner, Amsterdam, N. Y., assignor to the Magneto Electric Company, Amsterdam, N. Y. Application filed May 12, 1903.

Electromagnets actuate the shaft which operates the semaphore.

762,108. Sign for Street-railway Cars. Hubert Witte, St. Louis, Mo., assignor to the St. Louis Car Company, St. Louis, Mo. Application filed September 14, 1903.

A sign for designating the streets is electrically illuminated.

762,111. Electrically Conductive Coil and Method of Constructing Same. Vincent G. Apple, Dayton, Ohio. Application filed September 21, 1903.

An electrically conductive coil comprices a support, layers of convolutions of a continuous electrical conductor wound thereon, each layer being wound from the end opposite that from which the next preceding layer is wound and a body of insulation covering each layer and gradually decreasing in thickness from the first-wound convolution of the layer to the last-wound convolution thereof.

762,112. Electrically Conductive Coil and Method of Constructing Same. Vincent G. Apple, Dayton, Ohio. Application filed September 21, 1903.

The wires and strip of insulating material are wound simultaneously on the core.

762,114. Regulating Device for Electric Circuits. Malcolm H. Baker, East Liberty, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed June 25, 1902.

A regulator for maintaining constant current in a series alternating-current electric circuit combines a regulating reactance device having a moving part, a device producing a counter force opposing the movement of the part and connected therewith by a lever having a critical angle, and means for throwing a portion of the counter-force-producing device out of action when the limit of adequate regulation due to the critical angle of the lever has been reached.

762,115. Electric Arc Lamp. Malcolm H. Baker, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed December 6, 1902.

A pair of flat electrodes, each having a length greater than its height, two pairs of magnetic fields provided with suitable pole pieces, the whole being supported near the face of a suitable bed plate, are the essential features of the lamp. The pole pieces are located at opposite ends of the electrodes.

762,116. Electric Arc Lamp. Malcolm H. Baker, New York, N. Y., and Samuel P. Wilbur, Wilkinsburg, Pa., assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed December 8, 1902.

A pair of upwardly directed electrodes are so disposed that the arc is spread by the natural air draft and by the local field of the arc. Means for controlling the arc are supplied, consisting of a shunt-field acting in opposition to the local field and the air draft. (See cut.)

762,125. Electrical Temperature Alarm. Joseph P. Bolton, Fresno, Cal. Application filed June 16, 1902.

A temperature alarm comprises a dial thermometer with index hand and a circular non-conducting ring arranged concentrically in front of the dial and bearing a contact spring adapted to be touched by the index hand.

762,141. Electric Machine. Niels A. Christensen, Milwaukee, Wis. Application filed April 8, 1901.

A back-gearing device for electric motors is described.

762,186. Locking Mechanism for Electrically Controlled Elevator Mechanisms. John S. Mucklé, Philadelphia, Pa., assignor to the Standard Elevator Interlock Company, Philadelphia, Pa. Application filed July 23, 1903.

A lever for shifting the controlling mechanism is described.

762,192. Sign Receptacle. Clarence D. Platt, Bridgeport, Conn., assignor to the Bryant Electric Company, Bridgeport, Conn. Application filed January 11, 1904.

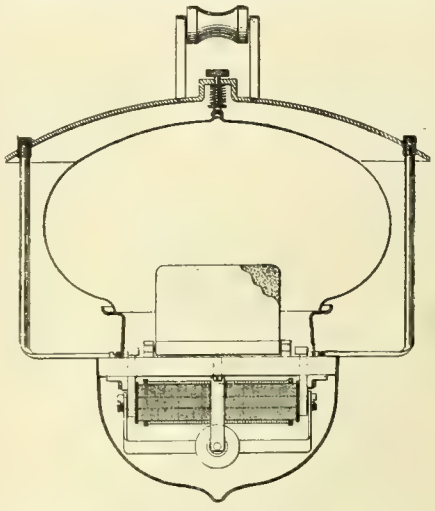
A lamp receptacle for sign work is described.

762,204. Circuit-breaker. Frank L. Sessions, Columbus, Ohio, assignor to the Siemens & Halske Electric Company of America. Application filed June 16, 1902.

In a circuit-breaking device are combined a pair of flat-faced carbon contact plates adapted to overlap and slide off and on to each other, one of these lates being movable with respect to the other and means for supporting the stationary contact plate so that it may be oscillated and will be spring-pressed toward the other contact plate. The means consist of a yielding support at one end of the plate and a pivotal support connected to it at a distance from the yielding support.

762,227. Anode and Process of Making Same. Henry Blackman, New York, N. Y. Original application filed December 8, 1896. Divided and this application filed April 24, 1903.

An electrolytic anode has its interior of iron and the exposed exterior of impermeable magnetic iron oxide integral with the iron, and of thickness and density sufficient to protect the iron from the action of oxidizing agents developed at the anode during electrolysis.



NO. 762,116.—ARC LAMP.

762,234. Process of Felting. Thomas B. Flavell and George W. Dykman, Yonkers, N. Y. Original application filed November 18, 1902. Divided and this application filed October 6, 1903.

The process of felting consists in revolving the material to be felted under pressure and simultaneously passing an electric current through it.

762,257. System of Distribution. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical and Manufacturing Company. Original application filed December 11, 1901. Divided and this application filed August 18, 1903.

Combined with a charging generator is a storage battery and an automatic magnetic circuit-breaker employing two coils, one of which depends for its current upon the battery pressure, the other carrying the line current. The latter cooperates with or opposes the former, depending upon direction of line current. Separable cooperative contacts are provided with means for causing their separation and means for normally restraining the separating means.

REISSUE.

12,228. Storage-battery Electrode. Johannes Von Der Poppenburg, Charlottenburg, Germany. Application filed November 12, 1903. Original No. 701,389, dated June 3, 1902.

An improved storage-battery electrode comprises a non-conducting frame and independently removable cross-pieces of non-conducting material carried by the frame and having perforated portions projecting on each side. Perforated protecting strips, active material interposed between the strips, and removable vertical elastic bars held in the perforations in the cross pieces adapted to press the protecting strips against the active material are further specified.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on June 14, 1904:

364,639. Galvanic Battery. Victor Francken, Liege, and Edouard Bender, Brussels, Belgium.
364,660. Battery Cell. Abraham V. Meserole, New York, N. Y.
364,721. Cutout Block. Edward McEvoy, New York, N. Y.
364,760. Electric Gas Lighter. Charles W. Holtzer, Brooklyn, Mass.
364,764. Electric Burglar Alarm. Geoffrey B. Lehy, Boston, Mass.
364,893. Synchronous Telegraphy. Robert G. Brown, Brooklyn, N. Y.
364,894. Synchronous Telegraphy, Robert G. Brown, Brooklyn, N. Y.
364,940. Low-water Alarm for Steam Boilers. William J. Kassler, Brooklyn, N. Y.
364,994. Terminal or Distributing Box. Frederick E. Degenhardt, Chicago, Ill.
365,018. Electrical Device for Operating Elevator Valves. Charles G. Otis, Brooklyn, N. Y.
365,023. Electric Synchronizing Apparatus for Clocks. Alfred Ramel and William W. Dean, St. Louis, Mo.

SPECIAL MENTION.

For the season of 1904 the Northern Pacific announces a great reduction in rates from Chicago, St. Paul, Duluth and other northwestern points to and through Yellowstone Park. These reductions materially decrease the expense of the park tour. New hotels have been built. Old Faithful Inn, modern in every respect, constructed of logs and boulders, is located near Old Faithful Geyser, and is probably the most unique structure of the kind in the country and bound to become a favorite. A new and stately hotel on the banks of Yellowstone Lake makes this the most reposeful spot in the park. Each of the park hotels now has a capacity for 250 guests, is electric-lighted, steam-heated and has a good orchestra. Season extends from June 1st to September 30th. Route via N. P. R., Livingston and Gardiner. Inquire of any agent of the N. P. R. or write to A. M. Cleland, general passenger agent, St. Paul, Minn., for particulars, and send six cents for "Wonderland 1904."

A good many of the electric roads are using a cedar tie a little smaller than that specified by the steam roads, but one that has given universal satisfaction, wherever the traffic warranted such a tie. When the railway manager can get a tie with a well-established record of 13 to 18 years' service in the track, he is certainly going to look the matter up before investing in the less-durable timbers. The Maltby Lumber Company of Bay City, Mich., states that it carries such a tie in stock the year round, in connection with its pole yards, and can quote delivered prices for immediate shipment, in any quantity desired.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXIV. CHICAGO, JUNE 25, 1904 No. 26

The Illumination of the Main Picture of the St. Louis Exposition.

The first publication outlining the plan and scope of the Louisiana Purchase Exposition—a bulletin issued in September, 1901—contained this statement: "The progressive policy of the exposition will be most especially manifest in the manner and extent of its use of artificial light, both for purposes of illuminating and as a means of decoration. Electric lighting in the latest, most striking and most effective form, as well as all other new and efficient modes of illuminating, will be liberally employed, that the exposition grounds and buildings may blaze with light at night, and their beauties successfully rival the attractions of daylight."

The appointment of Mr. Henry Rustin to the position of chief electrical and mechanical engineer, in which position he had direct charge of all lighting and power, was the first move in the fulfillment of the promise made to excel in night effects all previous efforts, as Mr. Rustin's work with Mr. Stieringer at Buffalo, where the means at hand were limited, had marked him as the one man capable of carrying out all that the promise of the exposition management implied; and the masterly manner in which he has brought about the beautiful results that attract thousands nightly shows the wisdom of the selection.

The problem as it was first propounded was not at easy one by any means. No sooner had the location of the exposition grounds been fixed upon than the general scheme of its building was determined. It was, of course, natural to bring the entire architectural effect to a focus at some point, and the natural elevation in the heart of the tract early gave rise to the idea of placing thereon a hall of music surmounted by a great dome, flanking the building on the right and left with a colonnade. From this focal point the main avenues would radiate, and upon these would be located the great exhibit palaces, the state and government buildings being located to the south and west, respectively. While many changes and modifications have been made in the preliminary plans, the general idea has remained unaltered, and, if anything, efforts have been made further to accentuate the crowning feature—Festival Hall, the Cascades and the Terrace of States.

While, to a certain extent, an exposition can be composed of many buildings, conceived and designed by as many architects, the whole being harmonious, yet when it comes to the illumination of these buildings, the separate treatment of each by its designer would probably result in each structure being at variance with its neighbor, and the effect would be bizarre in the extreme.

Given, then, a group of 12 great buildings, disposed over a tract of 600 acres, designed by as many minds, the problem of bringing about an illumination, the physical conditions of which are standard, which shall enter into the spirit of each and every structure, is one which demands more than ordinary skill, both as an engineer and an artist. One of the first matters that came up for discussion was the quality and unit of light. The great adaptability of the incandescent electric light for such purposes practically determined the first question, but the latter claimed the attention of Mr. Rustin and his engineers for some time. A large number of tests was made both in the laboratory and upon the partially finished buildings, and these, coupled with the experience of past expositions, resulted in the adoption of the eight-candlepower lamp, placed on 15-inch centers. With the exception of the dome of Festival Hall and the small lamp posts bordering on the lagoons, this standard has been adhered to.

Mr. Rustin's one idea, above all others, was that the structures themselves should partake of the incandescence of the lamps to such an extent that the impression would be that of a building constructed of light-emitting materials rather than a building treated with points of light. In carrying out this idea another step was made in the line of progress that has marked exposition lighting, as an examination of photographs of the expositions at Chicago, Atlanta, Omaha, Paris, Buffalo and Charleston, and finally at St. Louis shows clearly the trend in this direction. The attempts at group lighting in the earlier expositions show in the blurs of light and intervening dark areas, while the greatly improved condition of diffused and uniform illumination obtains at St. Louis.

Then, too, the introduction of colored lights in considerable number was planned and an elaborate color scheme, which has not as yet been shown in its completeness, was designed for that portion of the picture known as Art Hill, comprising the Cascades, Festival Hall and the Terrace of the States. In this conception three colors were chosen—emerald, amethyst and yellow—and the successive effects of these rather than their combination were planned. The use of colored lights was, however, limited to the area mentioned, and these were to be further supplemented with a most spectacular effect, produced by placing mercury-vapor tubes beneath the cascade spills, the peculiar phosphorescence of this light being thereby imparted to the water. Unfortunately this scheme had to be abandoned, but in its place an effect almost as striking is produced by placing emerald incandescent lamps under the spills, the water retaining this tinge during its plunge of nearly 100 feet. It is an interesting fact that all of the photographs of the exposition lighting shown in this issue of the Western Electrician were taken with this green light beneath the water, the actinic effect being fully as great as that produced by the ordinary incandescent lamps. The early idea of placing colored fountains in the cascade structure was abandoned, as it was found to detract from the simple magnificence of the

The nightly illumi[illegible] ing the gate receipts, as thousands of admissions are recorded after six

Palace of Varied Industries.
Palace of Electricity from Festival Hall.

View From Plaza of St. Louis with Louisiana Purchase Monument in Foreground.
Festival Hall, Cascades and Fountains.

VIEWS SHOWING THE ILLUMINATION AT THE LOUISIANA PURCHASE EXPOSITION.

before eight o'clock great crowds gather on the Grand Basin, and the launches swarming the basin are filled to overflowing. With the sun half an hour below the horizon and just as the bells in the tower of the German Building ring out the hour, the filaments in the thousands of lamps slowly come to a red heat, producing just the suggestion of light, and so gradually that the change is not perceptible, the pressure is raised until the buildings stand out as fairy palaces, while a torrent of water dashes down the ever-widening cascades. Four great fountains throw water high in the air, and in and out between them dart electric launches, grotesquely fashioned to represent swans and sea serpents.

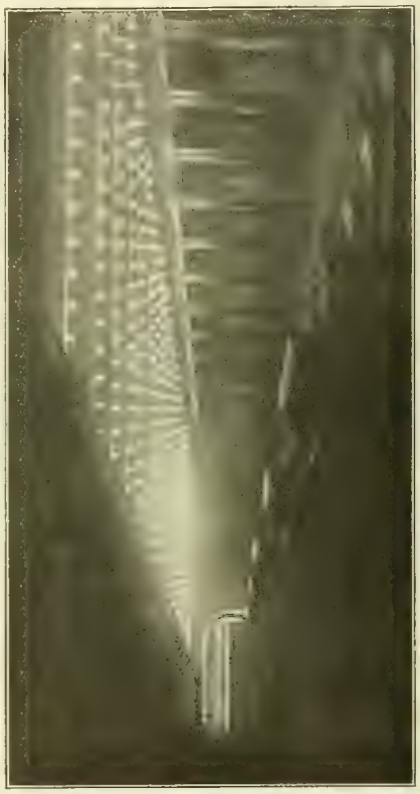
The treatment of Festival Hall, while simple in the extreme, carries with it a conviction of size and splendor. The columns supporting the dome are brilliantly lighted, while the circular cornice is heavily marked. On the ribs of the dome the lights have been placed six inches apart, while at the top several rings are formed of bulbs placed as close together as possible. The circular windows under the cornice enclose great stars of light, and here again the standard spacing has been discarded.

The colonnade extending to the right and left will enter into the color scheme already outlined, triple sockets having been placed on the rear of all columns. These are wired on a balanced three-phase system, one common neutral being used. Each of these three-phase systems is under rheostatic control of the color operator.

The most brilliantly lighted and the most universally admired of the exhibit buildings is the Palace of Electricity, which alone requires 20,000 lamps. The successive cornice and roof lines are marked with innumerable lights, the arrangement of the corner towers and middle entrances doing away with the straight-line effect more noticeable in the other buildings. The ornate ridge lines adapt themselves admirably to a somewhat irregular placing of the lights that produces a bewildering effect when viewed from a distance. The colonnade of this building is treated like those of the other buildings, the lights being placed in vertical lines on the rear of the columns. This causes the light to be reflected from the screen immediately behind the columns and produces an effect just the opposite from that obtained in the daytime, when the columns stand out white against a dark background. An idea of the arrangement of these lights is given in the view looking down the corridor of the Varied Industries Building. Just across the Grand Basin is the Education Building, and its simple treatment is in contrast with the building just described. Here the stately colonnade, plain corners and straight cornice line are treated in a manner that suggests alternate vertical lines of light and shade, supporting a broad band of light, the corners and side entrances being accentuated to relieve the monotony.

The Varied Industries Building is another example of the possibilities of exterior illumination and combines the scheme of reflected light as applied to its colonnade, 1,000 feet long, with the direct illumination marking the cornice and roof lines and flagpoles. The beautiful flying colonnade marking the main entrance is set off by a dome, rising above and behind, supplementary lights being placed to bring into strong relief the heavy statuary placed on top of the colonnade.

The Transportation Building has been well handled considering its very unpromising lines, the great arches and towers at either end being about the only redeeming features. Just south is Machinery Hall, and here opportunity is afforded to bring out the highest towers on the grounds. The architecture is well preserved and much of the fine detail of ornamentation is brought out. The Manufactures Building is characterized by a succession of arches and a somewhat broken scheme of cornice lighting, the most prominent feature being the great arch over the south main entrance. The very ornate character of the Liberal Arts Building permits of a corresponding elaborate treatment, and the result is quite a departure from the right-line effect of Machinery Hall. The Mines and Metallurgy Building, which, architecturally, is quite at variance with ordinary exposition types, is skilfully handled, and the daytime impression retained, and, if anything, enhanced. Many of the outlying buildings are elaborately illuminated, while on the Pike over a thousand



Showing Arrangement of Lights on Inside of Columns.

CORRIDOR PERSPECTIVE IN VARIED INDUSTRIES BUILDING, ST. LOUIS, AT NIGHT.

horsepower is required to handle the lighting load alone. The Ferris wheel is being wired, and this, with the 300-foot De Forest tower at the other end of the grounds flank over a mile of brilliantly illuminated structures.

The details of the generating plant have already appeared in the columns of the Western Electrician, and but a few words of interest can be added. All of the lighting load is carried by the Allis-Chalmers-Bullock unit and the generators of the Westinghouse power plant. These deliver current at 6,600 volts, which is carried through the underground conduit and duct system to the sub-stations in the exhibit palaces and at other distributing centers. At these points step-down transformers lower the pressure to 110 volts, when it is ready for distribution. Each building is divided, at the sub-station switchboard, into four sections, and these are still further divided at the distributing centers, where the circuits are fused in large wooden cabinets, lined with asbestos. The feeders are supported on cleats and the smaller wires are run on knobs. A comparatively small number of lamps are placed on each circuit in order that an accident to a section may show as little as possible. The wiring, while of the cheapest class, has been very carefully done and inspected, and after nearly two months of service no accidents have occurred.

Great credit is due to Mr. E. B. Ellicott, Mr. Rustin's successor for the physical condition of the

[illegible] AT ST. LOUIS EXPOSITION

NIGHT VIEW OF HEAD OF MAIN CASCADE, ST. LOUIS EXPOSITION.

electrical work, as nearly all of the actual installation of boilers, engines, generators, cables, wires and lamps was done under his direction, and the supervision of Messrs. Moore and Dixon, electrical engineers, and Mr. Smith, mechanical engineer. The fact that the entire illumination was in a practically completed state on opening day is also a testimony of high engineering and executive skill on the part of this department, as difficulties almost insurmountable were encountered at almost every step. The total power-house capacity is nearly 50,000 horsepower, of which 10,000 is required for the illumination load.

Indianapolis Meeting of Railway Telegraph Superintendents.

The twenty-third annual convention of the Association of Railway Telegraph Superintendents was held in Indianapolis on June 15th and 16th, and was well attended. The sessions were held in the convention hall of the English Hotel, and a more convenient and admirable arrangement could not have been made. The local committee had made very complete arrangements for the entertainment of the members and provided social entertainments and excursions for the visitors and their wives.

The object of the association is the improvement of the telegraph service and the promotion and advancement in general of the interest of the telegraph departments of railroads. There are three classes of members—active, associate and honorary. Active membership requires one to be connected in an official capacity with the telegraph, telephone, electric-light, electric power or electric department of any railroad. An associate membership requires connection with a telegraph or telephone supply house or publication. Honorary members are chosen from those prominent in railway-telegraph or telephone circles, and who have, by furnishing papers and otherwise, contributed to the success of the association. The annual conventions are calculated to bring the telegraph departments of railways into closer relationship, in order that uniform action may be secured on methods of handling railroad traffic that would otherwise be impossible.

The following-named railway-telegraph superintendents attended the Indianapolis convention: L. B. Foley, New York city; C. S. Rhoads, Indianapolis, Ind.; W. J. Camp, Montreal, Canada; T. H. Van Etter, Danville, Ill.; J. S. Stevens, Richmond, Va.; R. L. Logan, Kansas City, Mo.; E. Parsons, Chicago; V. T. Kissinger, Lincoln, Neb.; Charles Shelden, Baltimore, Md.; W. P. Cline, Wilmington, N. C.; George W. Weidman, Detroit, Mich.; W. W. Ashald, Montreal, Canada; G. C. Kinsman, Decatur, Ill.; E. A. Cheney, St. Louis, Mo.; F. S. Spoford, Chicago; John M. Dugan, Chicago; I. N. Miller, Cincinnati, Ohio; F. B. Hubbard, Tacoma, Wash.; H. F. Houghton, Indianapolis, Ind.; D. R. Davis, Chicago; E. P. Griffith, New York city; E. E. McClintock, Denver, Colo.; H. C. Sprague, Springfield, Mo.; J. W. Jacoby, South Bethlehem, Pa.; W. T. Williams, Portsmouth, Va.; H. C. Hope, St. Paul, Minn.; E. E. Torry, Jackson, Tenn.; U. J. Fry, Milwaukee, Wis.; W. A. Freer, Bloomington, Ill.; P. W. Drew, Milwaukee, Wis.; E. H. Willington, Detroit, Mich.; F. G. Sherman, Jersey City, N. J.; W. W. Ryder, Chicago; G. L. Lang, Chattanooga, Tenn.

Others in attendance were the following-named: J. E. Gordon, New York and New Jersey Telephone Company, Newark, N. J.; C. A. Randall, Adams-Randall Telephone Company, New York city; Eugene W. Vogel, Railroad Supply Company, Chicago, Ill.; A. P. Eckert, Safety Insulated Wire and Cable

Company, New York city; M. J. O'Leary, New York city; B. S. Keaser, American Telephone and Telegraph Company, New York city; B. F. Thompson, Baltimore, Md.; P. M. Miller, American Telephone and Telegraph Company, New York city; C. T. Hendrickson, Cincinnati, Ohio; Professor C. E. Freeman, Armour Institute, Chicago; G. M. Dodge, Dodge Institute of Telegraphy, Valparaiso, Ind.; E. E. Stacey, Indianapolis, Ind.; William J. Maiden, Central Union Telephone Company, Indianapolis; J. B. Taltavall, Telegraph Age, New York city; William Maver, Jr., New York city; M. J. Hedgeton, New York city; Frank F. Fowle, American Telephone and Telegraph Company, New York city; Moses R. Fill, American Telephone and Telegraph Company, New York city; W. D. Atwater, Central Union Telephone Company, Indianapolis; A. G. Francis, Chicago Telephone Company, Chicago; C. K. Jones, C. K. Jones & Co., Quincy, Ill.; William W. Mulford, American Telephone and Telegraph Company, St. Louis, Mo.; R. O. Pugh, Chicago.

The convention was called to order by the president, C. S. Rhoads of Indianapolis. Mr. Rhoads congratulated the association on the full attendance and also because Providence had dealt gently with the members, none having died during the year. Mayor Holzman was introduced, and in a felicitous speech welcomed the members and guests to what he declared to be the most beautiful and popular convention city in the world. The mayor's address of welcome was responded to by C. S. Selden of Baltimore.

The association next passed favorably upon the application of ten new active members and four associate members.

The first paper contributed was on the "Use of the Telephone Among Railways," by A. G. Francis of the Chicago Telephone Company. The paper was devoted to a description in detail of the manifold uses and economy of the telephone among railways. The use and economy of the direct exchange line, of the private-branch exchange and the short private or pony line, and the growth during the last five years, were all pointed out. The increased capacity and flexibility of the telephone service attained by the use of the branch-exchange system in a railway office is found by those who have had sufficient experience to appreciate its working, to be worth far more than it costs. When a railway company has a general office and headquarters in the heart of a city, and its stations and terminals are several miles away, it is frequently economy to put in two private-branch exchanges and connect them by trunks. The pony lines are placed principally along yards, connecting the roundhouse, freight yards, switch tenders' shanties, etc. Telephone facilities in freight depots should be adequate. Freight is often given to the first railroad easily reached by telephone and frequently a single item of freight lost because of inadequate telephone facilities would have paid for one or two additional telephones for an entire year. Some of the railway companies have extended telephone lines from their private exchanges through the signal towers along the various divisions of their system, placing a telephone in each tower, thereby, in case of accident, rendering quick communication from the train to the dispatcher, or, if necessary, the division superintendent can go in on the line and talk with the conductor of the disabled train. Railroads are in a very advantageous position to build telephone lines for their purposes by reason of rights-of-way and pole lines already constructed. Students of railroad telephone development maintain that we shall undoubtedly see in the near future a remarkable development of the use of the telephone by the various railway companies of the country.

Mr. Francis' paper brought out a general discussion by C. S. Shelden, W. W. Ryder, C. S. Rhoads, I. N. Miller and others. Mr. Shelden said the telephone had enabled the railroads to do away with 20 per cent. of their telegraph stations and also to take care of more traffic with fewer cars. Many roads are now moving their trains very largely by telephone, and, in his judgment, a set of rules will soon be adopted which will largely take the place of the standard telegraph rules. Mr. Ryder explained the troubles to be contended with and said they were growing fewer and that the telephone is coming into general use by the railroads.

In discussing the merits of the telephone several speakers went so far as to assert that the telephone might some day supplant the telegraph. If it did not do that it would at least become a very important factor in the direction of local, freight and work trains. The merits of the telephone were so generally admitted that the president was instructed to appoint a committee to confer with the American Railway Association in regard to authorizing the use of telephones as a standard for handling train orders, the same as is now done by means of the telegraph.

At this juncture a superintendent arose and created a laugh by remarking: "Do you gentlemen, who are so enthusiastic for the telephone, realize that you are talking yourselves out of a job? If the telephone ever supplants the telegraph in railroad service I can picture 16-year-old telephone girls holding the destinies of our fast passenger trains, and all other kinds, for that matter."

B. S. Kaiser of New York, special agent of the railroad department of the American Telephone and Telegraph Company, contributed a paper on the "Use of Modern Telephones as Applied to Railroads." The numerous uses of this type of communication were treated at some length, and the paper contained considerable data and figures relative to the use of telephones by eastern railroads. The paper served the purpose of bringing out a generous discussion, led by Frank F. Fowle of New York, who explained the railway composite system devised for the purpose of allowing telephone service to be added to grounded telegraph lines without additional line wire or interfering in any way with the telegraph service already carried on over such lines. The cutting of composite lines into private-branch exchanges was explained in an interesting manner.

"The Economical Use of the Commercial Telegraph by Holders of Franks Issued on Account of Railway Contracts," was the subject of a paper read by F. G. Sherman of New Jersey. This paper was well received and in its discussion the methods of the various railroads relating to the franking courtesies were brought out.

An interesting and instructive paper was read by J. B. Taltavall of the Telegraph Age. He said that the lack of a trained understanding in the more important details of his profession on the part of the average telegraph operator is too often a serious drawback to his true usefulness. A very small percentage of telegraph operators possess either the inclination or the necessary perseverance to acquire telegraph or other electrical knowledge through the instrumentality of books. However, the careful and systematic study of books is a most influential help, and operators should read technical books and journals. If a railroad company desires to increase the efficiency of its telegraph staff, it should as a preliminary move and as a part of its regular discipline, detail someone qualified to enlighten those operators needing the information. The exercise of such a supervision would work decidedly beneficial results. Mr. Taltavall pointed out that the failure to acquire an understanding of the proper management of the switchboard and adjustment of relays to suit changing atmospheric conditions, was a radical deficiency. Few operators are able to make a patch or to test wires for ordinary faults, such as grounds, crosses or openings, to manage repeaters and to balance duplex and quadruple apparatus, now so extensively used on many railroad systems. These facts point out grave defects respecting requisite technical information on the part of the operator. Textbooks are all right in their way, and their study should be encouraged for the general information afforded; but after an operator has read and reflected over the description of the mechanism of a switchboard it would be an invaluable aid to have someone call on him personally, especially qualified to explain the particular board the operator is expected to handle. The adoption of some plan for the supervisory instruction of its operators would go far toward improving the telegraph service of any railroad.

"The Typewriting Telegraph" was the subject of a paper presented by L. S. Wells of the Long Island Railway Company. Mr. Wells said that it is obvious that the commercial requirements of today call for a printing-telegraph system. There are many such systems in various stages of perfection. The type-telegraph, an invention of Dr. C. A. Cardwell, is of a selective type, being attached to the universal typewriter keyboard, and so connected as to operate a Page printing typewriter. The operation of the keyboard at the sending end of the line and of the typewriter at the receiving end are direct and simultaneous. This system has been operated successfully over grounded circuits, 240 miles in length, with 10 intermediate Morse relays. It is obvious that the gap between the present crude method of cutting up electrical currents into dots and dashes through the use of the manual key, deciphered by the skilled interpreter, and the ideal automatic method, does not reach any great proportions. Two conditions must exist in order to attain our great ideal in the automatic transmission of intelligence rendered in printed form. We must not concede that the great possibility has been met with in the Morse system; we must be liberal with inventive genius, placing at its disposal every available facility at our command.

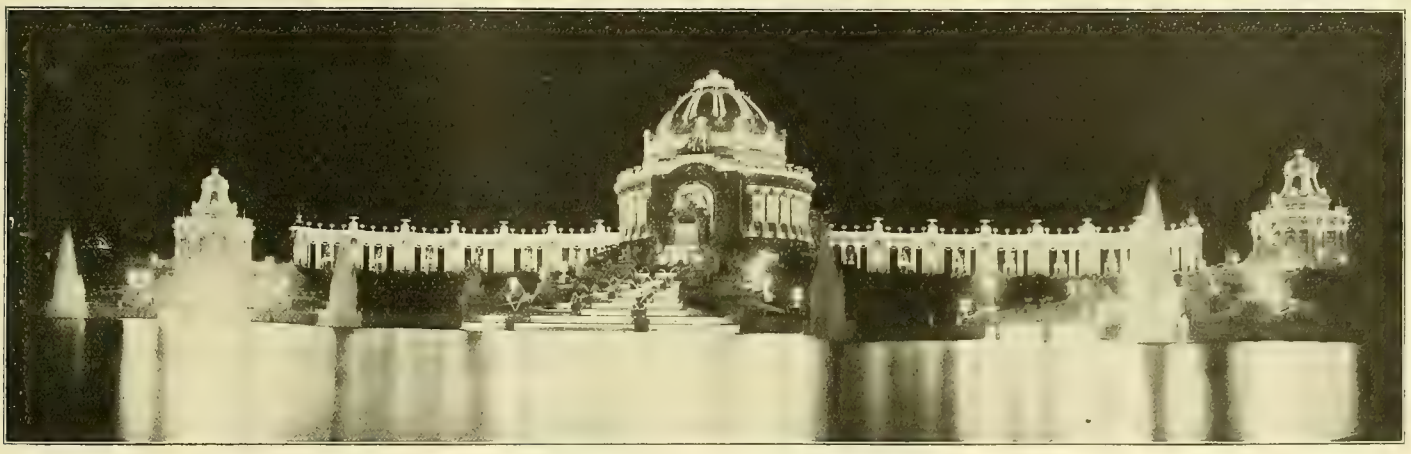
An interesting feature of the convention was provided by the representatives of supply houses. A large room in the hotel was fitted up with many kinds of improved instruments. S. R. Wright, secretary of the Circuit Protecting Relay Company, of Morton, N. Y., exhibited the circuit protecting relay apparatus and gave interesting tests of the many convenient features of the device. C. Adams Randall exhibited apparatus with an attachment for main-line relays that will do away entirely with the local batteries and sounders. A megaphone attachment magnifies the sound and does the work of a local sounder. C. P. Chenault, an electrical expert, who was in charge of the exhibit, said that it is now costing the railroads and telegraph companies nearly $100,000 a month to maintain the local sounders in all their offices. The electricity for the local sounders in all but the larger cities is furnished by jar batteries. The new sound magnifier will do away with all this expense.

The election of officers resulted as follows:

President, H. C. Hope of St. Paul, Minn., superintendent of telegraph of the Chicago, Milwaukee and St. Paul railroad; vice-president, E. E. Torry of Jackson, Tenn., superintendent of telegraph of the Mobile and Ohio railroad; secretary-treasurer, P. W. Drew of Milwaukee, with the Wisconsin Central.

Chattanooga, Tenn., was selected for the next annual meeting, to be held on the third Wednesday in May, 1905.

The local committee carried out an elaborate programme for the entertainment of the ladies of the party. The Big Four railroad took the party over the Belt railroad. The telegraph and the telephone companies gave the members free use of their lines while in the city. An enjoyable banquet at the Columbia Club ended the most successful convention in the history of the association.



Festival Hall, Cascades, Terrace of States and Pavilions.

A NIGHT VIEW AT THE ST. LOUIS EXPOSITION.

Edison Charges Denied.

A dispatch from Washington, D. C., dated June 14th, says that in the matter of the charges of Thomas A. Edison against two examiners in the Patent Office in connection with the grant of letters patent for an electrical invention by Ernest W. Jungner, the secretary of the interior has decided against Mr. Edison. The findings of Acting Commissioner Moore were that there was no evidence of malfeasance or intentional wrongdoing on the part of the examiners, and that the charges were not sustained and should be dismissed.

ALTERNATING-CURRENT WORKING.

By W. B. Gump, Asso. Mem. A. I. E. E.

Part VII.

Measurements and Tests.

It is essential for the engineer who is engaged in the design of power plants and transmission systems to have a clear understanding of the standard tests and measurements which are applied to the apparatus concerned, since the character of the system will have a direct influence upon the results of such tests, and if the latter are familiar to the designer he will be better able to apply his knowledge to meet the conditions suited to the highest efficiency of the system as a whole.

Power Measurements.

The power in an alternating-current circuit is measured most readily by means of a wattmeter.

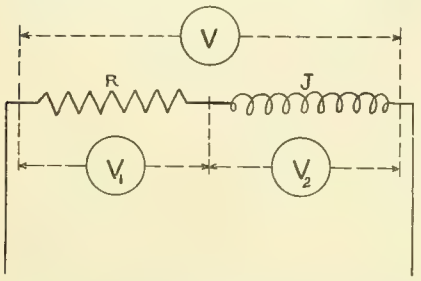


FIG. 57. CONNECTIONS FOR THREE-VOLTMETER METHOD OF TESTING.

This means of measuring is not always available, therefore some other method must often be used. Even when a wattmeter is used, it should be checked by another method, hence the necessity of knowing other methods is evident. There are a number of ways in which the measurement of power may be accomplished, notable among which are:

(a) Three-voltmeter method.
(b) Three-ammeter method.
(c) Voltmeter and ammeter combined.

These will be described in the order given above; first, the three-voltmeter method. Suppose in Fig. 57 that the alternator supplies the circuit, in which (R) is a non-inductive resistance, and (J) an inductive resistance. The object is now to construct an equation which will give the watts in terms of the electromotive forces E, E_1 and E_2.

Let e, e_1 and e_2 be the instantaneous values of the electromotive forces respectively.

Then $e = e_1 + e_2$

and $e^2 = e_1^2 + 2\, e_1\, e_2 + e_2^2$

$2\, e_1\, e_2 = e^2 - e_1^2 - e_2^2$

$$e_1\, e_2 = \frac{e^2 - e_1^2 - e_2^2}{2}$$

Now $W_2 = c \times e_2$, in which W_2 = watts in (J). C is of course the same in both (R) and (J). The watts in the non-inductive side (R) will be

$W_1 = c_1 \times e_1$

but $c_1 = \frac{e_1}{R}$ (instantaneous e and c being in phase).

Therefore $$W_1 = \frac{e_1\, e_2}{R} \quad \frac{1}{2R}\,(e^2 - e_1^2 - e_2^2)$$

since the effective values of e, e_1 and e_2, respectively, are the $\sqrt{\text{av. } e^2}$.

Then $$W = \frac{1}{2R}\,(E^2 - E_1^2 - E_2^2)$$

When it becomes more convenient to insert an ammeter than to measure the resistance (R), the equation will become by substituting the value of C,

$$W = \frac{C}{2E_1}\,(E^2 - E_1^2 - E_2^2)$$

The same result is obtained by means of calculus. Equating for the instantaneous values as before

$$W = \frac{1}{2R}\,(e^2 - e_1^2 - e_2^2)$$

The watts at the end of a period of time T will be

$$W = \frac{1}{T}\int_0^T w\,dt = \frac{1}{2RT}\int_0^T (e^2 - e_1^2 - e_2^2) =$$

$$\frac{1}{2R}\,(E^2 - E_1^2 - E_2^2)$$

The Three-ammeter Method.—In this method ammeters are used in place of votmeters, and instead of the inductive resistance being connected in series with the resistance (R), the two are connected in parallel, as shown in Fig. 58.

As before, c, c_1 and c_2 are instantaneous values of current; then

$$c = c_1 + c_2 \qquad (1)$$

$$2\, c_1\, c_2 = c^2 - c_1^2 - c_2^2 \qquad (2)$$

$$c_1\, c_2 = \frac{c^2 - c_1^2 - c_2^2}{2} \qquad (3)$$

$$W_1 = e\, c_2 = R\, c_1\, c_2 \qquad (4)$$

$$= \frac{R}{2}\,(c^2 - c_1^2 - c_2^2)$$

$$\text{or } W = \frac{R}{2}\,(c^2 - c_1^2 - c_2^2) \qquad (5)$$

$$= \frac{E}{2c_1}\,(c^2 - c_1^2 - c_2^2) \qquad (6)$$

It should be noted that equation (4) expresses the watts in terms of the electromotive force across the mains and the current in its branch. This in turn may be made equal to $R\, c_1\, c_2$, because of the fact that the resistance in (A_1) is made equal to the impedance in (A_2.) Therefore the current in each is the same. It is necessary in both of the tests just described to make the resistance equal to the impedance; otherwise the results cannot be depended upon, and will be far from accurate. The latter method (three-ammeter method) is at best not very accurate, and is not generally recommended.

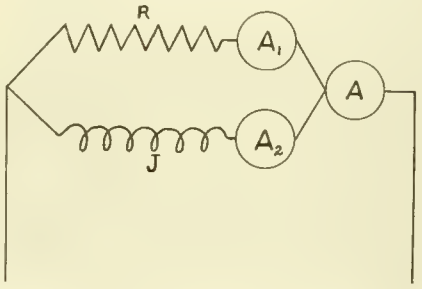


FIG. 58. CONNECTION FOR THREE-AMMETER METHOD OF TESTING.

The accuracy of both may be checked by substituting non-inductive resistances in place of inductive resistances in each, respectively The former method is best suited to circuits where the voltage may be regulated to suit the load. The second method is adapted to circuits where it is not convenient to change the potential to meet the conditions of load.

Combined Voltmeter and Ammeter Method.—This method was devised by Dr. Fleming and is more accurate than the other two methods. The connections are shown in Fig. 59. Instead of using a third ammeter in the non-inductive side (R), a voltmeter is connected across the terminals. The equation for power then becomes

$$W = \frac{R}{2}\left(C^2 - C_2^2 - \frac{E^2}{R^2}\right)$$

There are a number of other methods for measuring power, but space will not permit of their discussion here.

Measurements of Inductance and Capacity.

In regard to measuring the inductance of circuits, a number of methods are used. Since the inductance can be calculated from known quantities it is not

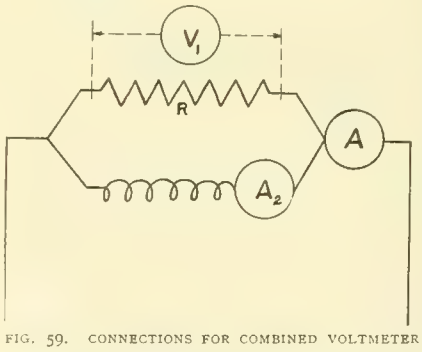


FIG. 59. CONNECTIONS FOR COMBINED VOLTMETER AND AMMETER METHOD OF TESTING.

expedient to take up the matter further than to give a few suggestions. The coefficient of self-induction (or self-inductance) L may be found by one of several methods. The unknown inductance may be compared:

(a) With a known resistance,
(b) With a known capacity,
(c) With a known inductance.

The most convenient method generally is the first—that of comparison with a known resistance. The unknown coil is first inserted in the circuit, in series with the known resistance, preferably a straight strip or zig-zag, which offers no appreciable inductance. The pressures of the known resistance and the inductive resistance, respectively, are measured by means of an electrometer or a high-resistance, non-inductive voltmeter. The following relation now exists, providing the pressure is sinusoidal, or nearly so:

$$\frac{E_1}{E} = \frac{C(R_1 + (2\pi f L_1)^2)^{\frac{1}{2}}}{C R}$$

In which E_1, R_1 and L_1 are electromotive force, resistance and inductance, respectively, in the circuit in question. From the above equation

$$L_1 = \frac{R_1}{2\pi f}\left(\frac{R^2 E_1^2}{R_1^2 E^2} - 1\right)^{\frac{1}{2}}$$

The measurement of capacity is not of sufficient importance to warrant its being considered here. In power-transmission work the capacity, and the inductance as well, may be calculated from tables which give values sufficiently accurate for engineering purposes.

In the case of transmission lines, the inductance may be calculated from the equation

$$L = \left(80.5 + 740 \log\left(\frac{d}{R}\right)\right) 10^{-6} \quad \text{..... for single phase.}$$

and

$$L = \left(139 + 1280 \log\left(\frac{d}{R}\right)\right) 10^{-6} \quad \text{..... for three phase.}$$

In these equations d = distance between wires and R = radius of a wire in circular mils. The results are expressed in henrys.

The capacity of a two-wire line in microfarads per mile is approximately,

$$C = \frac{.04}{\log_e\left(\frac{d}{R}\right)}$$

(e is the base of the Napierian system.)

The charging current per mile is

$$I = \frac{2\pi f E C}{10^6} \text{ amperes.}$$

Determination of Wave Form.

Methods will now be described which are used in determining the shape of the electromotive-force current and power curves, respectively. There are

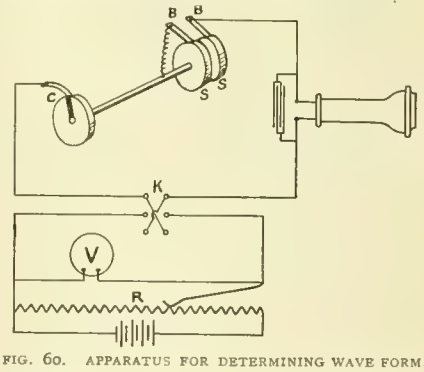


FIG. 60. APPARATUS FOR DETERMINING WAVE FORM.

two general methods of obtaining the electromotive-force curve of an alternator: First, by a device employing a contact-maker in connection with some form of ballistic galvanometer; second, by means of a wave meter. The simplest arrangement (and probably the most common) is the first, which, if followed out carefully, will give very satisfactory results. In this method the ballistic galvanometer may be replaced by a milli-voltmeter, which is often more expedient, especially in making shop tests. A device which is somewhat modified and gives very accurate results was contrived by Mr. R. D. Mershon and is shown in Fig. 60. Current from the alternator is led through the brushes (B B) to the slip rings (S S). A contact-maker (C) is so arranged that the contact brush resting upon it may be shifted, allowing it to be varied between zero and 360 electrical degrees, a number of readings being taken for different positions. The cylinder upon which the brush rests is fastened rigidly to the armature shaft, revolving with it. The circuit through the alternating-current terminals and contact-maker should be balanced by an opposing electromotive force. To obtain a balance, use is made of a storage battery which is connected opposite to the electromotive force. Now, instead of a galvanometer a telephone is inserted and the shunt resistance (R)

so adjusted that no sound is heard in the telephone. When this adjustment is made the external circuit and test circuit are balanced. A better adjustment is obtained by inserting a condenser in parallel with the telephone.

It is clear that for all positions of (C) under one pole of the alternator the impulse of alternating electromotive force will always be in one direction. This direction we shall assume is positive. Now, in order to obtain the negative side of the cycle it is necessary to employ a reversing switch (K), which changes either the alternating current, or the battery current, for all positions of (C) corresponding to the second half of each cycle.

If readings be taken for every five degrees, starting from a point at the beginning of one pole and shifting (five degrees at a time) to the trailing tip of the next pole, a curve may be plotted with the

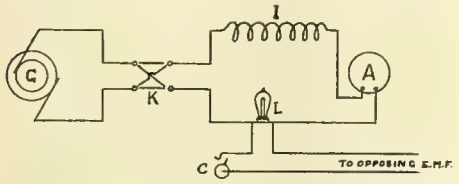


FIG. 61. APPARATUS FOR FINDING WAVE FORM IN INDUCTIVE CIRCUIT.

degrees as abscissæ, and the volts as ordinates, which will give the wave form of electromotive force through one cycle. It is more convenient to use a two-part commutator in the test circuit in place of a reversing switch, in which case the current automatically reverses when the position of the contact brush is brought under an opposite pole. In either case the values recorded will all be positive. In order to record the negative values it is necessary to change the sign of all values recorded after the position of the commutator has changed with respect to the first set of readings; that is, the readings taken under one pole. It must be remembered that the electromotive force recorded for each reading is the electromotive force for a particular instant of time, the effective value being the V mean of the squares of all the ordinates (readings) throughout one cycle. If the effective value is found and the average of all the ordinates obtained, then the form-factor is determined by dividing the former value by the latter. If the result is 1.11 the curve is a true sine wave, or is the equivalent of a sine wave.

The current wave in an inductive circuit may be obtained by arranging the circuit, as shown in Fig.

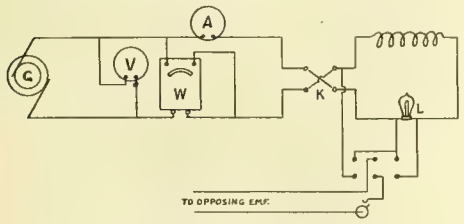


FIG. 62. MEASUREMENT OF VOLTAGE, CURRENT AND POWER CURVES SIMULTANEOUSLY.

61, in which (I) represents the inductive load (a coil which is inductive), (G) being the alternator, (K) the reversing switch, and (C) the contact-maker. A high-candlepower lamp (L) is inserted, whose resistance is measured under the working conditions, since the resistance of the filament varies with the temperature. If the electromotive-force wave is obtained by plotting the instantaneous values as before, the current wave may be found by means of Ohm's law for each instantaneous value of the electromotive force. In this case R will be constant and E and C will vary with the position of the contact-maker.

The circuit may be arranged to measure the electromotive-force, current and power curves simultaneously by combining the two circuits just described. The test circuit is connected as shown in Fig. 62. The conditions during the test should be kept as uniform as possible, readings from the voltmeter and ammeter as well as the wattmeter being taken and recorded throughout the test. A double-pole double-throw switch is used for convenience in taking the instantaneous values of electromotive force and current. The current values must be taken from readings across the lamp terminals, while the electromotive force readings are obtained with the switch in the opposite direction. It is best to take readings of both electromotive force and current before shifting the contact to a new position. Otherwise the readings may be changed enough to distort the waves from their correct relative position with each other.

Polyphase Measurements.

The power in polyphase circuits is most conveniently measured by inserting a wattmeter in each phase and adding the readings. A two-phase three-wire system may be measured with one wattmeter by connecting the current coil first to one outside wire, then to the other, taking readings for each position. The connections are shown in Fig. 63. A reading is first taken with the wattmeter in the position indicated; then the terminal (C) is connected to (C') and a second reading taken. The sum of these readings is the total power of the system. It should be stated that in this method the load should be balanced. Otherwise the sum of the two readings will not be the true power. The connections for measuring a three-phase system with three wattmeters are shown in Fig. 64. In this case the system may be unbalanced, the total power being the sum of the three readings under all conditions of load.

The power in a three-phase, four-wire system may be measured by means of one wattmeter, as in Fig. 65, in which (n) is the neutral wire. If a reading is taken in the position shown and the instrument is then shifted to (b) and (c), respectively, (the wire (P) being kept on the neutral) the sum of the readings taken at each of the three positions will be the true power, provided the load is balanced. It is not necessary to shift the wattmeter, but simply to multiply the first reading by three. In any balanced system the reading from one phase multiplied by the number of phases will give the total power.

Testing Alternators.

The items usually sought when making a complete test of an alternator are:

(a) External characteristic,

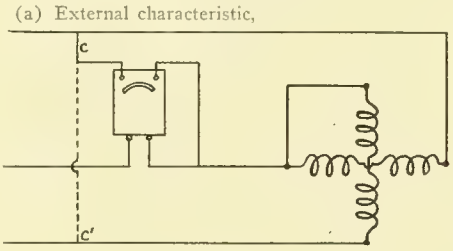


FIG. 63. WATTMETERS CONNECTED TO TWO-PHASE SYSTEM.

(b) Curve of compounding of the field,
(c) No load saturation,
(d) Full load saturation,
(e) Core loss,
(f) Synchronous impedance.

The external characteristic is found by arranging a load (preferably lamps) which can be varied from zero to about 50 per cent. overload, and taking readings of the current in the armature and the voltage at the terminals. Plotting the pressures as ordinates and the currents as abscissæ will give a curve known as the "external characteristic." The speed of the armature and the excitation of the field should be kept constant in order to obtain satisfactory results.

Item b is obtained by running the alternator at its rated speed, arranging a non-inductive load (such as lamps), and then adjusting the field current for each reading of the load so that the terminal voltage is maintained at its rated value. Plotting readings of the armature current as ordinates and the field current as abscissæ will give the compounding curve of the field. In taking the readings of the

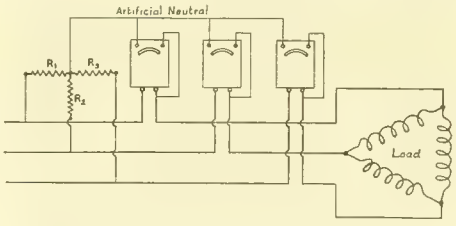


FIG. 64. WATTMETERS CONNECTED TO THREE-PHASE SYSTEM.

field current the values when varied should be raised and not lowered, since the residual magnetism will alter the values if the current is brought down from a high to a lower reading. It is necessary therefore to make the adjustments carefully, raising the value of current to the point desired without going above it.

The no-load-saturation curve is obtained in the following way: Excite the field, varying the field current from zero to full load, taking readings at regular intervals of the field current and armature voltage. When the maximum is reached, descend in the same way, taking readings. Using the terminal pressures as ordinates and the field currents as abscissæ, plot curves from both sets of readings. It will be found that the two curves will not coincide, due to residual magnetism, and for this reason extreme care is necessary to increase values for each new reading when ascending, and decrease them to obtain readings when descending.

To obtain the full-load saturation, run the machine at its rated speed, with no field excitation; then load the machine with a low-resistance rheostat, or make a short-circuit of the terminals. Now excite the field gradually until normal full-load current is flowing in the external circuit, taking readings up to this point. Next increase the resistance of the external circuit and alter the excitation until the rated full-load current again flows in the arma-

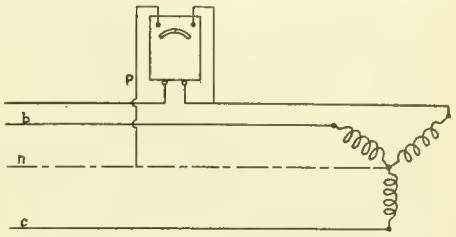


FIG. 65. WATTMETER CONNECTED TO THREE-PHASE FOUR-WIRE SYSTEM.

ture, taking readings of the field current and the terminal voltage. From these readings plot curves as before.

The core loss of any alternator armature may be found by measuring the difference in power required to drive it with and without field excitation. When such a test is to be made it is most convenient to drive the alternator by means of a motor whose exact rating is known. The motor should be just large enough to drive the armature of the alternator at its normal speed and excitation. The motor should also run at its rated speed. To accomplish this it may be necessary to put a special pulley on the motor. The power input of the motor is measured most easily by means of a wattmeter.

If W = watts input with no excitation of alternator,
e = efficiency at this input of the motor,
W^1 = watts input when alternator is excited,
e^1 = efficiency at this input,
and W_c = core loss in watts,
then

$$W_1 = W^1 e^1 - W_c.$$

Transformers.

Transformers are usually tested for efficiency, regulation and core losses. Since the latter are constant at all loads, they are quite easily determined, as will be shown later. Transformer efficiency is expressed:

$$\% \text{ efficiency} = \frac{\text{watts in secondary} \times 100}{\text{watts in primary.}}$$

The transformer should be connected as shown in Fig. 65, a wattmeter being placed in the primary circuit. It is convenient to use a double-throw switch so that the primary voltage and secondary voltage can both be read from one voltmeter. When the difference between the primary and secondary voltage is great it is best to use a voltmeter for each circuit suitable to the voltage to be read. When there is a non-inductive load on the secondary an ammeter may be inserted and the product of the volts and amperes will be the power in the secondary.

In making the test for efficiency, start with zero load on secondary and gradually increase the load, taking readings at intervals of the wattmeter and voltmeter in the primary and the voltmeter and ammeter in the secondary. For each set of readings calculate the efficiency from the equation given above; then plot a curve from the results, having the watts in secondary as abscissæ and per cent. as ordinates.

The regulation of a transformer is the rise in secondary volts from full load to no load, divided by the full-load pressure at the secondary terminals, the primary impressed voltage remaining constant. The per cent. regulation may be expressed by the equation,

$$R = \frac{T[\text{volts prim.} - \text{volts sec.}] \times 100}{\text{volts full-load sec.}}$$

In which T is the ratio [illegible] this equation a curve may be plotted [illegible] calculations from each set of readings recorded as the load is changed.

In order to determine the core losses, it is first necessary to [illegible]

[Continued on page.]

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

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REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company**, and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

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DATES AHEAD.

Indiana Mutual Telephone Association (annual meeting), Lafayette, Ind., June 28th and 29th.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.

Colorado Electric Light, Power and Railway Association, Colorado Springs, September 1st to 3d.

American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

WHILE it is disappointing that the full measure of color effects planned for the decorative lighting of the St. Louis Exposition has not yet been realized, the pictures and descriptive matter given in this issue of the Western Electrician show that the electrical illumination of the great exposition is beautiful and striking. The wonderful adaptability of incandescent lamps in small size and great number, artfully placed, to give the great buildings and the bridges, columns and other structures the appearance of themselves emitting light, rather than bearing lines of light made up of many dots, is exemplified better at St. Louis than ever before. The illumination is one of the great attractions of the exposition and is creditable to the exposition management and to Mr. Henry Rustin, who, as artist and as technician, is mainly responsible for the design underlying the work.

CHICAGO was favored as the meeting place of two conventions this week. One was the national Republican gathering, at which, unless the unexpected happens, President Roosevelt will be renominated for his high office. The other meeting, also in session as the Western Electrician goes to press, is the High-tension Transmission convention of the American Institute of Electrical Engineers. Both of these assemblages will be of interest to the readers of the Western Electrician, but as the larger one is attracting considerable attention in the daily press we can refer our readers to that medium for further information in relation to it. The other is more immediately in our line, however, and a brief report of the proceedings of the opening day is given on another page. Next week we hope to give a more detailed account of the discussions. The attendance at the transmission convention was between 80 and 90 on the opening day, and an intelligent interest was manifested in the problems under discussion.

ONE significant feature of the Indianapolis meeting of the Association of Railway Telegraph Superintendents of last week, as reported elsewhere in the Western Electrician, was the prominence accorded the telephone. The very first paper presented was on "The Use of the Telephone Among Railways," in which the remarkable development in the use of the telephone by railroad companies was commented upon. In discussing this paper one speaker said that the use of the telephone had enabled the railroads to do away with 20 per cent. of their telegraph stations, while others went so far as to predict that the telephone would some day supplant the telegraph altogether in railroad service. As an upshot of the discussion the president, Mr. C. S. Rhoads of the "Big Four" road at Indianapolis, was instructed to appoint a committee to confer with the American Railway Association in relation to the authorization of the use of telephones as a standard means of conveying train orders on the same footing as the telegraph. Another paper related to the same subject, and, all told, the telephone was given as much attention as the telegraph. At this rate, it will not be long before the association will be compelled, for the sake of accuracy, to change its name.

THE PHILIPPINES are developing but slowly, industrially as well as sociologically. The need of railways is perhaps the most important element involved in the commercial development of the islands, and yet the benefits would be of little consequence without inter-island transportation facilities of an adequate nature to afford intercourse with the outside world. The value of the importations of cars for electric railways during the last year only reached a total of $3,791, as against $8,927 in 1902. The United Kingdom and Germany were the main sources of supply. In 1901 the importations into the islands of electrical instruments and apparatus reached a total value of $20,307, of which the largest contribution, $9,630, was from the United States. In 1902 the total importations under this heading amounted to a value of $76,646, of which the United States was again the largest contributor, with a value of $63,883. During the last year the total value decreased until it reached $49,088. Of this amount the United States sent $26,406 worth, France $9,737, Great Britain $6,474, Germany $2,168, and other countries smaller amounts. The value of the incandescent electric lamps imported in 1903 was $6,925, as against $8,182 in 1902. The largest import value was to the credit of the United States, $4,634, Germany standing second with $1,753. Somewhat more encouraging is the showing made by electrical machinery, which is, however, far from large. In this item the importations for 1903 were $15,560, as compared with $3,530 in 1902. Of this amount the United States contributed $11,484. It is evident from these figures that the electrical promoter has as yet but feebly exerted himself in Uncle Sam's great island possession in the Pacific.

ONE of the questions continually arising in central-station management is the competition of the private or isolated plant. This is perhaps a less serious problem to the central-station manager than it was a few years ago, for the proportion of small isolated plants in cities appears to be decreasing. Nevertheless there will always be isolated plants in places where central-station current is available, especially where the demand for power for lighting and motors is complicated with a heating proposition. But in a general way it is true that the central station is gaining and the isolated plant is losing; and in any case it will be to the interest of the consumer of electricity, either in large or small quantities, to consider carefully the proposition of the central-station man, for many times it will be found that the large station, with its experienced management and carefully worked-out economies, will be able to supply current at a price less than the corresponding cost to the man considering or operating an isolated plant.

In every case where the question comes up there should be a free and candid discussion of the merits of the proposition on both sides. Considering the problem from the central-station point of view, Mr. S. M. Bushnell of Chicago, who is an authority on the subject, says that the first thing to be done is to form as nearly as possible an accurate estimate of the probable consumption of current by the building under consideration. "This," says Mr. Bushnell in a communication prepared for the National Electric Light Association, "should be fully discussed with the customer and should be based not only on the ideas of the customer as to his probable requirements but also on the actual results in buildings using current under similar conditions. The customer will usually estimate his consumption very much higher than the results will prove, and this estimate would naturally be in favor of the isolated plant. After having arrived at a common basis with the customer, so far as the estimate on current to be consumed is concerned, there should be a carefully tabulated statement of the various costs entering into the operation of an isolated plant. These costs should be estimated not on a theoretical basis, using the guaranteed consumption under test conditions, but should be figured on the basis of the actual results as shown in similar installations. These results should be secured by the central-station company from as many sources as possible, and should be at hand in a convenient form so as to be accessible to the customer if necessary. The customer usually finds that after figuring the matter over in this manner, taking into account all the different costs of operating a plant, he has omitted a large portion of these costs from his consideration, and in nearly every case he will find it to his advantage to accept the central-station proposition."

By this means, too, the supply company will not be led into the mistake of making rates too low in the belief that the consumption of current is larger than it really is. Of course there is no object in taking over isolated-plant business merely to make an unprofitable customer. The customer, too, should investigate the subject carefully under technical advice. In some cases he may find that it will pay him to install his own plant; in many others it will be to his advantage to enter into contract with the central station. As in other electrical problems, individual conditions constitute the determining factor.

Canadian Electrical Association.

The delegates to the fourteenth annual convention of the Canadian Electrical Association met in the Hotel Royal, Hamilton, Ont., on June 16th for a three-day session. The meeting was an interesting one. The executive committee held its meeting on the morning of June 16th, and at 11:30 a. m. an address of welcome by the mayor of Hamilton marked the opening of the convention. The interesting programme which followed was enjoyed by about 200 delegates and guests.

E. B. Walker read a paper on the "Origin and Development of the Storage Battery," and this was followed by some valuable information gained through the medium of the Question Box. In the evening papers were read on "The Curtis Steam Turbine," by Frank C. Smallpiece, and "The Niagara Power Development," by K. L. Aitken.

On the morning of the second day the delegates visited the Victoria Avenue sub-station of the Cataract Power Company, the International Harvester Works and the Westinghouse company's plant. In the afternoon papers were read by Roderick J. Park, on "Aluminum Wire as a Conductor;" P. M. Lincoln, on "Heavy Electric Traction by Alternating Currents," and George Johnson, Dominion statistician, on "Canadian Progress in Electrical Application." A brief summary of Mr. Johnson's paper appears elsewhere in this issue.

The convention proper was brought to a close on the evening of the second day with a banquet at the Hotel Royal, which was attended by 150 guests. On the third day trips were taken to Decew Falls and Niagara Falls.

The following-named officers were elected:

President—H. B. Thornton, Montreal.

First vice-president—A. A. Wright, M. P., Renfrew.

Second vice-president—R. G. Black, Toronto.

Secretary—C. H. Mortimer, Toronto.

Executive committee—A. A. Dion of Ottawa, A. B. Smith of Toronto, B. F. Reesor of Lindsay, J. A. Kammerer of Toronto, G. J. Henderson of Hamilton, C. B. Hunt of London, F. Thompson of Montreal, J. J. Wright of Toronto, John Murphy of Montreal, and A. E. Evans of Quebec.

New Members of the Institute.

Among those elected to associate membership in the American Institute of Electrical Engineers at the directors' meeting in New York city on June 15th were the following-named:

Adams, Charles F., Stanley Electric Manufacturing Company ..... Pittsfield, Mass.
Ferrin, A. W., American Locomotive Company..Schenectady
Gardener, W. R., Pittsfield Electric Company.Pittsfield, Mass.
Gilmore, J. M., Stanley Electric Manufacturing Com pany ..... Pittsfield, Mass.
Lowenstein, Fritz, consulting engineer.....New York city
Morgan, C. C., Stanley Electric Manufacturing Company ..... Pittsfield, Mass.
Morton, A. A., Stanley Electric Manufacturing Company ..... Pittsfield, Mass.
Stover, J. W., Gamewell Fire-alarm Telegraph Company ..... New York city
Carman, C. W., Charles Whitney Carman & Co..Chicago, Ill.
Dean, E. W., Havana Electric Company.....Havana, Cuba
Fogarty, J. P., Citizens' Telephone Company..Columbus, Ohio
Foy, J. D., Ford, Bacon & Davis.....Birmingham, Ala.
Glenn, W. H., Georgia Railway and Electric Company... ..... Atlanta, Ga.
Hadfield, R. H., Iowa State College.....Ames, Iowa
Hibbard, Truman, Electric Machinery Company..... ..... Minneapolis, Minn.
Jones, A. H., General Electric Company.....Atlanta, Ga.
Jones, B. J., Sargent & Lundy.....Chicago, Ill.
Kettering, C. F., National Cash Register Company..... ..... Dayton, Ohio
Lawton, J. H., Iowa State College.....Ames, Iowa
McCulloch, Richard, St. Louis Transit Company..... ..... St. Louis, Mo.
Pielsticker, F. A. .....Carroll, Iowa
Playter, O. B., Seattle Electric Company.....Seattle, Wash.
Rawson, Hobart, Cincinnati Gas & Electric Company.. .....Cincinnati, Ohio
Scott, A. H., Iowa State College.....Ames, Iowa
Stokes, H. G., United States Geographical Survey..... ..... Livingston, Ariz.
Treeby, W. V., Macartney, McElroy & Co..... ..... London, Eng.
Wills, H. LeVague, Georgia Railway and Electric Company .....Atlanta, Ga.

Membership Classification of National Electric Light Association.

By a stenographic error in the abstract of the amendment to the constitution of the National Electric Light Association adopted at the Boston meeting, the membership classes and new schedule of dues as published in the report of the convention were incorrect. The correct abstract is as follows:

Class A. Member Companies.—Private corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use. Entrance fee, $25. Annual dues for companies in towns of less than 20,000 population, $10; in towns of 20,000 to 300,000, $25; in towns of over 300,000, $50.

Class B. Members.—Officers or employes of member companies, elected and continued from year to year with the written consent of the member company with whom connected. Entrance fee, $5. Annual dues, $5.

Class C. Instructors and Teachers of Engineering and Related Sciences.—No entrance fee. Annual dues, $4.

Class D. Associate Member Companies.—Electricians, electrical or mechanical engineers, manufacturers, corporations or individuals, who are directly or indirectly interested in advancing the interests of electricity. Entrance fee, $25. Annual dues, $20.

Class E.—Officers and employes of Class D, elected and continued by written consent of the Class D member employer. Entrance fee, $5. Dues, $5.

Honorary members.

Electric Railroading in Indiana.

Robert P. Woods has just issued an interesting pamphlet giving information about the electric railways of Indiana. Mr. Woods was the chief civil engineer for the location and construction of the Indianapolis and Northwestern traction line. The speed, he says, is from 18 to 27 miles an hour, except on the limited cars of the Indianapolis and Northwestern and the Muncie division of the Indiana Union Traction line, where the average speed is 30 miles an hour. The average rate of fare in the state is 1.62 cents a mile, but a few of the roads sell 1,000-mile books for 1¼ cents a mile, and some sell round-trip tickets at a reduced price. The automatic block-signal system is used on the Indianapolis Northwestern and the Fort Wayne and Southwestern roads, while on the Cincinnati, Lawrenceburg and Aurora road a manual block is in operation.

Grade crossings with steam roads in Indiana are frequent. The interurbans cross the steam roads at no less than 151 crossings and on 277 tracks, or an average of one grade crossing with two tracks every five miles. Of these 116 crossings with 332 tracks are in cities or towns, and 35 crossings with 45 tracks are in the country. There are 15 undergrade crossings, nine overgrade. Twenty crossings have hand-operating derails. There is only one full interlocking station in operation, but an agreement has been entered into for one more. Two cabin interlockers are in Indianapolis. There are eight electric lines entering Indianapolis which operate 557 miles of interurban tracks, and this is 72½ per cent. of all in the state.

The mileage of electric lines has become so extensive in Indiana that the encroachment they make on the steam roads becomes a matter of importance. J. Q. VanWinkle, general superintendent of the Big Four, says that fortunately the trolley lines are educating people to travel and thus creating a new business. The Big Four has 450 miles paralleled by electric lines, and between certain points the electrics have taken quite a per cent. of the local travel. The Lake Erie and Western has 325 miles of trolley roads to compete with and has had to reduce rates to do so. The Pennsylvania line has 150 miles paralleled by trolley roads. At present all the trolley and steam roads are having a very heavy travel, due to conventions and the St. Louis Exposition.

Electrical Progress in Canada.

An interesting paper, prepared by George Johnson of Ottawa, Dominion statistician, entitled "The Statistics of Canadian Progress in Electrical Applications," was read before last week's meeting of the Canadian Electrical Association at Hamilton, Ont. In this paper the writer noted that May 24th last was the sixtieth anniversary of the sending of the first Morse message over a telegraph wire. The commercial use of the invention has so grown since that time that there are now 1,764 private and government cables with a length of 204,527 nautical miles, and on land 5,004,200 miles of line, worth a total estimated outlay of $850,000,000. Over these the daily transmission is 1,400,000 telegrams and 36,000 cables, with an annual total of 478,330,000 land messages and 13,140,000 cables. These figures do not include the press messages for Canada, which are large in proportion. In regard to miles of wire, in proportion to population, Canada greatly exceeds the United States, which would have to add 200,000 miles to be equal.

Regarding electrical propulsion, Mr. Johnson says that Canadian street railways during 1903 carried 167,704,000 passengers, which equals 26 per cent. of the city population, as against 37 per cent. in the United States. In Canada in 1903 there were 46 street railways with 455 miles of track, capitalized to the amount of about $30,000,000 paid-up capital, and $17,000,000 of bonded debt.

In respect to telephones, Mr. Johnson says that in Canada there is one telephone to every 65 persons, and that the summer of 1904 is the thirtieth anniversary of the invention of the telephone. Canada now has 815,000 instruments, an increase of 144 per cent. in the last four years.

In point of light and power companies, it is stated that Canada in 1903 had 324 establishments employing 1,786 hands, with an invested capital of $20,000,000. For the same year the Dominion had 14,780 arc and 1,212,861 incandescent lights. Ontario is the largest user of electric light, it having 203 of the 324 plants employed. British Columbia in this respect shows the largest proportionate increase. In the concluding paragraph of the paper Mr. Johnson states his belief in the outlook for the prosperous development of the electrical industry in Canada.

Reports state that Pennsylvania capitalists have formed a company with $2,000,000 capital to furnish El Paso, Texas, with water by means of a pipe line from Mimbres, N. M. J. S. Delamater of Pittsburg, Pa., is local representative, and R. C. Kennedy is chief engineer.

High-tension Transmission Convention of the Institute in Chicago.

Enthusiasm and interest in the work marked the first day's session of the High-tension Transmission meeting of the American Institute of Electrical Engineers in Chicago, June 21st. As the Western Electrician goes to press one-half of the programme has been successfully carried through, and there is every indication that the remainder will be as enjoyable and profitable. Tuesday morning members and visitors began to arrive at the rooms of the Western Society of Engineers in the Monadnock Building, and before the meeting opened all were given an opportunity to register and meet acquaintances. The body which gathered together was a representative one, including men from New York, Pittsburg, Schenectady, and other places in the East, while the register also showed men from Texas, Minnesota and the Middle West. In the morning 73 were registered, which number was swelled in the afternoon to 85.

Bion J. Arnold, president of the Institute, called the morning session together shortly after 10 o'clock and said that, in view of the fact that the Republican national convention was then in session in the city, he was highly gratified with the attendance. After a few explanatory remarks by Secretary Ralph W. Pope, the first introduction to discussion was presented to the meeting, being the paper by F. O. Blackwell upon "Line Construction with Steel Supporting Structures and Long Spans." Mr. Blackwell gave an abstract of his paper. Before any discussion took place W. G. Carlton read his paper on "Protection of Cables from Arcs Due to Failure of Adjacent Cables," after which both subjects were open for discussion. The discussion which followed was animated and contained many valuable suggestions. It was opened by Otto E. Osthoff of Chicago, who was followed by Ralph D. Mershon of New York, W. Wells of New York, Charles F. Scott of Pittsburg, C. E. Freeman of Chicago, William Hoopes of Pittsburg, H. B. Alverson of Buffalo, President Arnold, N. J. Neall of Pittsburg and A. S. Hatch of Detroit.

The afternoon session was called to order promptly at 2:30 p. m. by Mr. Arnold, and the two papers for the afternoon read. They were, "The Use of Ground Shields in Transformers," by John S. Peck, and "Conditions for Continuous Service over Lines Operated in Parallel," by M. H. Gerry, Jr., the latter being read by Mr. Mershon, in the temporary absence of Mr. Gerry. The rest of the afternoon was devoted to the discussion of these papers and also further discussion of the forenoon's papers. Those participating were the gentlemen who took part in the morning and also Dr. F. A. C. Perrine of Pittsfield, who had not arrived in the city in time to take part in the morning session, P. Junkersfeld of Chicago and W. B. Jackson of Madison, Wis. The paper by H. C. Wirt of Schenectady upon "Protection of High-tension Lines Against Static Disturbances" was scheduled for the next day, but as some of the discussion which took place bore directly on this paper it was thought best to have it read at this point, which was done. The discussion concluded, the meeting was adjourned at five o'clock.

A pleasant feature of the convention was the entertainment provided for Wednesday evening through the generosity of the Chicago Edison Company, General Electric Company, Westinghouse Electric and Manufacturing Company, Western Electric Company, Arnold Electric Power Station Company and Sargent & Lundy, consisting of a dinner at the Chicago Yacht Club. After dinner, by the courtesy of Captain Darby of the U. S. S. Dorothea, the members and guests of the Institute were taken for a short cruise on Lake Michigan.

A detailed report of the convention will be given in the next issue of the Western Electrician.

Encouraging Reports from Sao Paulo.

It has been decided to place the stock of the Sao Paulo Tramway Company of Brazil upon an eight-per cent. dividend basis, being an increase from six per cent. The Sao Paulo Company is only four years old, but it has made an enviable record. The company controls the electric-railway, electric-light and power facilities of Sao Paulo, which city has increased in population during the last 14 years from 50,000 to 280,000. Owing to cheap power and cheap labor the Sao Paulo Company is able to operate at 31 per cent. ratio of expenses to the income, and the [illegible] per cent. The securities are largely held in Canada. Mr. Mitchell, the manager, says that the amount of illumination in Sao Paulo has increased more than 100 per cent. since the company started business.

Different Applications of Steam Turbines.[1]

By Prof. A. Rateau.

Since 1894 the firm of Sautter-Harlé of Paris, with the assistance of the author, has been experimenting upon the construction of steam turbines. The first turbine constructed had only a single moving wheel, like the De Laval turbines, and this wheel was formed with vanes in the form of a double arc similar to the buckets of a Pelton wheel, and these vanes were milled out of a solid block of steel. This type has since been copied in the Riedler-Stumpf type, built by the Allgemeine Elektricitäts Gesellschaft, but which was rapidly abandoned, as it did not offer any chance of obtaining the maximum efficiency. The most recent Rateau turbine is of the action type, that is to say, expansion of the steam is fully carried out in the distributor for each group consisting of a distributor and one moving wheel. The steam therefore acts by its velocity and not by its pressure. These turbines are moreover multicellular,

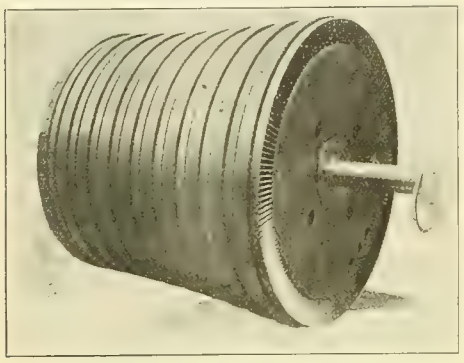


FIG. 1. RIVETED VANES OF RATEAU TURBINE.

that is to say, they consist of a certain number of elements, each element comprising one distributor and one moving wheel. A very interesting characteristic of the type of action turbines is the possibility which it allows of leaving very considerable play between the fixed parts and the moving parts, and this greatly facilitates construction and obviates the chances of dangerous friction if the bearings should become worn or the shaft somewhat bent. Besides this the wheels revolve in a chamber where the pressure is uniform. There is for that reason an absence of longitudinal thrust upon the moving parts and no necessity for the use of dash-pots for the purpose of overcoming the effect of this thrust. Finally, in the action type partial injection of steam is possible, that is to say, the steam may be directed upon a limited portion of the circumference. The moving wheels are formed of discs of sheet steel more or less thin, and upon the periphery of these discs are riveted vanes of cylindrical form, Fig. 1. A steel band riveted to the periphery maintains the correct spacing of these vanes and insures great rigidity to the construction. Wheels so constructed are extremely light, and remain in equilibrium at a velocity far higher than that to which they are subject in the turbine. These moving wheels turn between circular diaphragms provided with distributing vanes which enter circumferentially into grooves formed in the interior of the turbine case. Between two adjoining diaphragms is therefore produced a cell or very flat chamber in which the moving wheel revolves. The shaft passes through the diaphragms in collars of anti-friction metal with very slight friction. In the first diaphragm which the steam passes through the distributing vanes are placed only upon a part of the circumference. Partial injection of the steam is therefore obtained, and thus the velocity of the steam is better utilized. Moreover, to produce the same effect the useful part of each distributor is set with an angular advance on the preceding section; this angle of advance is calculated according to the speed of rotation, so that the steam leaving one moving wheel enters into the following distributor and never encounters a solid wall, which would produce a shock and therefore a loss of kinetic energy. For the last wheels it is necessary to employ total injection, that is to say, the distributing vanes must be set upon the whole circumference of the diaphragm, and moreover, owing to the expansion of the steam, the radius must be increased. The bearings of these turbines are external, and by means of a special system of spring packing they are kept perfectly tight. No oil is carried by the exhaust steam to the condenser, and this has an important advantage, as the water of condensation can be used for feeding steam boilers direct without any necessity for the use of an oil separator. The speed of rotation is controlled by a centrifugal governor with a Denis compensator, which acts upon an obturator which controls the pressure of steam entering the turbine.

Mixed Turbines.—In the case of installations where exhaust steam must be used it is often desirable to supply the turbines temporarily with steam at high pressure when the primary machine is stopped or is furnishing less steam, and the work done by the turbine must remain the same. In order to obtain economical working it is preferable not to expand this steam in order to lower it to the pressure for which the low-pressure turbine is built. Therefore, the author has designed a turbine which may be described as of the mixed type, and this can be supplied either simultaneously or separately by steam at high pressure and by steam at low pressure without any lowering of the efficiency of the mechanism. In order to attain this result the turbine is constructed in two parts, one designed for high-pressure steam and the other for low-pressure steam. The steam at high pressure having done work in the first portion will pass to the second portion, which may be fed either by steam coming from the accumulator or by the exhaust from the first portion. The admission of high-pressure steam into the first portion is automatically obtained by means of a special regulator, which allows steam from the boilers to pass to the first portion as soon as the pressure in the accumulator falls below a given value.

Calculation of the Efficiency of Turbines.—The efficiency of a turbine may be calculated à priori when a preliminary study has been made of the practical coefficients which must be introduced into the theoretical formula. We calculate this efficiency with quite a remarkable degree of accuracy by dividing the losses of the machine under two headings: First, the internal losses, which are produced by friction and eddying of the steam in the fixed and moving vanes; second, the external losses which correspond to the leakages of steam in the play between the fixed and moving parts, and to the friction of the wheels upon the steam and to the friction of the bearings. The first kind of losses give rise to the internal efficiency, which may therefore be called the "hydraulic efficiency" by extending the use of the term employed for hydraulic turbines. This internal efficiency depends upon the more or less perfect form of the vanes, and also to the relation between the peripheral speed of the moving vanes and the speed of flow of the steam. It is possible to draw a curve showing the efficiency as a function of the peripheral velocity, and therefore it is easy to at once assign the degree of efficiency which a given turbine will realize.

Once having fixed the internal efficiency, then, in order to obtain the net efficiency, we must deduct the losses by leakage as well as the losses by friction of the wheels upon the steam, and also those in the bearings. Let us take, for example, a multicellular turbine of 1,500-brake horsepower upon the shaft with a speed of 1,500 revolutions per minute. By means of practical coefficients found by experience we can calculate that the internal efficiency of such a machine may easily rise to 69 per cent.; on the other hand, the losses by leakage and by friction in the bearings absorb 1.5 per cent. of the normal power, and the losses due to friction of the wheels upon the steam amount to 2.5 per cent., making a toal for the external losses of four per cent. The net efficiency upon the shaft at the speed stated will then be 0.69 multiplied by $0.76 = 0.66$. From this value of efficiency it is easy to calculate the consumption of steam per horsepower-hour which would be required by this turbine under conditions of

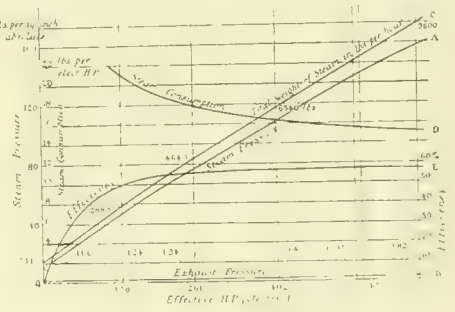


FIG. 2. CURVES OF PRESSURE, CONSUMPTION AND EFFICIENCY OF STEAM TURBINES AT 2,400 R. P. M.

pressure and of superheat of the steam already determined. All calculations for designs of turbines that we have made by this means have always proved correct within one or two per cent. of actual practice. Such accurate calculations are not possible in the case of reciprocating engines, owing to the action of the cylinder walls, which makes calculations uncertain and often inaccurate, while in the turbine the continuity of flow of the steam allows practical calculations of a high degree of accuracy to be based upon theory once having determined the fundamental coefficients which are employed in the formulæ.

Turbo-dynamos for Direct Current.—The company of the mines of Peñarroya in Spain installed in their central electric-lighting station a little more than a year ago three groups of turbo-dynamos developing 500 electric horsepower with direct current at 240 volts. Each of these three generating sets comprises two turbines for high and low pressure, and two dynamos for direct current, the latter directly driven from the turbines upon the same shaft and upon the same bedplate, and the two dynamos supply a three-wire network with a potential of 480 volts between the outer wires. The speed of rotation is about 2,200 revolutions per minute, and the floor space occupied by the turbine with its two portions is only 12 feet by five feet six inches, with a height of five feet, inclusive of a bedplate one foot high. The condensation of the steam is carried out by means of ejector condensers of a type designed by the author.

The works tests of the first group were made in September, 1902, with the greatest care, and they have given the results which are shown in Table I.

TABLE I.

Data.	One-fourth Load.	One-half Load	Full Load.	Over-load.	Over-load at 2,400 rev.
Electrical H. P. at brushes	135	259	525	627	611
Admission pressure, absolute, lbs. per sq. in.	46.21	76.6	136	156	156
Exhaust pressure, absolute, lbs. per sq. in.	1.24	1.33	1.63	1.82	1.82
Theor. steam consumption of perfect engine per H. P. hour, lbs.	10.93	9.8	8.89	8.73	8.73
Actual steam consumption per electrical H. P. hour at brushes, lbs.	21.3	18	15.8	15.39	14.90
Combined efficiency of the electrical generating set	0.513	0.540	0.560	0.569	0.580

The condensation was made for these tests by means of a surface condenser belonging to the works, so that the water of condensation might be collected and measured. It will be seen that the vacuum at the condenser declined as the power increased. This result arises from the fact that the condenser was designed for machines of 250 horsepower only, and therefore was of insufficient size for the larger volumes of steam.

It follows from the preceding figures that a turbine developing 644 electric horsepower and working without appreciable superheat between an admission pressure of 156 pounds absolute and an exhaust pressure of 1.8 pounds (notably higher than the results given by good condensers in practice) has given the reduced consumption of 14.9 pounds per electrical horsepower at the terminals; the combined efficiency for the set being then 59 per cent. when compared with the energy contained in the steam for the same fall of pressure. With steam at 180 pounds superheated 50° and a vacuum of 29 inches of mercury, the consumption at 2,400 revolutions per minute would decrease to 11.5 pounds per electrical horsepower-hour.

Fig. 2 gives the curves corresponding to the figures taken at a speed of 2,400 revolutions per minute. The abscissæ denote the power of the machine in electric horsepower at the terminals of the dynamos. The ordinates vary with the curves. For curve (A) the ordinates denote the absolute pressure of the steam on reaching the turbine in pounds per square inch. For curve (B) they show the absolute back pressure at the exhaust in pounds per square inch. For curve (C) they show the total consumption of steam in pounds per hour, and for curve (D) they show the consumption per electrical horsepower in pounds per hour, and lastly for curve (E) they show the combined efficiency. These graphic curves show clearly a remarkable characteristic of turbines, which is the very low relative consumption of steam at small loads. It will be seen that in order to drive the machine at its normal speed with no load but with the dynamo excited, the total consumption of steam is only 10 per cent. of that at full load.

Turbines with Alternators.—The construction of generators for two-phase and three-phase current for direct driving by turbines offers much less difficulty than the design of direct-current dynamos for the same purpose. The absence of the commutator renders possible higher angular velocities for alternators than for direct-current dynamos. Three types of alternators have been tried successively. The machine with the solid rotor, that with the rotating field magnet and that with the rotating armature. The first type would be, from a mechanical point of view, the ideal generator for coupling to a steam turbine. Unfortunately from its design it is impossible to use speeds higher than 1,500 revolutions per minute for a frequency of 50 periods per second. On the other hand, this type of machine permits much greater magnetic leakage than the others, and this necessitates disproportionately large dimensions and a comparatively low efficiency. These circumstances are unfortunate, for the alternator with the solid rotor would permit of making the movable part of very solid construction, which is easy to balance once for all, and thus avoid any chance of mishap. It is on these grounds that types of alternators with revolving field magnets or revolving armatures are in actual use.

Turbines for Vessels.—The author read a paper on the 25th of March last in London before the meeting of the Institution of Naval Architects upon the application of steam turbines to the propulsion of vessels. He then described the difficulties which occur in the application of turbines to the propulsion of vessels, which are as follows: (1) the difficulty of adapting screw propellers to the high speeds of rotation of the turbines, (2) the poor efficiency of turbines at low velocity, (3) the inconvenience of the combination in stopping and approaching quays.

The author believes that the best solution will be reached in the employment of a reciprocating engine of small power and of steam turbines coupled to independent shafts so that the reciprocating engine would always be working at any speed of the vessel. Then each type of machine would be perfectly adapted to the part which it has to play, and ex-

1. Abstract of a paper read before the joint convention of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers of Great Britain, in Chicago, June 1, 1904.

cellent results in consumption of fuel would be obtained at all speeds. The equipment of the French torpedo boat No. 243 with steam turbines was decided upon several years ago, in 1898. The French Admiralty wished at that time to make experiments upon turbines and upon the working of multiple propellers. In order to reduce the costs of this experiment as far as possible it was thought desirable to make use of the hull of an ordinary torpedo boat, but great difficulty was found in making room for the turbines, and moreover the propeller shafts were placed very high at the turbine end and were necessarily considerably inclined; in this case to 11° from the horizontal. The back supports had to be considerably increased, and therefore the total resistance of the boat was much greater. All these conditions are extremely unfavorable and the screws fixed upon the inclined shafts gave a very bad efficiency. The two turbines, each of a nominal output of 900 horsepower, are completely independent of each other. They are provided on the exhaust side

FIG. 3. TURBINE-DRIVEN PUMP AT FALKENAU.

with a single moving wheel for movement in a reverse direction. As the experiment was solely made to see if the installation of turbines with propellers of small diameter was suitable for producing in a vessel a speed comparable to that given by a reciprocating engine, the backward movement of the turbine was willingly sacrificed. Very careful experiments have been made with this machinery, and it will be seen from Table II. that a speed of 21 knots has been attained. It is quite certain that if the shafts had not been set at such a great inclination a speed of 24 knots would easily have been exceeded, for the turbines gave an output somewhat higher than was expected.

The turbines worked in a most satisfactory manner, as is proved from the numerous reports of the trials made under the control of the engineers of the French navy.

TABLE II.

Number of Trial.	I.	II.	III.	IV.
Speed of vessel (mean of three runs) knots	17.07	19.50	20.94	21.26
Rotation of turbines, revolutions per minute	1,348	1,572	1,748	1,774
Effective pressure of steam on admission to turbines, pounds per square inch	68.26	100.08	120.42	132.26
Condenser vacuum, ins	28	28	27	27.5
Mean slip of propellers	0.217	0.230	0.260	0.260

Turbine-driven Pumps.—The application of steam turbines for the purpose of direct driving of centrifugal pumps enables most remarkable results to be obtained and particularly renders possible height of lifts much greater than those which are at present obtained. It is well known that the pressure produced by the wheel of a centrifugal pump increases directly as the square of the peripheral speed, and therefore with the velocity produced by steam turbines it becomes possible with a single wheel to raise large volumes of water to heights of more than 900 feet in a single lift. If it is desired to obtain either greater pressures or to obtain the same results with relatively lower speeds, it is sufficient to couple steam turbines with pumps, consisting of several similar wheels arranged in series, so that each one increases by an equal quantity the pressure already given by the preceding wheels. From a practical point of view, by combining the advantage of high velocities of rotation with the advantage obtained by putting the wheels in series, it would be quite easy to deliver to heights greater than 1,500 feet. The first machine of this kind (Fig. 3) which was made was delivered to the mines of Falkenau in Bohemia. This apparatus consisted of a single bedplate upon which were mounted a steam turbine with multiple wheels enclosed in the same casing, and a pump with four wheels also mounted in a single case. The regulation of speed was obtained by a centrifugal governor arranged in the base of the principal bearing. The lubrication of the end bearing of the shaft on the pump side was effected by means of a little hydraulic Servo motor. A compensating piston enabled the longitudinal thrust received by the moving part of the pump to be exactly counterbalanced. This thrust is moreover inconsiderable owing to the special arrangement adopted for the wheels of the pump. Condensation of the steam is effected by means of an ejector condenser on the system designed by the author.

Turbo pumps for boiler-feed purposes can be used very readily and several such sets have already been constructed. Where there is a group of generators of the same size, a turbo pump can easily carry out the whole feed service with a consumption of steam much less than that of the small feed pumps usually employed. While ordinary reciprocating pumps consume from 150 to 250 pounds of steam per brake horsepower in water moved, the turbo pump for boiler-feed service will not usually require more than 40 to 60 pounds per brake horsepower. Turbo pumps of large output, both from the point of view of efficiency and also of ease in working, are particularly suitable for raising water into reservoirs for the service of towns.

Turbines for Low Pressure with Steam Accumulators.—One of the most interesting and promising applications of steam turbines is the employment of steam at low pressure, and particularly exhaust steam coming from engines working intermittently. This last class of engines, which are, of course, usually employed in installations for the working of minerals or for rolling mills and pile drivers, has not until recently been able to benefit by the same advantages as is the case with engines working continuously, and this is owing to the special difficulties in the application of condensing plant, multiple expansion, and superheating to such engines. The majority of such engines discharge the exhaust freely into the air, and the quantity of steam which is thus lost is considerable. The author has given special attention to the interesting problem of the employment of such waste steam, and he has obtained satisfactory results by means of his regenerative accumulator of steam, combined with turbines at low pressure, which are themselves coupled directly to dynamos, centrifugal pumps, or fans. The regenerative accumulator is intended to regulate the intermittent flow of steam before it passes to the turbine, and it consists essentially of a vessel containing solid and liquid materials which play the part of a flywheel for heat. The steam collects and is condensed as it arrives in large quantities in the apparatus, and is again vaporized during the time when the exhaust of the principal engine diminishes or ceases. The necessary variations for condensation and regeneration of the steam correspond to fluctuations in pressure in the accumulator, this pressure rising when the apparatus is being filled and descending when it is discharging into the turbine. Water which has a very high calorific capacity has been used as a heat flywheel, but in order to rapidly commuicate to a liquid mass a considerable quantity of heat corresponding to the latent heat of steam to be condensed it becomes necessary, owing to the poor conductivity of water, either to arrange it in thin layers or to cause a rapid circulation in order to increase the surface of contact between the steam and the water itself.

Alternating-Current Working.

[*Continued from page 519.*]

losses are those which vary with the load, and are generally considered independent of the core losses. Connect the primary circuit as shown in Fig. 66, short-circuiting the secondary. This will cause a demagnetization of the core and reduce the core losses to a negligible value. Care is necessary, in order to prevent excessive current in the transformers. This may be controlled from the primary side, observing carefully the ammeter when adjusting the load. Since the core losses are negligible, the losses which take place will be the load losses. First adjust the lamp load so that a current of 100 per cent. overload flows in the transformer. From this value start to reduce the load step by step down to zero,

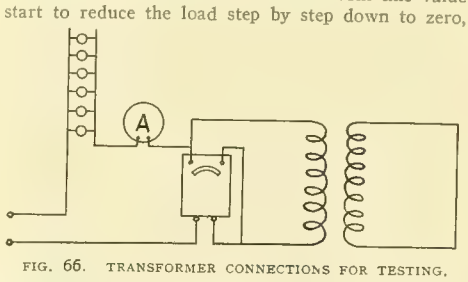


FIG. 66. TRANSFORMER CONNECTIONS FOR TESTING.

taking readings of the current, and also from the wattmeter.

Plot a curve with the ampere readings as abscissæ, and watts as ordinates, the latter representing the load losses. The leads from the wattmeter should be large enough and the contacts sufficiently secure to make their resistance negligibly small; otherwise the results will not be accurate.

The core losses are now to be determined. These losses are hysteresis and eddy-current losses. They are constant at all loads. Therefore the energy supplied to the primary when the secondary is open-circuited will be the core losses. Connect a wattmeter in the primary and note the reading. This is the core loss of the transformer.

There are a number of other tests on transformers, which would be interesting to discuss, but space does not permit their description. The tests which have been given are not intended to cover more than the elements, and have been much condensed. If, however, they give any insight into the means of performing the ordinary measurements and tests which pertain to the shop and the power plant, the purpose sought will have been fulfilled.

[*The end.*]

A Washable Storage-battery Cell.

One of the disagreeable and arduous duties in connection with the care of storage batteries is cleansing the cells of the sediment which is bound to collect in the bottom and in time short-circuit the plates. To do this it is necessary, ordinarily, to

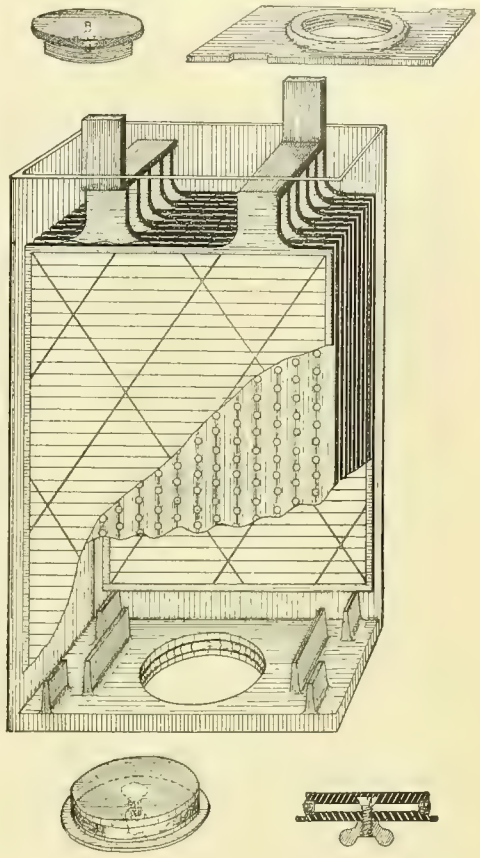


FIG. 1. A WASHABLE STORAGE-BATTERY CELL.

take apart the connections and remove the grids. In doing this the grids are very liable to injury. A cell, therefore, which can be washed out without removing the grids possesses a decided advantage.

The Duntley washable battery, manufactured by the Chicago Storage Battery Company of Chicago and illustrated herewith, may be cleaned without disturbing the connections, and the device which permits of this is very simple. Fig. 1 shows a perspective view of one type of the cell and its parts, which is used for automobile work, but the device may be applied to larger cells as well. In the bottom of the cell is a hole, as shown in the picture, which is fitted with an expansion stopper, which may be removed and the electrolyte allowed to run off without disturbing the plate. This stopper is the

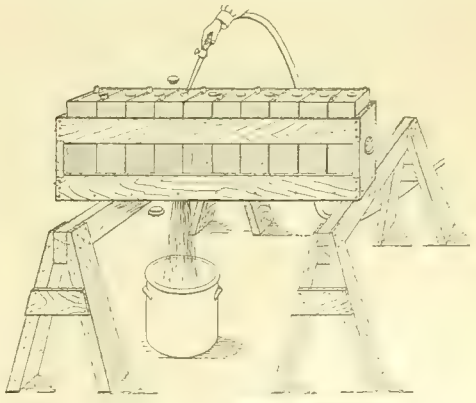


FIG. 2. WASHING [illegible]

novel feature of the cell. It consists (as shown in detail in Fig. 1) of two disks of metal, which may be drawn together by a thumbscrew. The disks are grooved at the edges [illegible] rubber gasket, which, as the disks are brought together, is expanded and fits into a groove in the hole at the bottom of the cell. The arrangement is liquid tight, but only a moment is required to unfasten or fasten it in place.

Fig. 2 [illegible] case of storage-battery cells such as is generally used for automobile work. A common garden hose

is all that is necessary thoroughly to clean the cells out in a few minutes' time, and that, too, without touching the grids.

The projections in the bottom of the cell, as shown in Fig. 1, are to support the grids.

Improving Telephone Service in Private Branch Exchanges.

By Howard S. Knowlton.

The application of the telephone to modern commercial and social life has brought about many improvements in apparatus and methods in the past decade. From the clumsy wall set, with its open-circuit battery, magneto generator and low-powered transmitter, we have passed to the exquisitely compact instrument of today, with its battery at the central office, its magneto generator abolished, and its "long-distance" transmitter and bipolar receiver mounted upon a movable and artistic standard. Even in farming regions the installation of instruments capable of operating in connection with the longest toll lines is growing more and more common. On the Colorado ranch we find, for example, instruments as modern in design, esthetic in finish and as useful in toll service as those in operation in Denver, Boston or Chicago. Metallic circuits have largely superseded the old grounded lines; magneto exchanges are rapidly being replaced by the central-energy, lamp-signal equipments, while the development of the "automatic" exchange is today challenging the attention of every telephone expert in the country.

Among the developments in method which have attained great importance in the last few years stands the private branch exchange. Few persons outside the telephone field realize the extent to which this kind of service has been applied in business life. In Washington, D. C., at the beginning of last year, 29 per cent. of the total telephones having Bell service were connected to private branch exchanges, while New York, which had the largest number, reached 33 per cent. The variety of service offered by the large city companies of the present day is a surprise to the outsider who is unfamiliar with the progress made by the contract departments in fitting service and prices to every kind and length of purse.

Primarily, the private branch exchange is a labor-saving and therefore, a time-economizing device. It fulfills a number of requirements which are beyond the scope of several direct or "trunk" lines between the subscriber's place of business and the central office. It thus allows a large number of different stations to be supplied with service at a moderate expense per station; it enables a given amount of business to be disposed of by the use of a smaller number of trunk lines to the central office, requiring at the same time less apparatus at the central office itself. The problem of local service between the stations of any single private branch exchange is entirely removed from the supervision or concern of the central office operators, and placed in the responsible charge of one or more private operators whose knowledge of the local relations of departments and individuals, coupled with what is generally a lighter traffic per operator than the central office exhibits, insures quicker and more accurate service to a business house which makes use of the private branch exchange. Not only is the local traffic from desk to desk and from office to factory more expeditiously handled, but incoming calls are more quickly assigned to their proper destinations. Calls which are misdirected either through the fault of the calling party or the central office operator may be set right in a few seconds by the private branch operator, who knows her business, thereby saving the time of both calling and called parties and improving the service at the central office besides. It is an axiom in modern telephony that the highest efficiency of operation is directly dependent upon the quickest possible establishment of connections between the two parties who desire to talk, and also upon the quickest possible removal of those connections after the conversation is finished. The private branch exchange is a powerful factor in accomplishing this result when it is correctly operated. If the private operator is inefficient, however, no end of trouble may be encountered.

The practice of securing operators for private branch exchanges from the ranks of the experienced central office force is thoroughly to be commended. When this plan is followed good service is much more certain of attainment. The discipline and operating facility gained at the switchboard of a large central office proves most valuable in the private exchange, and the skill which the service demands is by no means a matter of acquirement in an hour or two by any three-dollar-a-week office boy who may be assigned to the private switchboard. A tactless person or one who is flippant and discourteous can work great harm to any firm or company's business. Whenever an employe is assigned to the work of handling a house's private exchange traffic that employe should be thoroughly instructed and supervised by the telephone company's expert operators before being allowed control of the private switchboard. Poor service in a branch exchange affects the service all over a system, and for this reason it is a good plan for the operating telephone company to supervise or control all private branch exchange operation within its territory. If this is done the service can be maintained at the proper standard throughout the city.

Several forms of private branch exchange are in operation at the present time. Where the business handled is extensive the usual practice is to install an exchange in which all connections between stations are made by the private operator, regardless of whether the call is from one station to another within the private exchange limits or from a station to the central office. Even if an operator's whole time is not required by the traffic to be handled, this procedure coincides with the best service. Frequently an operator can be given certain clerical or other work to do if her time is not fully taken up by the telephone switchboard.

Another form of exchange utilizes the services of a private operator only upon incoming calls from the central office. Each station served by the private exchange is provided with suitable jacks and plugs, dial or ringing key whereby any other station in the exchange may be called, while the services of a private operator are likewise dispensed with in communicating with the outside world. Incoming calls are received by some clerk or employe at one of the private branch stations and transferred by him to the proper party with little delay. It is evident that this system is not adapted to the needs of large business establishments, and it is not ordinarily used where a private branch operator can be afforded. The best service is obtained when a private operator gives her entire time to telephone work, not attempting to engage in any other duties whatever.

The practice of giving a call to one's private operator and then attending to other matters until the desired party is secured is a great advantage to the busy man of affairs, but it is liable to prove seriously detrimental to the service as a whole, through the delay incurred in bringing the parties together. If many calls of this kind are received the private operator cannot keep track of the progress of each one, so that often the called subscriber upon answering finds no one upon the line to speak to him. Even if the private operator answers at once the called subscriber has to put up with the vexation of waiting until the calling subscriber can be notified that his call is completed. The delay may become serious if neither party will come to the telephone until the other party is secured. For this reason this method of giving calls ought to be restricted to members of firms, officers of companies and heads of departments, and not permitted in the case of subordinates whose time is naturally much less valuable than that of their superiors. In this connection it is worth while to point out the delays and "busy signals" due to the social conversations of employes which have absolutely no bearing upon the business of the company. It may be unreasonable to prohibit all personal use of the telephone by subordinates, but in any case the service should be watched for the purpose of seeing that privileges are not abused.

In handling private branch exchange trunk lines at central offices the lines should as far as possible terminate in consecutive jacks following the guide or pilot number, which is listed in the telephone directory. When a switchboard is originally laid out the best practice provides each group of both present and prospective private-branch-exchange trunks with enough spare jacks to satisfy the demands of from three to five years' increase in business. These extra jacks may be temporarily connected with other private-branch exchanges in time of need, but permanent transfers of this character are not advisable. It is important not to place groups of these trunks so near together that they will overlap in the future, as much confusion is likely to arise in such cases. For the sake of quicker handling it is customary to mark a white line beneath each group of trunks, regarding them as a unit for operating purposes. The practice of bringing all the different private-branch-exchange trunks in an office to a single panel or adjacent panels of a multiple switchboard is open to criticism. It is likely to result in overlapping and also tends to throw too much work upon the operators who handle the traffic at this point, as private-branch-exchange trunks are generally busier than the lines of other subscribers. This latter point should be borne in mind in locating private-branch jacks at some low point in the multiple in order to economize in the reach of operators handling these trunks. The use of multiple jacks which are not adjacent to each other for a private-branch group is generally inadvisable. In cases where the private-exchange business is extensive it often pays to separate the incoming and outgoing trunk lines to each exchange, carrying the outgoing trunk jacks through every multiple section of the switchboard at the central office, and terminating the incoming trunks at the answering jacks of one position only.

The calling of private-branch-exchange stations during the night, on Sundays or holidays, and at such other times as the private operator is not on hand, is best provided for by connecting the stations likely to be called, with the private-branch trunks—the central office, of course, giving the calling signal. This is well illustrated in railroad service, calls for the train dispatcher or night yardmaster passing directly through the private switchboard on their way from the central office to the employes' telephones. For this work the private-exchange switchboard may be regarded as non-existent in the operating sense. This service may be much furthered by the listing of the trunks and stations upon which night and Sunday calls will be received, as well as the exchange or pilot number, in the telephone directory. It is very important that the operators at the central office should pay special attention to these calls for private-branch-exchange numbers, doing their best to help the calling party secure the desired official. This involves the keeping of a record at the central office which shows the officials or stations, and the trunk numbers which will receive calls outside of regular business hours.

The essential characteristics of good private-branch-exchange service coincide with those which mark good service in the central office, the operating methods simply being upon a much smaller scale. These requirements are: Courtesy in addressing calling or called parties; accuracy in connecting to the party called; quickness in responding to signals; speed in connecting to the person desired; absence of frequent "busy" and "don't answer" reports, and the absence of "cut-offs" in conversations.

The importance of courtesy can hardly be overestimated. Standard and polite forms of address in dealing with the operators in other exchanges, the public and employes of the house itself are as essential to good service as courtesy to heads of the firm itself. Discourtesy in private-branch telephone operators is no more tolerable than impoliteness in any other employe of a business establishment. In replying to the signals of subscribers in the private-branch exchange the operator should either repeat the name of the firm, saying, for example, "Smith and Jones?" spoken with a rising inflection, or the word "Number?" likewise with the rising inflection of the voice, similar to that adopted in central-office practice. The slow repetition of the desired number back to the calling subscriber by the private-branch operator should then follow, the object, of course, being a check upon the calling subscriber and operator's accuracy and clearness of enunciation. In dealing with the central office, the private-branch operator simply speaks like any other calling subscriber except that incoming calls should always be answered with the firm name, "Smith & Jones." Standard forms of address are important as time-savers, and tend to become automatic with constant use.

The accuracy of the private-branch operator's work depends mainly upon her making sure that she understands the calling subscriber correctly; that she does not plug into the wrong local jack, through heedlessness or failure to understand the calling subscriber, and that she repeats numbers wanted with clearness and accuracy in talking with other operators. A little care in these matters, added to brevity and courtesy in address, will go a long way toward securing efficiency in the operation of the private exchange, as well as maintaining a high standard of service elsewhere. It is just as important that private-branch operation should be good as that local branch trains on a railroad which connect at junction points with through expresses should be run on schedule time.

Quickness in responding to all signals is also a matter of great importance. Owing to the heavier traffic per wire found in private-branch-exchange trunks than in ordinary subscribers' lines, it is most essential that all trunks be released as soon as possible after their respective conversations have ceased. The ringing down of a trunk-line drop on which a cord is connected at a branch exchange generally indicates trouble, and should receive the operator's attention at once. If she cannot remedy the trouble, the wire chief in charge at the central office should be immediately notified, providing he has jurisdiction over the private-branch exchange. Naturally

the trunk lines are much more important than the local connections within the branch exchange, and for this reason every effort should be made to keep every trunk line in service or available for use at all times. Slowness in pulling down connections after disconnect signals have been received on lines connected to trunks may sometimes result in false or wrong signals being given at either the central office or at the telephones of private-branch subscribers. This is one of the reasons why the reading of books and papers, or the accomplishment of needlework by the private-branch operator should not be done when she is on duty.

Particular attention ought always to be given to toll calls. Not only is lack of promptness in disconnecting these likely to lead to overcharges at the central office, but the trunks concerned are needlessly tied up, and the efficiency of the service correspondingly lowered. It is also to the advantage of the telephone company to be able to place its toll lines at the disposal of the succeeding calling parties as soon as possible. A long chain of operations is necessary to establish toll connections; the plant involved is very expensive, and economy requires that not only should such equipment be at work as large a part of the time as possible, but it should be turned over to waiting parties with a minimum of delay. In the same way, the speed of attending to local traffic inside the private exchange has an important influence upon the dispatch of the firm's or company's business.

When more than one operator is on duty at a private-branch-exchange switchboard the service can be greatly facilitated by what is called "team work" in telephone parlance. That is, each operator should endeavor to answer all calls within her reach, regardless of whether or not they originate in the section of the switchboard directly in front of her. Expressed colloquially, the Donnybrook Fair principle of hitting every head in sight is the one to follow, both in making and destroying connections.

In exchanges where the trunks are not divided into incoming and outgoing groups it is a good plan for the branch operator to plug into the higher numbered jacks in giving outgoing calls to the central office. This is because the best central-office practice uses up the lower numbers in the multiple first in calling the private exchange. Much confusion in the choice of trunks can be easily avoided by this means. In ringing the called stations of private-branch exchanges the practice of the Bell companies is to ring the subscriber's telephone bell for two-second periods at intervals of about 30 seconds for a minute and a half, in case no answer is forthcoming. At the expiration of this time the operator then announces that the party wanted does not reply, and asks if anyone else will do. The connection with the trunk jack should never be taken down until the calling party has been asked this question.

A great advantage of the private-branch exchange is the opportunity it affords to prevent the occurrence of "busy" and "don't-answer" reports. These reports are the bane of ordinary telephone practice. In case the private-exchange trunks are all found busy many times each day, more trunks should be installed, provided a study of the service in the private exchange shows that no unnecessary delays are occurring within the limits of the local exchange itself. If such an exchange has a sufficient number of trunks and care is taken to respond to all calls properly at the local stations, "busy" and "don't-answer" reports may be cut down to insignificant proportions. In case any single station of the private exchange is overburdened with calls, it is a matter of slight difficulty to arrange for the reception of a part of these on another telephone in the same office.

One of the most inexcusable faults in operating is the "cutting off" of subscribers before the end of their conversation. It is almost always caused by operators' carelessness, and should be strongly guarded against.

Uniformity in phrasing telephone numbers is a mark of good service. Its attainment is a matter of importance to both subscriber and operator. Examples of good practice in this respect are given below. The word O is used instead of the word "naught."

Number.	Pronunciation
Main-6000	Main-Six thousand
Main-3007	Main-Three-double O-seven
Main-5222	Main-Five-two-double two
Main-9870	Main-Nine-eight-seven-O
Main-1717	Main-One-seven-one-seven
Main-6411	Main-Six-four-double one
Main-5508	Main-Double five-O-eight
Main-432 b	Main-four three-two-b
Main-323-5	Main-Three-two-three-ring five

It is desirable, as before stated, that the practice of calling subscribers by name instead of by number should be restricted to the heads of departments or members of the firm, in large private exchanges. This does not apply so much to local connections inside the exchange as to outside calls. There is considerable danger that the private-branch operator will have too much work to do if this practice is followed to any extent. The time of some officials, however, is so valuable that the employment of an additional operator may be justified by the convenience of giving names instead of numbers. Under no circumstances, however, is it advisable for the private-branch operator to give the central-office operator subscribers' names in place of numbers. In this connection it may be noted that the best practice of today precludes the printing of specific telephone numbers on the stationery and advertising matter of a company. It is far better to use the words "Telephone connection" than to risk the inconvenience of a change in number, which is oftentimes unavoidable on the part of the telephone company.

Another point which makes for good service consists in both the private-exchange and the central-office operators taking care to complete any call started over a particular trunk line, over that particular trunk, rather than beginning the call again over some other trunk line.

Considerable time can be saved by preparing a list of the stations served by a private-branch exchange, giving the names of departments, officers and other employes who are reached by every line in operation. This list ought also to include all telephones which are to be connected to the central office outside regular business hours, giving the number of the trunk line to which each station is to be connected. Great care is necessary at night in setting up these connections, as considerable delay and trouble are liable to ensue if the plugs are left in the wrong jacks. Particularly is this true in railway offices. Each private-branch telephone which is on duty out of hours should have a copy of that part of the list which shows the stations and trunks which are connected through to the central office. It is scarcely necessary to say that the central office should also have the same information.

The detailed operation of the private switchboard should be reduced to the simplest possible duties. The connections may be made rather complicated without much harm, but good service depends much upon simple operation. In case the board is not working perfectly, no time should be lost in notifying the proper authorities, and an inspection of its working parts ought always to be made as soon as the operator begins her day's work. If, for any cause, the operator is obliged to leave the switchboard, care should be taken to switch in the night bell, so that calls shall not come in unheeded.

It is probable that the future holds in store great changes in the methods of handling traffic at telephone central offices, judging both from past experience and present progress. The apparatus which is standard today becomes obsolete tomorrow, and prediction of the types of even five years hence is well nigh impossible. The private-branch exchange has undergone considerable modification also since its inception, especially in relation to methods of signaling and current supply. As a form of telephone service, however, it has undoubtedly come to stay, and, as far as can be foreseen, it will remain with us, increasing in importance as long as the telephone is a factor in business life.

Telephone News From The Northwest.

The Maple Leaf Telephone Company has installed a new 100-capacity switchboard at Braham, Minn.

The Citizens' Telephone Company will erect a large brick exchange building at Racine, Wis.

The Farmers' Co-operative Telephone Company of New Sweden, Minn., has been incorporated with a capital of $12,000. J. H. Nutter is president, and E. B. Rounsville, secretary.

The Shakopee (Minn.) Telephone Company has been incorporated by J. B. Ries and others.

S. H. Dick has resigned as manager of the local telephone exchange at Long Prairie, Minn.

The Interurban Telephone Company of Alexandria, Minn., has raised the rental for that village to $2.50 for business connections and $1.50 for residence, the change being effective July 1st.

A telephone war is on at Sioux Falls, S. D. Recently the meat dealers announced that on July 1st they would drop the Northwestern's service and would use the Citizens' exclusively. Thereupon the Northwestern is understood to have decided to start a meat market on that date.

The Northwestern Telephone Exchange Company has fitted up a new office in Lake City, Minn., and has withdrawn its toll connection from the Dwelle Telephone Company.

The Independent telephone companies about Council Bluffs, Iowa, will unite to build an exchange at that city, and ask for a franchise.

The Farmers' Connective Telephone Company will soon establish an exchange at Bonaparte, Ia. R.

Ohio Telephone Notes.

The Ohio Supreme Court has affirmed the decisions of the Common Pleas and Circuit courts in the case of the city of Findlay against the Findlay Home Telephone Company, in which the municipality sought to restrain the company from charging higher rates for service than were fixed by the ordinance under which it is operating. The company was limited to $12 per year on residence telephones by this instrument. It began taking orders at this figure and after about 200 contracts had been secured the price was raised to $18 and about 600 contracts were made. Charles Micklin brought suit to prevent the company from removing his telephone after he had refused to pay more than $12 under his contract for $18. A full hearing was given in the Circuit Court and the decision was that the City Council has no more right to set the price for telephone service than for groceries, dry goods or other like commodities. The case was then taken to the Supreme Court and the two decisions were confirmed. The same question is up in Cleveland. President Dickson felt so certain that the company at Findlay was right in the position it had taken that he was willing to follow the same course in regard to rates, and it is altogether probable that the Cuyahoga Telephone Company will now be able to proceed with its work.

Residents of Bryden Road, Columbus, are opposed to the plan of the Central Union Telephone Company to put down a new set of poles on that aristocratic thoroughfare. For years small poles have been used there, and the people object to the large ones that are to be put in.

Manager Hamlin of the Home Telephone Company at Toledo reports that improvements and extension to the system amounting to $150,000 have been made the last year and that the money has been taken from the earnings and not raised by the sale of bonds as was thought. The company has been answering an average of 160,000 calls a day, or about 22 calls per telephone.

The City and Suburban Telephone Company of Cincinnati has followed the example of the United States Telephone Company and is now sending out weather reports to its subscribers. The reports reach Hamilton, Clermont and Butler counties in Ohio and Campbell, Kenton, Boone and Pendleton counties in Kentucky.

The Camden Telephone Company will endeavor as soon as possible to connect with the Home Telephone Company of Hamilton at Somerville in order to secure a direct line to Cincinnati. The company now has 12 party lines either completed or under construction and will give service to more than 120 country subscribers. College Corner is on a direct line with the Camden exchange and free service is given to all patrons. C.

Indiana Telephone Items.

Two new telephone companies were incorporated during the week—the Scireleville Telephone Company of Scireleville, with a capital stock of $5,000, and the Farmers' Mutual Telephone Company of Switzerland County, capital stock $6,000.

The New Telephone Company at Bloomington is replacing the old telephone poles with much longer ones. The new poles will take the wire above the electric-light wires and this will stop the buzzing noise at night so troublesome now. The company will continue to make other improvements during the summer and expects to expend $25,000 in bettering the local system.

Over 6,000 farmers in Indiana, who live remote from city or town, are now receiving the daily weather report or forecast of the government weather bureau by telephone.

The majority of the telegraph superintendents attending the Indianapolis convention who took a part in the discussion relative to the merits of the telephone were of the opinion that the telephone would some day supplant the telegraph in the direction of trains. Indeed the convention went so far as to appoint a committee to confer with the American Railway Association in regard to authorizing the use of telephones as a standard for handling train orders the same as is now done by means of the telegraph. F.

Southeastern Telephone Developments.

The returns of the Southern Bell Telephone Company accepted recently by the comptroller general of Georgia show an increase of $150,263 over those of last year, $116,910 being on the tangible property and the remainder on the franchise.

The charter of the Charleston (S. C.) and Sea Island Telephone Company has been filed, with a capital of $15,000. This company succeeds a former organization operated in connection with the Gordon system.

The telephone system of Rome, Ga., was damaged recently to the extent of $500 and 200 telephones were put out of business by contact with a trolley wire. Experts from Atlanta were called upon to repair the damage done to the cable.

The Gass Bridge Telephone Company of Greene County, Tenn., has been chartered with $300 capital. W. S. Babb is interested.

A long-distance telephone line will be constructed between Natchez, Miss., and Jonesville, La., by the Cumberland Telephone and Telegraph Company.

District Heating.[1]

By E. F. McCabe, D. F. McGee and C. R. Maunsell.

It has been the effort of this committee to learn, if possible, the present condition of district heating as an auxiliary to central-station lighting and power supply from a physical and financial point of view for the benefit of those companies now engaged in heating and those that have this subject under consideration.

A list of 24 questions was prepared and sent out, with an explanatory circular letter outlining the objects of the committee, and requesting replies in percentages, which it was thought would meet with the least objection from central-station managers.

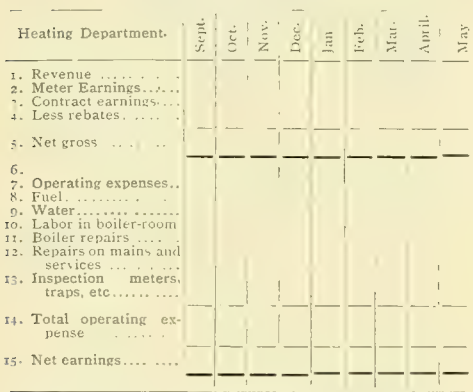
Of 100 companies addressed 52 made reply; 36 operating steam and 16 operating hot-water systems. A comparative schedule of 11 of the most pertinent questions and replies is submitted. From these data the committee makes its suggestions and recommendations.

The schedule gives a fair insight as to the relation of investment and income from heating systems as compared with lighting and power properties and revenues, and demonstrates that when once established they grow better each year. It also shows what proportion of fuel cost can be paid with heating income.

A comparison of the cost of steam coal and domestic coal would indicate that the central station had a tremendous advantage in first costs of operation, and it follows that if the same care is exercised in the sale of heat as in the sale of current a combined property will show better returns on the money invested.

The committee recommends that a standard form of accounting be used by all companies operating heating systems, and submits herewith for the approval of the association such a schedule. Further, the committee suggests that central-station managers give this point careful and immediate attention so that they may derive by next year the benefits from the adoption of such a form.

Comparative Statement Revenue and Expenses.
Season of 190 and 190 .



It is the idea of the committee in making this suggestion that it would be well for operating companies to keep an account of this character (separate, if necesary, from their general accounting), so that for future reference comparisons could be made by proportions.

It is thought that this would be of value to many in comparing the work of their company with that of others, and it will enable the committee to formulate suggestions that will materially assist in bringing up the standing of district heating.

The replies to question No. 5, as follows, "What per cent. of gross-heating income do you charge to operating expenses?" are in many cases not to the point and indicate a lack of knowledge of this important feature, which is to be regretted. We therefore suggest that an effort be made by the management of companies operating heating plants to determine, as closely as local conditions will permit, the cost of supplying heating service.

In many cases this can be arrived at only on an approximate basis, and for the benefit of those interested we suggest the following method for determining such costs:

Costs should be figured for each month separately.

$$A = \frac{\text{Total pounds coal burned}}{\text{Total output in kilowatts}} = \text{Pounds coal per kilowatt (heating months.)}$$

$$B = \frac{\text{Total pounds coal burned (all non-heating months)}}{\text{Total output in kilowatts (all non-heating months)}} = \text{Average pounds coal per kilowatt (non-heating months.)}$$

A—B=Total pounds coal per kilowatt chargeable to heating system.

Charges:

Coal at [illegible] proportionate amounts of water, labor in boiler-room and boiler repairs; also total of all charges in direct connection with heating system.

It will be found that in many cases this basis will not give accurate results on account of the varying load factors on each individual plant in summer and winter, and particularly in the cases of condensation [illegible] a proper modification of the suggested basis may be safely left to the operating superintendent.

[1] Report of committee presented to the National Electric Light Association at Boston May 26, 1904.

No Co.	System	Year Established	Per Cent of Heating Investment to Electrical Inv.	Per Cent of Heating Income to Electric Inc.	Heating Income Pays % of Fuel Bill: Heating Season	Heating Income Pays % of Fuel Bill: Entire Year	Method of Charges	Do You Control Charact'r of Inside Piping	Do You Insist on, and Charge for Coohng Coil Surface		What is Charged to Depreciation	Price of Steam Coal per Ton	Price of Domestic Coal per Ton	Are you Satisfied with Investm't	Reports Received from States
					a	b			Insist Chg.						
1	Hot Water	1900	15	25	75	57.5	R.	No			None	S. $1 65	So. $3 50 H. 8 00	Yes	
2	"	1902	50	15	80	55	R.	Yes			2% and Repairs	M. run 2 15	4 50 7 50	Very	
3	Steam	1899	20	14.5	Pays all fuel and labor and leaves some net		M.	No	Yes	Yes	N. G.	Mixed, Hard & Soft 4 70	6 50 9 50	Yes	
4	Hot Water	1899	50	50		100	R.				10%	2 12	So. 3 00 and 5 00 H. 10 00	No	Alabama 1
5	Steam	1897	20	20	80	55	M and A.	Yes	Yes	Yes	N. G.	2 25	4 00	Yes	Connecticut.. 1
6	"	1901	25	22	80	67	M. and A.	Yes	Yes	Yes	None	2 35	6 50	Yes	Colorado 1
7	"	1900	N. G.	N. G.	N. G.	N. G.	M.				N. G.	Mixed, Hard & Soft 4 50	So. 8 00 H 10 00	Very	Georgia 1
8	"	1901	N. G.	N. G.	N. G.	N. G.	M.	Yes	Yes	Yes	None	Lp. 4 00	6 50	No	Indiana 5
9	Hot Water	1900	100	120	Pays all fuel used		R.	Yes			N. G.	M. run 1 57	2 50	Yes	Illinois 8
10	"	1900	2.04	5	50	25	R.	No			None	3 75	H. 8 50	No	Iowa..... 7
11	"	1902	N. G.	N. G.	N. G.	N. G.	R.	Yes			N. G.	1 70	So. 4 00 H. 8 00	Yes	Kentucky 1
12	Steam	1902	40	15	65	40	M.	Yes	Yes	Yes	7½%	3 00	7 00	No	Kansas 1
13	Hot Water	1900	15	15	Pays all fuel and more		A.	Yes			10%	2 00	7 00 10 00	Yes	Maryland.... 1
14	Steam	1903	N. G.	5		25	R. and M	Yes	Yes	No	None	1 62	3 50	Yes	Missouri..... 1
15	Hot Water	1900	25	17	120	65	R.	Yes			2%	1 00	2 75	Yes	Massach'etts. 1
16	"	1903	33⅓	40	Pays all fuel and labor		R.	Yes			5%	2 40	4 50	Yes	Michigan.... 3
17	Steam	1900	20	6	N. G.	N. G.	R.	Yes	Yes	Yes	None	2 40	3 25	Very	Minnesota... 2
18	"	1902	10	18	100	66⅔	M. and R	Yes	Yes	Yes	4%	1 70	2 50	Yes	New York... 2
19	"	1903	18	N. G.	N. G.	N. G.	M. and R.	Yes			N. G.	1 40	3 00	Yes	Ohio 4
20	"	1901	40	19	125	90	R.	No	Yes	Yes	6%	Nat. Gas 7c. M.	2 75	Yes	Pennsylv'nia 6
21	"	1901	263	N. G.	N. G.	N. G.	M.	No	Yes	No	None	S. 1 00 1 17	1 50	Yes	North Dakota 1
22	Steam	1903	N. G.	N. G.	N. G.	N. G.	M.	Yes	No		None	N G.	$7 00	Yes	Rhode Island 1
23	Hot Water	1901	100	100	N. G.	N. G.	R.	Yes			20%	$1 70	H. 10 00	Yes	Wisconsin... 2
24	Steam	1903	40	N. G.	N. G.	31.5	M. and A.	Yes	Yes	Yes	None	1 10	2 90	Yes	
25	"	1901	45	25	N. G.	N. G.	M.	No	Yes	Yes	None	2 00	4 50	Yes	
26	"	1903	N. G.	N. G.	N. G.	N. G.	A.	Partial	Yes		N. G.	1 50	3 50	Yes	
27	"	1896	10	14.3	100	68	M. and R.	Yes	Yes	Yes	6%	2 60	H. 11 00 So. 5 00	Very	
28	Hot Water	1901	15	15	70	50	R.	Yes			5%	4 00	H. 10 50 So. 6 00	Yes	
29	Steam	1895	20	25	87.5	63⅓	A.	No	Yes	Yes	5%	1 15	2 50	Yes	
30	"	1900	N. G.	8	66⅔	33⅓	M. and R	Yes	Yes	Yes	None	2 90	3 50	Yes	
31	"	1902	125	24	100	N. G.	A.	No	Yes	Yes	None	1 87	So. 3 50 H. 7 50	Yes	
32	"	1896	N. G.	N. G. Feb	N. G.	N. G.	A.		Yes	Yes	N. G.	Lp. 4 00	6 50	Very	
33	"	1902	30	32.7	over 100	N G.	M.	Partial	Yes	Yes	None	2 46	4 25	Yes	
34	"	1888	25	33.5	N. G.	130	M. and R.	Yes	Yes	Yes	5%	90	2 25	Very	
35	"	1896	16⅔	33⅓	N. G.	88	A	No	Yes	Yes	5%	1 75	Slack 2 00	Yes	
36	Hot Water	1901	12	5	50	33⅓	A. and R.	No			None	2 60	8 50	No	
37	Steam	1902	25	20	100	72	M. and R.	No	Yes	Yes	None	1 77	3 00 to 5 75	Yes	
38	"	1903	N. G.	N. G.	N. G.	N. G.	A				N. G.	N. G.	N. G.	Very	
39	"	1900	25	18	125	100	M. and R.	Yes	Yes	No	5%	1 40	2 00	Very	
40	"	1892	2	2	1	1/10	R.	Yes	No	No	None	3 40	So. 4 50 H. 7 50	Yes	
41	Hot Water	1900	N. G.	N. G.	N. G.	100	A.	Yes			5%	2 33	H. 9 50	No	
42	"	1899	N. G.	58.3	N. G.	62⅝	R.	Yes			10%	2 50	So. 6 00 H. 10 00	Yes	
43	Steam	1902	55.5	16⅔	N. G.	83	M. and A.	No	No		10%	2 25	6 00 to 4 25	Yes	
44	Hot Water	1901	100	50	150.	100	R.	Yes			None	2 00	3 00 to 8 00	Yes	
45	"	1903	33⅓	12.5	50	12.5	R.	Yes			N. G.	3 00	So. 4 50 H. 7 50	Yes	
46	Steam	1903	20	N. G	N. G.	N. G.	M.		Yes		N. G.	2 00	So. 4 00 H. 6 50	Yes	
47	"	1897	Live Steam	N. G.	N. G.	N. G.	M. and A.	No	Yes	Yes	5%	2 90	6 25	Yes	
48	"	1892	51.5	30	102	84	M.	Yes	Yes	No	4%	2 00	So. 3 00 to 5 00 H. 9 50	Yes	
49	"	1898	14	11.5	45	24	R.	No	No	Yes	5%	3 55	6 50	No	
50	"	1898	[illegible]	8⅓	N. G.	25	M. and R.	No	No	No	None	1 85	2 75	No	

N. G = Not Given. R.—Square Ft Radiation. M.=Meter. A.=Cubic Ft. Air Space. S.=Slack. M =Mine Run. H.=Hard. So.=Soft.

Schedule of Questions and Answers Relating to District Heating.

It is evident from the reports that, from a mechanical standpoint, the meter has not been fully perfected. This, no doubt, can be attributed to the short time that it has been on the market, and the consensus of comment indicates failures in mechanical detail rather than of the principle involved in its construction.

It is also desirable that some form of meter be devised for hot-water systems, judging from replies to question No. 7 by company No. 41, operating a hot-water system, which is as follows, "I believe meters would be the best. It would undoubtedly keep the doors and windows closed."

A set of standard rules and specifications for inside piping, if enforced, would solve many a problem as to the way in which pressures now required may be materially reduced. This is clearly shown by the replies to questions Nos. 10, 11, 12, 13, 14 and 15.

The committee cannot too strongly urge that these questions and replies be given the most careful consideration, as here lies the bulk of the difficulties in the way of securing maximum benefit.

Discussion.

C. H. Parker, Boston, Mass.: The report of the committee on district heating is excellent and great credit is due it. There are, however, a number of points not touched on in the report which seriously change the simple building-heating proposition in this city. In the past I have been intimately connected with two steam-heating systems in Boston, neither one of which could be reduced to the simple proposition of heating buildings in the cold months, as the customers demanded high-pressure steam all the year around for cooking and power purposes. One of the systems comprised five hotels, one lunch room and bar, one theater, one Turkish bath parlor and 11 other buildings.

The total radiating surface of this heating system was a little over 30,000 square feet. In order to get this on our system we had to give high-pressure steam all the year round to the following apparatus: five large hot-water heaters, one hot-water urn for afternoon tea, etc., 11 coffee urns, 10 dish warmers, five steam tables or serving tables, 23 stock kettles and vegetable boilers, one live steam jet for hot water, one oyster stew pan, one egg boiler, one dish washer and engine, two elevator pumps, one ammonia compressor on refrigerating system, and seven small pumps used for pumping bilge water from basements below the level of the main street sewer. Altogether, there were 69 pieces of apparatus taking high-pressure steam all the year round.

Some of them, of course, could be put on a condensation meter, but some of them blew the steam right into the material to be cooked, and these could not be metered. There is no way of estimating what their all-year consumption is with any accuracy as a test made today may not be within 100 per cent. of what it was last month or what it may be next month. A careful test of four months' duration in this high-pressure system shows a yearly consumption of about 3,500 tons of coal, while the heating of the buildings used 1,700 tons of coal during the season. The four months' test referred to showed that the heating system was returning a good profit, but that the power system, as I have called it, did not. This whole business was given up when the station was shut down and turned into a sub-station.

The other heating system was not as badly handicapped with high-pressure steam customers, but still there were some, notably a large lunch room doing practically all its cooking with live steam, a gold-leaf stamping concern, and a few elevator pumps and engines. There were 22 buildings heated by the exhaust from the engine, which was superheated about 125 degrees in the boiler flue. One-half to three pounds was sufficient to do the heating in any weather. In the coldest weather, however, some live steam was needed, but not a great deal. In this plant also the heating was very profitable, while the high-pressure steam system was unprofitable. There was very little on this system, however, that could not have been measured by a condensation meter. Considerations entirely outside of the heating question led to a discontinuance of this plant.

My experience shows me that a pure heating business can be made quite profitable in a city even where live steam is used for heating, and that all the quantities are well enough known, so that the cost can be closely approximated, but that when high-pressure steam is furnished for cooking and power the greatest care must be taken to determine the steam used, for the quantities will surprise the uninitiated. The only fair way is to measure all condensation by a meter. Do not attempt to supply steam to another man's engine or pump unless you assume at the same time all repairs needed to keep it in condition; for the owner of an engine paying flat rate for steam for it will not spend one cent for repairs until he is forced to.

E. J. Richards, Newburg, N. Y.: I ask if any of the members can give any information as to the deterioration of their mains in the underground construction?

Mr. McCabe: As to the deterioration of the underground mains, I will say that out of 52 members

reporting, only five or six made any charges for deterioration in underground mains. One company reported only an expense of 2.5 per cent. for the maintenance of underground mains; another company, in business eight years, had no expense whatever for keping up the underground mains.

Paul Doty, St. Paul, Minn.: I would inquire if the committee has considered to what account should be credited the net earnings from the operations of the steam plant? They submit a form for comparative statement of revenue and expenses. They have on the form, line 15, net earnings. What I would like to know is—is steam heating treated as a residual account and credited to the coal for steam generated, in the analysis of the expenses, or do they treat the earnings from steam-heating plant as an item of income, and credit to it the general-earnings account? It is the practice of some gas companies to credit the residual to the cost of coal carbonized, and there is a variety of opinion as to the proper method of procedure, and I would like the information of the members in regard to the disposition of revenues from steam in electric heating.

Mr. McCabe: It is the committee's recommendation that the heating accounts be kept separate from the electric-lighting and supply account. We suggest that you charge to the heating account that amount of coal per kilowatt during the heating months above that used during the non-heating months, and for labor and expenses we recommend you charge per unit so many pounds of coal to the heating system above the amount used for electric-lighting output.

R. M. Kimball, Kenosha, Wis.: I do not think that the committee's report takes in consideration the distribution expenses, which include the proportion of expense of management, complaint work and general expenses. There is no question that these factors bear on this important part of the work. It has been the experience of the several plants with which I am connected that on account of expansion and contraction there has been a great deal of money lost from leakage caused by this expansion.

Arthur Williams, New York: It is unquestionably true that the supplying companies suffer great disadvantage in negotiating large contracts through their inability to supply steam for heating purposes. The argument is frequently advanced that, having to maintain steam service, the additional cost of supplying electric light and power from that source is very slight. A reference is also advanced in favor of a private plant, that through its operation the exhaust steam will be sufficient for the heating, and therefore the heating service may be obtained for nothing. In this argument sight is lost of the fact that before occupancy the building must be heated. At that time there can be no exhaust steam unless the machinery is operated unnecessarily, and therefore extravagantly, and consequently only live steam can be used. The coal consumed in generating the steam is necessarily additional to any coal consumption by the power plant. As a usual thing, the further and more important fact is not advanced that the steam supplied through the complication of the steam engine or pump is obtained with an average expenditure of fuel of not less than 10 pounds per indicated horsepower; sometimes as high as 20 pounds. Steam heating directly can be obtained by an expenditure of five pounds of coal per boiler horsepower. Thus, for an equivalent volume of heating, the coal expenditure is at least double in the case of the private plant. A good rule to follow in connection with this matter is to estimate the installation of a boiler horsepower for every 8,000 to 15,000 cubic feet of contents. The smaller number relates to hotels, apartments and office buildings, and the larger to department stores and buildings of that nature. Such factors as window area and exposure will, of course, enter into the final calculations, but the figures given are sufficiently general and broad to enable anyone to obtain an approximately accurate result. The coal consumption should be based upon an average load of three-fifths of the maximum boiler installation at an average consumption as before stated of five pounds of coal per boiler horsepower. The possession of these figures will be found an advantage in negotiating contracts in which a steam-heating service enters as a factor in the final determinations.

The advantage possessed by thus figuring the installation of plants which require steam service we have recognized and we have in a number of instances offered to supply steam heat from the boilers on the premises, supplying the fuel and using our own men. In no instance has our offer been accepted, but through the medium of a low maximum cost placed upon the heating service it has had the effect of bringing us the desired contract. It will be found that heating service can be had at a cost to company of from 0.15 to 0.03 of a cent per cubit foot of contents, depending upon the size and character of the building.

During a severe electrical storm in Wilmington, Del., lightning recently caused consternation in the County Court House Building, where Chief Justice Lore and Judges Pennewill and Grubb were on the bench and an important damage case was being tried. Balls of fire entered the court room by way of an electric wire and traveled down a big chandelier within a yard of the judges. The room was brilliantly illuminated, telephones and call boxes were put out of service, but the building was not damaged.

CORRESPONDENCE.

Great Britain.

London, June 11.—During the last few months two legal cases, interesting to electrical engineers, have been decided. Both have reference to the vibration caused to surrounding properties by electric-generating stations, and they serve to reveal one of the anomalies existing in the law in England at present. One case concerned a London Borough Council and the other a provincial electric-supply company, and each authority had to pay an exorbitant price in order to purchase the freehold of the properties owned by the claimant. It appears that the present state of the law relating to electric-generating stations in Great Britain is that if the land for the power house is acquired by agreement the electric-supply authority is liable to action for damages in respect of nuisance, owing to vibration. If, however, the land is acquired compulsorily by act of Parliament no such liability exists. Therefore a little uniformity is necessary. In the two cases mentioned an injunction was granted to abate the nuisance. Therefore the authorities were either to discontinue supply, which they would be prevented from doing by law, or else to pay any price that might be asked for the adjoining property. In order to endeavor to remedy this condition of affairs the St. Pancras Borough Council called a conference of electrical undertakings last week, and a subcommittee was appointed to deal with the matter and report, with the object of sending in a petition to Parliament giving compulsory powers to purchase land in every case, and also endeavoring to arrange that all authorities who have in the past acquired their land by agreement should be placed in the same position as those who have acquired by compulsion.

Some important extensions have been made to the electric-tramway systems in and around London during the last few days. The London County Council has just completed the conversion of a length of cable tramway in the south, and a still further length will be put into operation in a very short time. A new route from London to Uxbridge, built by the London United Tramways Company, of which Mr. Yerkes is now chairman, has also been completed, officially inspected and opened for traffic.

The power station which is being built by the Metropolitan Railway Company as distinct from the Metropolitan District Railway Company is fast nearing completion. In the engine room there are three 3,500-kilowatt turbo-alternators capable of giving 17,000 horsepower during heavy periods of traffic. It is also probable that another set of this output will be added almost immediately. There are 10 boilers, each having the capacity to evaporate 20,000 pounds of water per hour to a steam pressure of 180 pounds per square inch. The generating pressure is 11,000 volts, but this will be transformed and converted at nine sub-stations to 600 volts continuous current. All the trains will be built of non-inflammable material. Trains will be made up of six cars, the two end ones being motor cars. The horsepower of the motor upon the latter will be 1,200. The company is spending a sum of $7,250,000 upon the work of electrifying its steam lines.

An extension of the electric-railway service on the Northeastern railway is to be opened in a few days.

Tunbridge Wells, which, a year or two back, had an unfortunate experience with its municipal telephone system, is now in trouble with its electric-light undertaking. A proposal was made to apply for parliamentary powers to increase the scope of the undertaking in regard to free wiring, hiring out motors, etc., but a determined effort was made to prevent it. Several members of the electric-lighting committee stigmatized such municipal trading as this as immoral trading. Eventually the proposal was defeated by four votes.

An agreement has been come to between the postmaster-general and the National Telephone Company for intercommunication in the Newcastle district.

All appearances point to the fact that in spite of what the public has been led to expect the government will not buy out the National Telephone Company in accordance with the terms of its license. Under the license the postmaster-general has power to purchase the company's undertaking after December 31, 1904, by giving six months' notice, so that if this course is to be followed the notice will have to be given on the 30th of this month. Apparently this is not to be so, as the postmaster has stated that he cannot at present give the House of Commons any details of what he proposes to do. G.

New York.

New York, June 18.—An ingenious sociologist has noted that crime and other undesirable practices are disappearing from the pleasure resorts at Coney Island in proportion as the use of the electric light is increased. The new tower at "Dreamland" alone uses 100,000 incandescent lamps, which are lighted from dusk till midnight. Coney Island has perhaps more lamps to the acre than any other place in the world.

The commissioners appointed by the Appellate Division of the Supreme Court to inquire into the question of compensating the owners affected by the Park Avenue tunnel to be used for the electric tracks of the New York Central Railroad have reported this week that public interest demands that no obstacles should be put in the way of the completion of the tunnel, and that the owners should be duly compensated for damage to the property.

Details have been made public this week of a comprehensive system of police street telephones covering the entire city of New York. Brooklyn has had such a system for the last 20 years, and last year the lower part of Manhattan was so equipped, so that there are now below Fifty-ninth Street about 660 police telephone stations existent. These stations connect with switchboards in the 29 local station houses and each switchboard can be connected with the headquarters at Mulberry Street. From Mulberry Street there are extensions to each outlying station house, and such of these as have not yet been equipped with street connections are to be so connected without delay. The work is done by the New York Telephone Company, the operators being supplied by the city. The silver-colored call boxes, placed at the street corners, consist of a telephone transmitter and receiver and a call bell placed in a cast-iron box securely fastened to the wall of a building; six of these telephone stations comprise one circuit. Each patrolman is provided with a key and is required to report to the station house at a designated time in each hour.

The Edison Company has completed the electrical outfitting of the "Fourteenth Street Store," just opened by Henry Siegel. Features of the equipment are the electric escalators. Current for the whole building is supplied from the Edison mains.

The McComb Dam bridge across the Harlem River at One-hundred-and-fifty-fifth Street, Manhattan, is now operated by a 20-horsepower electric motor worked from a controller of the trolley-car type. The bridge is 412 feet long and weighs 3,800 tons. It requires only four minutes to open the draw as compared with six minutes hitherto.

J. F. Calder of this city is the local representative on the directorate of the newly incorporated Dossert Electrical Appliance Company, capitalized at $5,000. The other directors are James C. Minehan of Albany, N. Y., and W. F. Blake of South Beach, Conn.

North Beach, a pleasure resort a short way up Long Island Sound, is to have an electric horse race carousel under the direction of the North Beach Jockey Club, which has been incorporated this week with a capital of $20,000. The directors of the concern are J. A. Bill and Michael Seitz, Jr. of Brooklyn, and Emanuel Brandon of North Beach.

Wallace Murray, P. A. Gould and A. K. Botsford of Saranac Lake, N. Y., have organized the Ausable Valley Light, Heat and Power Company, which has been incorporated with a capital of $30,000.

The Cranford Company, which has the contract for the Brooklyn portion of the rapid transit subway, is making good progress with its work along Flatbush Avenue. The excavation is done in 100-foot sections, and since the tunnel is wider than the Flatbush Avenue elevated tracks it is necessary to support the elevated system temporarily with large wooden beams and girders. The work is much hampered by the presence of many underground lighting and telephone circuits.

The spirited competition of the Auburn and Syracuse electric road during the last two years has at last led to a reduction of fares upon that portion of the New York Central Railroad system which runs parallel to the trolley line. A similar reduction is to be made in the Mohawk Valley.

The Manila Electric Railroad and Light Company, whose head office is in New York city, announces that it will very shortly have a complete system of electric lines in operation in and around Manila, P. I. The fares within city limits will be the equivalent of five or six cents, with an additional fare to points beyond. D. W. W.

Dominion of Canada.

Ottawa, Ont., June 17.—A recent cable from London, Eng., states that Coley Bromfield, a London promoter, representing $15,000,000 of British capital, has sailed for Canada to invest capital in Canadian electric railways.

Two telephone companies have made application to the Board of Civic Control of the city of Toronto, Ont., for permission to install a telephone system in the city to compete with the Bell telephone. The Bell interests have offered to enter into a five-year agreement and to give some concessions. The board decided to call for offers for a competitive telephone system.

The Canada Electric Company applied to the Quebec Legislature at its recent session for a bill giving it similar powers to those enjoyed by the Montreal Light, Heat and Power Company—that is, the right to enter Montreal streets and do business under the direction of the city authorities without first having to secure permission of the City Council. The bill was passed, however, with some amendments which considerably reduced its scope.

In respect to the new submarine bell-buoy system, which is about to be installed in the St. Lawrence River and Gulf by the Canadian government, Commander Spain of the Canadian fisheries protection service, states that they intend equipping 30 stations with this apparatus. The bells are attached to a lighthouse, a light

rung by electricity. The sound is carried through the water for a distance of from four to six miles and is heard through a receiver in the chart room, thus warning of the approach of ships. W.

Winnipeg, Man., June 17.—Work upon the lines of the new electric street railway at Edmonton is now under way. Large quantities of construction material are on the ground and it is expected that the cars will be running before the snow flies.

The Vancouver (B. C.) Street Railway Company is now obtaining the power with which its cars are operated from Lake Beautiful and the old steam-power plant has been relegated to the reserve.

F. B. Warren, manager of the Winnipeg, Selkirk and Lake Winnipeg Electric Railway Company, states that the line will be in running order by July 1st.

S. Y. Wootton of Chilliack, B. C., gives notice that the Chilliack Power and Light Company has been specially incorporated with a capital of $500,000.

Messrs. Blake, Lash & Cassels, solicitors of Toronto, have made an application to the Parliament of Canada for an act authorizing the Rio de Janeiro Light and Power Company of Brazil to acquire and operate railways, tramways, telegraph and telephone lines outside the Dominion of Canada and also changing the name of the company. H.

Ohio.

Cleveland, June 18.—The name of the Urbana, Mechanicsburg and Columbus Electric Railway Company has been changed to the Columbus, Mechanicsburg and Western and the capital stock has been increased from $100,000 to $2,000,000. Senator J. B. Foraker has become interested in the company and Charles E. Prior of Cincinnati has been made president. General H. A. Axline, who has been at the head of the enterprise, states that he will probably retire from the management when the reorganization is completed. The road is in operation for a short distance out of Columbus and construction work on the remainder will now be pushed to completion as rapidly as possible.

George Whysall, manager of the Columbus, Delaware and Marion, has moved his office from Columbus to Delaware in order to be nearer the middle portion of the line. The company owns a building at Delaware, in which the offices are located. A. L. Neereamer, traffic manager of the road, will retain his office in the Ruggery Building at Columbus.

President Shonts, General Traffic Manager Ross and Superintendent Williams have been elected to the board of directors of the Detroit and Toledo Shore Line Company in place of Benjamin Norton, C. D. Whitney and J. L. Frazier. It is said that the road will not attempt to do much passenger business for a time. The freight business has been good and the tonnage is increasing at a satisfactory rate.

Several county auditors have consulted State Auditor Guilbert in regard to the appraisement of roads under the Bruce law, which provides that the value of power houses shall be distributed over the entire line for tax purposes. Most of them wanted to appraise the power stations in the cities or counties where they are located, but Mr. Guilbert advised them that power houses are similar in their nature to locomotives for steam roads and that their value, therefore, should be ascertained and distributed in the same way.

It is said that the Allis-Chalmers Company has placed $430,000 to the credit of the Bullock plant in Cincinnati for improvements and extensions. Representatives of the Allis-Chalmers Company appraised the Cincinnati plant a few days ago at $2,716,000, according to report.

All the Ohio roads, with one or two possible exceptions, are now showing an increase over the business done last year. The first of the year was particularly discouraging because of the bad weather and damage from floods, but all this has been overcome and the summer bids fair to show a very handsome gain for all.

The Western Electric Company has received an order for 10,000 feet of cable to be used in putting the police signal system in Cleveland under ground.

The Moffatt Electric Manufacturing Company of Cincinnati will shortly send a Moffatt roller-bearing car truck to Omaha to be tested on the street railway there. George B. Kerper is interested with others in this company.

John A. Dunn will probably secure a franchise to build an electric line from the Casino, near Toledo, to the Michigan state line. Cincinnati capital is said to be interested with Mr. Dunn in the enterprise.

The Simmons-Moore Manufacturing Company of Columbus has been incorporated with a capital stock of $100,000 to make a sand-carrying device for interurban roads. Samuel Simmons, Walter T. Moore, James E. Butler, Edward E. Moore and Martin L. Walker are the incorporators.

Thomas N. Fordyce, general manager of the Miami and Erie Canal Transportation Company, says that the people interested in the company expect to meet and reorganize soon with a view to completing the work to Dayton. He says the plant is in operation now and has considerable business. The ultimate end of the plans is a passenger and freight electric road, he says, and the company expects to pay the state a good round sum for the privilege

[illegible] Richard Morgan has expressed a willingness to take over the property of the Cincinnati Gas and Electric Company on the same plan that the Cincinnati street railroads are operated.

The Stewart Electric Company of Cincinnati has made an assignment to Alfred S. Allen. The assets are given as $3,000 and the liabilities $14,500.

The Columbus, Delaware and Magnetic Springs road has been completed and will be put in operation within a short time. O. M. C.

Indiana.

Indianapolis, June 20.—The Evansville Electric Plow and Traction Company has filed articles of incorporation with a capital stock of $50,000. The articles state the purpose of the company to be to furnish water, heat, light and power to corporations, cities, towns and communities. The directors are Frank Elmendorf, C. G. Covert and G. P. Heilman. The company controls the American rights and patents of an electric plow invented by C. H. Roberts of Evansville, and the intention is to manufacture the plows and furnish the power to operate them. Experiments with the plow in Posey and Gibson counties have proved their utility. The company also controls the electric power house now operating at Owensville, where the plant will be situated.

Work was begun last week on the main power house, car barns and machine shops at Decatur for the Fort Wayne and Springfield interurban line. The grade of the roadbed is completed from Fort Wayne to Decatur and cars are expected to be running by late fall.

The interurban mileage books issued by the Ohio Interurban Railway Association, good on two of the Indiana lines, have made their appearance in Indianapolis. Interurban men say that by another year there will be a system of interchangeable mileage books good over all the lines in the middle West. The principal thing interfering with the immediate adoption of the system is that the rate of fare varies greatly.

The Indianapolis-Northern has completed its Wabash-Marion branch and will run cars by July 4th. The car barns and power house at Lafontaine are nearly completed. Power will be obtained from the Marion City plant until the power house is completed.

The directors of the Union Traction Company of Indiana held a meeting at Anderson on Saturday. The directors present were Philip Malter, Hugh J. McGowan, J. A. Van Osdal, E. E. Carpenter, N. W. Brady and W. C. Sampson. It is rumored that the resignation of George F. McCulloch as president was not accepted.

The Angolia Electric Railway and Power Company was incorporated last week. The capital stock is $100,000. The company proposes to build a street-railway system in Angolia and interurban lines through Steuben County connecting a number of good towns. The company will also furnish light and power to the cities and towns along its line. Henry Paul, W. J. Vesey and others are directors.

The Mooresville Town Council has granted a franchise to the Indianapolis and Martinsville Rapid Transit Company to light the city from its power house, which is situated at the edge of the town.

The Fort Wayne Water Power Company has filed articles of incorporation with the secretary of state. The capitalization is $100,000. The company proposes to furnish motive power for carrying on manfacturing business. John H. Bass, Jno. W. White and W. A. Fleming are the principal incorporators. F.

Michigan.

Detroit, June 18.—It is understood that the Michigan Traction Company is negotiating for the purchase of the Galesburg mill property at Galesburg, and that it is intended to use the mill race for crossing under the Michigan Central railroad tracks.

The city of Pontiac is in the field for bids for lighting. The present contract expires this fall.

The Monroe Common Council has passed a resolution prohibiting the Detroit, Monroe and Toledo electric short line from carrying on a freight business in that city.

The offices of the Matheson Motor Car Company, which are at present located at Holyoke, Mass., will be moved to Detroit. The officials of the company are now looking for a site.

It is understood that G. R. Lovejoy, who has been promoting an electric railway between Bay City and Port Huron, has abandoned the project, temporarily at least.

The Detroit Lighting Commission is agitating the question of increasing the size of the plant as the engines now in use are worked to their full capacity. The additional equipment will cost from $50,000 to $100,000. Contracts for $40,333 worth of supplies were approved at the last meeting of the commission. The Western Electric Company, National Carbon Company, Valentine-Clark Company and the Standard Underground Cable Company are among the concerns to which contracts were awarded.

In a map recently published by the Detroit United Railway, the Detroit, Ypsilanti, Ann Arbor and Jackson Railway, the Detroit, Monroe and Toledo Short Line and also the Rapid Railway were shown as a part of the system. A formal announcement of the purchase of the Detroit, Ypsilanti, Ann Arbor and Jackson Railway has been expected for the last year and a half.

The Flint and Saginaw Traction Company has been incorporated under the general railway act with a capital of $25,000. This company will build an electric railway between Saginaw and Flint.

The Jackson Consolidated Company's electric line between Jackson and Chelsea will be in operation in about 10 days.

The work of construction on a new electric railway from Saginaw to St. Charles will begin at once C. G. W.

Pacific Slope.

San Francisco, June 16.—A. H. Babcock of the electrical engineering department of the Southern Pacific railroad has gone to Portland, Ore., to make cost estimates on plans to convert the West Side line of the Southern Pacific from Portland to Forest City, into an electric line. The plan is to string trolley wires above the present track and do away with the steam train.

Manager F. W. Webster states that about $250,000 will be expended shortly on improvements to the street-railway system at Stockton, Cal. Most of the details have been arranged for and the reconstruction will be commenced soon.

L. M. Davies, an electrical supply man of Tacoma, Wash., is visiting San Francisco on business.

E. M. Fraser and associates are organizing a new company in San Francisco for the construction of electric elevators. It is proposed to establish works in the East as well as in this city. Mr. Fraser invented and constructed a new type of electric elevator in this city some years ago.

The Los Angeles Lighting Company and the Los Angeles Electric Company have been consolidated by the Pacific Lighting Company, under the name of the Los Angeles Gas and Electric Company, which was recently organized with an authorized capital of $5,000,000, of which $4,000,000 has been issued. The Los Angeles Lighting Company has issued $1,000,000 in bonds and the Los Angeles Electric Company has issued $500,000, both issues being guaranteed by the Los Angeles Gas and Electric Company.

Harry L. Shannon of San Francisco, who is promoting a new electric power system in Shasta County, hopes to have the first 1,500-horsepower unit in operation by January 1st. Later, as the market justifies, the second unit of 1,500 horsepower will be installed. Water will be diverted from Hat Creek, just below Mt. Lassen.

An ordinance has been passed by the trustees of Emeryville, Cal., granting a franchise to the San Francisco, Oakland and San Jose Railway Company for the construction of a single-track electric road in the city.

The Adin (Cal.) Electric Light and Power Company has been incorporated by G. H. Knight, E. S. Pickard and others, with a capital of $10,000.

President H. H. Noble of the Northern California Power Company has returned from a trip to Honolulu. A.

PERSONAL.

O. Finnis has resigned as superintendent of the electric-light plant at Grand Rapids, Minn., to accept a similar position at Hibbing, Minn. A. Garris succeeds him at Grand Rapids.

John Erhard has been elected president of the Detroit Lighting Commission. He has been for 27 years connected with Detroit's public affairs. The retired president is Edgar H. McCurdy.

Captain Leonard D. Wildman, U. S. A., will proceed on July 1st to Nome, Alaska, to take charge of the government space-telegraph Signal Corps, now about to install a wireless system of communication across Norton Sound.

Lieutenant Nathaniel T. Bower of the Engineer Corps at Fort Leavenworth, Kan., was killed on June 13th near the target range, whence he was going to shoot. A bolt of lightning out of a comparatively clear sky struck his rifle and passed through his body into the ground.

W. K. Vanderbilt, Jr., is working in the department of W. J. Wilgus, fifth vice-president of the New York Central railroad, where he is busily engaged in studying electricity and getting informed on the electrical points of railroad administration. He gets to his office every morning before 10 o'clock and leaves about 4 p. m. for his yacht.

George Bullock of Cincinnati has been made a director in the Allis-Chalmers Company. Joseph S. Neave, vice-president of the Bullock Electric Manufacturing Company, was in New York a few days ago on business for the company and reports that manufacturers are sending a large amount of electrical machinery to the Pacific Coast.

John C. Barclay, Albert S. Richey and Philip Torchio have been transferred from the grade of associate to that of member in the American Institute of Electrical Engineers. Mr. Barclay is assistant general manager of the Western Union Telegraph Company, with offices in New York city; Mr. Richey is electrical engineer for the Indiana Union Traction Company at Anderson, Ind., and

Mr. Torchio is engineer of distribution for the New York Edison Company, New York city.

Frederick C. Esmond, an electrical engineer and the inventor of a number of devices, among them an appliance for trolley cars, died at his home in Richmond Hill, L. I., on June 11th. Mr. Esmond had been confined to his bed for several days; becoming restless, he left the bed and walked to the porch of his home, where he lost his balance and fell to the ground, sustaining a fracture of the skull. He was 50 years old.

At the annual meeting of the directors of the Chicago Edison Company last week all the retiring officers were re-elected as follows: President, Samuel Insull; first vice-president, Robert T. Lincoln; second vice-president, Louis A. Ferguson; secretary and treasurer, William A. Fox; assistant secretary, Robert L. Elliott; controller, William M. Anthony. The meeting was very short, nothing but routine business being brought up and disposed of.

Mr. George A. Damon, managing engineer of the Arnold Electric Power Station Company of Chicago, was married on June 8th to Miss Harriette Diller of Chicago. The wedding, which was attended only by relatives and a few most intimate friends, took place at Lake Bluff. Mr. and Mrs. Damon immediately started on an extended tour throughout the West. Mr. Damon, who is an almunus of the University of Michigan, has been associated with Mr. Bion J. Arnold since the completion of his university work, and to the able assistance he has given Mr. Arnold the success of the Arnold company is due in no small measure. The scope of the company's work has increased from that of general consulting engineers, and now includes both the design and the entire construction of large electrical properties. The growth of an efficient office organization under the direction of the managing engineer has kept pace with the growth of the enterprises undertaken by the company. Besides his professional undertakings, Mr. Damon finds time for active work in various engineering and social societies of which he is a member.

Charles E. Kailer, a member of the 1904 graduating class of the School of Electrical Engineering of Purdue University, Lafayette, Ind., was accidentally killed by electric shock on June 18th. Mr. Kailer was an exceptionally bright and studious young man, ranking among the first in his class, and his graduation from Purdue was attended by every indication of a successful career in his chosen field. After graduating he took a position with the Indianapolis and Northwestern Traction Company as electrical engineer and was put in charge of installing the substation near Crawfordsville. On the night of June 18th he improvised an electric light for use in the incomplete station. While thus engaged, and standing on a new cement floor which had not thoroughly dried, the wires with which he was working came in contact with the transmission wire and he received the shock which caused his death. He was found on Sunday morning lying on the cement floor, with a pair of nippers clutched in one hand, the other hand still holding the wire which hung over the transmission wire. Both hands were severely burned and there were large burns on his chest and back. Mr. Kailer resided with his parents and one sister at Naperville, Ill., where he enjoyed an enviable reputation, and the news of his sudden death has brought grief to a large circle of friends. He was 24 years of age, a member of the Masonic lodge and of the student branch of the American Institute of Electrical Engineers.

ELECTRIC LIGHTING.

J. B. McCrary of Senoia, Ga., is preparing plans for an electric-light plant to be built by the town of Ocilla, Ga.

The Magnolia (Ark.) Ice and Light Company has been incorporated with a capital of $50,000. J. O. Hutchison is president.

The Key West Electric Light Company and the Electric Light and Power Company at Key West, Fla., have been united.

The Neillsville Light and Power Company of Neillsville, Wis., has been incorporated with capital of $30,000 by Victor E. Huntzicker, M. J. Root and others.

A stock company has been formed by the business men of Mooneville, Miss., for the purpose of erecting a modern electric-light plant and a system of telephones.

The Dividend Consolidated Gold Mines Company, with offices in Los Angeles, will put in an electric-lighting system for surface and underground workings of its mines.

The United Water, Gas and Electric Company is the name of a company just incorporated in Sedalia, Mo. The capital stock of the company is $1,000,000 and the incorporators are headed by L. W. Rumsey and Joseph Clark.

The City Council of Chattanooga, Tenn., has recommended that the city extend its credit to the firm of James & Guild to the amount of $1,000,000 in four per cent. bonds, to be loaned for the purpose of constructing a lock and power dam in the Tennessee River 13 miles below Chattanooga. The city will reserve right to purchase the plant after 50 years, and for that term is to receive electricity for 500 arc lamps. Congress has already provided for permitting this work.

A charter has been granted to the Gibson Electric Light and Power Company of Gibson City, Ill., with a capital of $30,000. The company will operate a heat, light and power plant. The incorporators are L. J. Hiland, S. J. Lefevre and A. L. Phillips.

Alderman Carey of Milwaukee will introduce a resolution at the next meeting of the City Council asking the city engineer to give his opinion on the feasibility of establishing small electric-light plants at the various pumping stations, to be run by the men in charge.

The directors of the Utah County Light and Power Company are preparing to increase the capacity of their plant at Salt Lake City. President Evans states that there is no doubt that the company will be able to market the increased surplus when the new plant is erected.

An ordinance providing for a special election to vote upon the issue of $90,000 bonds for the erection of a municipal light plant has been introduced in the council at Newport, Ky. Mayor Heimbold urges the passage of the ordinance at the earliest date possible, and says it is a most important measure.

The Sacramento Electric, Gas and Railway Company has installed two new transformer stations. The effect will be the removal of a large number of the overhead wires used for transmission and of a large number of poles. Unsightly transformers will be removed from many of the poles and better service is expected.

City officials in St. Louis have been considering the matter of lighting that part of the city below Keokuk Street, and some favor a municipal plant. At present the total cost of lighting this quarter of the city is about $65,000 annually, and those in favor of municipal operation believe that it can be done for $20,000. The board has asked the lighting companies if any of them are prepared to do the work for less than it would cost the city. This matter has been discussed by the Union company's officials, and an answer will probably soon be made. Should this answer prove unsatisfactory, President Phillips of the Board of Public Improvements stated that an ordinance for a municipal plant would probably be submitted soon to the municipal assembly.

ELECTRIC RAILWAYS.

The capital of the Souderton, Skippack and Fairview (Pa.) electric railway has been increased from $100,000 to $300,000.

John M. Roach, superintendent of the Chicago Union Traction Company, was in Belvidere last week in the interest of a new electric interurban railway which, it is stated, will be constructed between Belvidere, Elgin and other points, making a complete system from Chicago to Freeport, Ill.

Robert Malone has begun grading a section of the Omaha, Lincoln and Beatrice railway, and Manager Hurd is looking after the possibility of getting right-of-way from Omaha to South Omaha. When this is done contract grading work will begin in earnest from the Lincoln and Omaha terminals.

W. W. Wheatley, general manager of the Federal District Railway system in the City of Mexico, states that the new cars, which had been ordered some time ago from St. Louis, were expected about the latter part of July. Mr. Wheatley is studying the system closely, and several improvements are under consideration, that will be effected in a short time.

The St. Paul (Minn.) Dispatch says: "It is reported that a small group of St. Paul men, among whom is President A. B. Stickney of the Chicago Great Western railroad, are considering a proposition to build the first long interurban electric line in Minnesota, to run south from St. Paul, linking a number of small towns, to Rochester."

Four franchises for suburban electric lines in the vicinity of Stockton, Cal., have been granted to H. H. Griffiths. The projected roads will connect with the new electric street-railway system which Mr. Griffiths will construct at Stockton. He has already secured a franchise for a network of roads in all parts of Stockton, and wishes to reach all of the suburban points of interest.

A project is reported to be on foot to build an electric railway from Hedley, B. C., to Curlew. J. M. Hagerty of the Similkameen Falls Power and Development Company and Manager Rogers of the Nickel Plate mine, at Hedley, are reported as making negotiations for the construction of the road. A preliminary examination of the suggested route by an engineer has been made and a map laid out. It is expected that a permanent survey will soon be made.

An application of the Chicago, Milwaukee and St. Paul railroad for a franchise to use electricity as a motive power on its Evanston branch has been sent to the committee on local transportation of the City Council of Chicago. It provides for a junction with the Northwestern Elevated, so that cars can be run from Evanston into the heart of the city.

The rate of fare from [illegible] Park around the [illegible] than five cents. [illegible] surface line north of Graceland Avenue.

It is expected that the Joliet, Plainfield and Aurora electric railroad will be completed to Aurora in July. The company has purchased a beautiful grove of 10 acres located on both sides of the DuPage River at Plainfield, and has fitted it up for picnic purposes. The river has been dammed, affording a two-mile boating course. The line from Joliet to Plainfield has been in operation since last summer and has proved profitable.

AUTOMOBILES.

Some remarkable claims are made for the new automobile storage battery of the Rhode Island Electromobile Company of Providence, R. I. Runs to Narragansett Pier and return and from Providence to Boston and 30 miles additional around Boston on one charge are said to be well within its capacity. Two electric vehicles are used in this demonstration. The smaller is a Waverly runabout, provided with 32 cells and a 2½-horsepower motor. The larger is a Columbia, fitted with a body designed for 40 cells and having a three-horsepower motor. On level roads the discharge averaged 30 amperes; on the hills between Pawtucket and Boston the variation was from 60 to 70 amperes. The highest discharge was 100 amperes. Where conditions were favorable for fast running, speeds of 15 or 20 miles an hour were made. The cells on the remodeled Columbia were new, but those on the Waverly are said to have been in regular service a year and a half, and the vehicle has a mileage record of 12,000 miles. The claim of durability is based on the mechanical construction of the cell. The active or working material is confined to the grid by a separator, which keeps the plates apart, and while retaining the active material in its place in the grid allows circulation of the electrolyte to every part of the plate. The positive plate, which is subjected to the hardest wear and tear, is heavier than the negative plate, and thus the load is equally divided. The weight of each cell is 29 pounds, or 928 pounds for the 32-cell battery in the Waverly runabout. The maximum rate of discharge of the new battery is 200 ampere-hours, and that of the lighter battery is 96 ampere-hours.

SOCIETIES AND SCHOOLS.

The next annual meeting of the Colorado Electric Light, Power and Railway Association will be held at Colorado Springs on September 21st, 22d and 23d. George B. Tripp of Colorado Springs, Colo., is secretary of the association.

John F. Wallace, recently appointed chief engineer of the Panama Canal Commission, delivered the address at the thirty-eighth annual commencement of Armour Institute of Technology, held last week in Armour chapel. Engineering degrees to the number of 39 were conferred.

The annual meeting of the British Association for the Advancement of Science is to be held this year at Cambridge, the Right Hon. A. J. Balfour, prime minister, being president. The meeting will commence on August 17th and conclude on the 24th. Next year a visit will be paid to South Africa.

Non-resident lectures will be given in the electrical engineering department of the University of Minnesota during 1903-04 as follows: "Speed-torque Characteristics of Steam and Electric Locomotives," by Edward P. Burch, consulting engineer, Minneapolis; "Experiences of an Installing Engineer," by Lee M. Coleman, electrical engineer, Minneapolis; "Telephone Cables," by J. Danner, telephone engineer, Western Electric Company, Chicago; "The Training of Engineering Apprentices in an Electrical Manufacturing Plant," by Charles E. Downton, foreman of apprentices, Westinghouse Electric and Manufacturing Company, Pittsburg; "The Engineer Salesman," Locke Etheridge, district engineer, Stanley Electric Manufacturing Company, Chicago; "Commercial Features of Dynamo Design," by Truman Hibbard, chief engineer, Electric Machinery Company, Minneapolis; "Design and Construction of the Municipal Electric-lighting Plant at New Ulm," by Charles L. Pillsbury, consulting engineer, St. Paul.

The register of Purdue University of Lafayette, Ind., for 1903-04 shows a total enrollment of 1,440, of whom 418 were students in the electrical engineering department. The annual commencement of the university was held on June 8th. The graduating class numbered 187. Advanced degrees were conferred on 12 candidates, and the degree of doctor of engineering was conferred upon Elwood Mead, class of 1882, chief of the Bureau of Irrigation, Department of Agriculture of the United States. Of the graduates in electrical engineering F. H. Miller, F. Riebel, Jr., Hartley Rowe, F. H. Nealis, H. Berthold, R. H. Davidson and L. J. Kirby have entered the employment of the Westinghouse Electric and Manufacturing Company; J. G. Anthony, the Bullock company; L. D. Waldron, Commercial Electric Company; R. G. Mansfield and M. E. Weidner, Stanley Electric Manufacturing Company. [illegible]

F. C. Watson, Norfolk and Western Railway Company, Roanoke, Va.; J. M. Reynolds, Western Electric Company, New York; J. R. Whitehead and Frank Loring, Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.; J. R. Gregory, W. J. Drury and C. E. Layton, Western Electric Company, Chicago; Clyde Keirn, Chicago Edison Company, Chicago; R. M. Harris, electrical department, Purdue University; C. C. Bradbury, Underwriters' Laboratory, Chicago; W. M. Hinesley, Dayton Railway Company, Dayton, Ohio; W. C. Martin, Arnold Electric Power Station Company, Chicago; H. E. Smiley, Chesapeake and Ohio Telephone Company, Baltimore, Md.; A. P. Wood, Fort Wayne Electric Works, Fort Wayne, Ind.; C. E. Kailer (since deceased), Indianapolis and Northwestern Traction Company, Lebanon, Ind., and H. H. Arnold, Indianapolis Light and Power Company, Indianapolis, Ind. In the absence of Professors Goldsborough and Matthews, Professor J. W. Esterline is in charge of the school of electrical engineering.

POWER TRANSMISSION.

An electric power plant is to be constructed on the Withlacoochee River in Florida by the Camp Phosphate Company of Dunnellon, Fla. A large dam is now being built from which waterpower will be secured.

A. R. Ayers and associates are interested in the Holston Springs Industrial Company of Gate City, Va., which was recently incorporated to take over and develop the projected waterpower at Horseshoe Bed. The company proposes to transmit power by electricity.

A pole line is being constructed between Stillwater, Minn., and Apple River Falls, Wis., for the transmission of electrical power to Stillwater by the Western Gas and Investment Company, which owns the lighting plants in Stillwater. The company is building a power house and dam at the falls and will have its pole line ready in July.

TELEGRAPH.

J. W. Grigsby, Charles Peterson and I. M. Nelson of Independence, Okla., are the incorporators of the Deer Creek (Okla.) Mutual Telegraph Company. The company is capitalized at $50,000.

It is stated that about July 4th General Greely expects to send cable dispatches to Juneau, Alaska, over the all-United States telegraph lines, and it is expected that communication will continue the year around, over lines controlled absolutely by the United States.

It is reported from Berlin that a syndicate of German and Dutch capitalists has been organized for the financing of a cable from the Dutch island of Menado Tua, off the coast of Celebes, East Indies, to the Island of Guam, and thence to Shanghai. Through a connection with the American cable it is intended to eliminate British influence over the German and Dutch cable business with East Asia. A company for laying the cable will be formed with a capital of $1,750,000, the German and Dutch governments giving large subsidies.

PUBLICATIONS.

"An Old Saw with Re-set Teeth" is a new leaflet issued by the Northern Electrical Manufacturing Company of Madison, Wis. It contains some of Poor Richard's maxims, with interpretations by "Rich Roger," which suggest many reasons why motor drive should be adopted in factories.

A mailing card from the Sterling Electrical Manufacturing Company of Warren, Ohio, calls the attention of the trade to the Sterling Special incandescent lamp which, the company asserts, is more than ordinarily efficient, owing to the peculiar form of the filament, which directs as much light downward as out at the sides.

The Gardner Electric Drill and Machinery Company of Cleveland, Ohio, has issued a pamphlet describing the Adams all-steel rock drill. The bulletin contains some illustrations of different types of the drill and enumerates many reasons for the use of the apparatus. The machine has been designed to stand rough usage and obtain results.

The Joseph Dixon Crucible Company of Jersey City, N. J., distributes two booklets, one relating to Dixon's graphite cup grease and the other to Ticonderoga graphite grease. The booklets set forth the well-known merits of the Dixon products for lubricating purposes. "Oil vs. Grease" is the title of another booklet, also the production of this company's advertising bureau.

Of simple design and in good taste the new catalogue of the Green Engineering Company of Chicago will at once attract and hold attention. It is devoted wholly to Green traveling link grates, and the illustrations and typographical work are first class. The theories of the proper firing of boilers are set forth, followed by a detailed description of the Green apparatus. Fuel tables for Ohio, Illinois and Pennsylvania have been arranged, showing the results of analyses of various coals in these states, classified by counties and seams. These tables contain in order the name of the county, annual output, seam, heat value, sulphur per cent., moisture, ash per cent., volatile matter per cent., fixed carbon and the ratio of volatile matter to combustible and fixed carbon.

A fine wall map of the S. K. C. system of long-distance transmission in California is issued by the Stanley Electric Manufacturing Company of Pittsfield, Mass. The map is a very interesting one, showing lines of electrical-power transmission in the vicinity of San Francisco from 147 to 232 miles in length, including the celebrated Bay Counties system.

"Reflectric" is the appropriate name of the latest catalogue of the Western Display Company of St. Paul, Minn. It consists principally of pictures of numerous artistic signs illuminated by the reflectors which are built by this company. The reflectors are made entirely of iron and glass and the wiring is contained in galvanized-iron channels which are part of the reflectors and is thoroughly protected from the weather. The Reflectric is furnished complete, except for the lamps, and ready for hanging up.

Pony catalogue No. 44, issued by the Dean Bros. Steam Pump Works, has appeared, illustrating a few of the standard styles and sizes of the company's steam pumps. A list of sizes of each pump accompanies the illustrations, with a few words upon the particular work to which each particular style is adapted. Condensers and air pumps take up a part of the catalogue and there are also included some directions for installing and some rules to engineers and firemen for the operation of steam apparatus.

MISCELLANEOUS.

It has been estimated that there are at the present time in Spain over 1,000 works generating electric current for lighting and power, and that in these works over 2,000 generating sets are installed. A large proportion of the capital for this enterprise has been obtained from Bilbao. Many of the companies working these electricity undertakings are using waterpower. In 1903 Bilbao imported 53,336 incandescent electric lamps, compared with 224,806 in 1902.

The Electric Cotton Mills has been incorporated by W. I. Young of Greensboro, N. C., James L. Orr and J. E. Sirrine of Greenville, S. C., H. C. Parker of St Louis, Mo., T. J. Thornhill and C. C. Waller of Dallas, Texas, and L W. Llewellyn of Chattanooga, Tenn. This company will own and operate the 20,000-spindle mill to be built at Mabank, Texas. It is the intention of these manufacturers to build three mills in Texas, one at Mabank, one at Paris and one at a town not yet named. Each plant will cost about $400,000. Electricity will be the motive power.

Apparatus has been installed in the old cement works at False Creek, B. C., to experiment with the De Keyser electrocyanide process of free-milling gold ore. The plant was installed at a cost of $20,000 and will ultimately be used for commercial purposes. The ore is first crushed, then pulverized and ground to dust, being afterward plentifully sprinkled with water. The pulp is then directed through a large amalgamated copper drum, where electric current is passed through the mass. The pulp is next passed through potassium-cyanide traps. Here, also, electric current is used, which further aids in the precipitation of the gold.

The following mysterious item comes from St. Louis and is dated June 20th: "By the explosion of an X-ray machine in the office of Dr. August Siebert 700 bottles of liquid light, the preparation of which took Dr. Siebert 18 years to perfect, were destroyed. The liquid light was composed largely of alcohol and chloroform. Dr. Siebert stated that he could place no money value on the loss of his liquid, but, from a scientific standpoint, the loss was great, and had the accident occurred a few months ago the loss would have been irreparable. The explosion of the X-ray machine was caused by a spark coming in contact with acid in the machine."

The new turbine steamer Turbinia, destined for service on Lake Ontario, between Hamilton and Toronto, and the first vessel of the kind in the merchant service to cross the Atlantic, arrived in port at Quebec on June 15th. Captain Erskine, who brought the vessel out, said that in his estimation the new system was a great success and highly to be commended. It was delightful to travel on one of these vessels, because there was absolutely no vibration or unpleasant motion. The trip out was made under disadvantageous weather conditions, and it was, therefore, difficult to make an accurate estimate of the steamer's speed, but an average of 13 or 14 knots was made.

The Merchants' Heat and Light Company of Indianapolis, whose plant was described and illustrated in the Western Electrician of May 28th, recently placed an order with the Westinghouse Machine Company for two 750-kilowatt Westinghouse-Parsons turbine generating units, to be installed as an addition to the present capacity of the power plant. The turbines will operate on the exhaust-heating system throughout the winter months. During this period a back pressure of from three to five pounds will be carried and during extremely cold weather, probably eight pounds. With this back pressure, the turbines will develop 20 per cent. in excess of their rated capacity. During warm weather the turbines will operate condensing upon a Worthington condensing system giving 27-inch vacuum, referred to 30-inch barometer.

TRADE NEWS.

A new company recently incorporated in Sioux City, Iowa, is the Electric Supply Company, with capital of $30,000. H. O. Woodruff is interested in the new concern.

Schedules in bankruptcy of the Geneva Electric Equipment and Construction Company of 469 Fourth Avenue, New York, show liabilities of $50,579 and nominal assets of $12,659.

The Chicago Tool and Supply Company has been incorporated to manufacture pneumatic and electric tools and supplies. The incorporators are C. R. Green, George H. Hayes and Thomas J. Peden.

A company has been formed at Charleston, W. Va., by J. T. Devise and others, to be known as the Electric Mine Door Company. It is proposed to manufacture and install electrically operated mine doors.

The B. F. Sturtevant Company announces the removal of its entire plant from Jamaica Plain, Mass., to its new works at Hyde Park, Mass. Nine acres of floor space and all modern appliances will be used in the manufacture of the company's products.

The American Electric and Controller Company, with a capital of $5,000,000, has been incorporated at Wilmington, Del. The new corporation, which has its headquarters at Dover, is authorized to acquire sundry patents affecting electric generators and devices.

A petition in bankruptcy has been filed against the United States Electric Clock Company of 304 Hudson Street, New York city, by creditors. Judge Holt of the United States District Court appointed Dougall Hawkes receiver. The liabilities are $16,000, and the assets are put down as $14,000.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until July 12th for furnishing the Pensacola (Fla.) navy yard with arc-light poles, switchboards, wire, conduit and fittings, electrical supplies, etc. Blank proposals will be furnished upon application to the bureau at Washington.

The Chicago office of the Nernst Lamp Company, in charge of A. E. Fleming as district manager, has been removed from 638 National Life Building, La Salle Street, to 99 East Lake Street. The new offices are larger and better equipped in every way to care for the increasing business of the company in this locality.

A new organization, known as the Universal Electric Company has opened general sales offices in the Ellsworth Building, Chicago, Ill. Its executive officers are F. C. Royal, president, and F. B. Kavanagh, secretary and treasurer. Mr. Royal is a well-known Chicago business man, having been connected with the Nelson Morris packing house for a number of years, while Mr. Kavanagh was formerly of the Sterling Electrical Manufacturing Company, Warren, Ohio, and later of the Brilliant Electric Company of Cleveland, Ohio. This new company is the northwestern distributor for the Brilliant Electric Company of Cleveland, maker of the Universal tipless incandescent lamps, and it will job a full line of arc lamps, fans, motors, generators, telephone systems, etc., as well as several special lamp accessories.

BUSINESS.

The Chicago Storage Battery Company announces the equipment of a sub-station at 107 Twentieth Street, Chicago, where it will do expert storage-battery repair work, washing, testing, etc.

J. J. Egan, Chicago, manufacturer of the Acme commutator compound, says that several supply dealers have placed large supplies of this compound in stock, after having thoroughly satisfied themselves of its worth by severe tests.

An incandescent lamp that can stand up under the jolts and jars and hard knocks of street-car service is an article of value. The Electric Appliance Company of Chicago says that it has a lamp fitted for this strenuous service, and, as proof of its statement, the company points with pride to the large traction companies throughout the country which are using the Packard railway lamp.

A. Bushnell of Kansas City, Mo., manufacturer of cypress telegraph poles and piling, creosoted and treated with zinc, especially recommends the larger sizes of his product for electric line work. Poles of this wood are said to have unequaled lasting properties and to be immune from dry rot.

The Canadian Westinghouse Company of Hamilton, Ont., has recently closed a contract to furnish the Shawinigan Water and Power Company, Shawinigan Falls, Quebec, a 6,600-kilowatt, two-phase, 2,200-volt, 3,600-alternation, rotating-field alternator for direct connection with a waterwheel. Two 2,200-

kilowatt, oil-insulated, water-cooled transformers (2,200-volt primary, 50,000-volt secondary) are included in this contract.

The Crescent Company of Chicago is exclusive western agent for the Crescent time switch, and feels confident that it made a good move when it secured this agency. The company's bulletin, No. 205, tells all about this suitable device for turning on and off show-window, sign and hall lights at a predetermined time.

The F. Bissell Company of Toledo, Ohio, has added to its list of specialties, novelty potheads, sleeves, terminal heads, etc., for telephone cable work. This business has been purchased outright from the New Haven Company, the transfer including all patents, special machinery, good will and merchandise, finished and unfinished. The Bissell company says that, owing to its advantageous location and special additional facilities, it will be in excellent position to serve the trade promptly and satisfactorily.

At the Elks' convention, to be held in Cincinnati on July 8th to 25th, there will be used nearly 30,000 Norbitt porcelain temporary sockets for decorative purposes, illuminating the streets for 37 blocks. Over 500 Norbitt temporary sockets will also be used in making the huge American flag, which is to be hung over Government Square. These handy little devices, which can be installed in a few moments without scraping the insulation from the wire, are manufactured by the Crouse-Hinds Company of Syracuse, N. Y.

The L. B. Allen Company, Chicago, received, under date of June 17th, the following rather significant letter: "Among other items, we want to bid to the Washington navy yard on Tuesday next on soldering sticks. We wrote the storekeeper asking whose make was satisfactory and he said, 'The Allen.'"

Among the recent sales made by the Crocker-Wheeler Company is that of electrical machinery to the value of about $30,000 to the Barbour Flax Spinning Company, Paterson, N. J. The equipment includes a 600-kilowatt standard direct-current 250-volt generator, and motors aggregating 515 horsepower. The W. & J. Knox Net and Twine Company of Baltimore, the United States Naval Academy of Annapolis, the J. B. Williams Company of Glastonbury, Conn., Armour & Co. of Chicago and the Traitel Marble Company of Ravenswood, L. I., are also recent customers. Armour & Co., it may be added, use over 7,000 horsepower of Crocker-Wheeler motors.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) June 14, 1904.

762,279. Telephone Lamp Jack. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago. Application filed October 12, 1901.

Several lamps and spring jacks are arranged within a common chamber in the holder, and opaque heat-proof coatings are applied to the outer surface of the lamp bulbs, whereby the light from one lamp is excluded from the adjacent lamps.

762,297. Third-rail Insulator. Henry L. Fritze, Jersey City, N. J. Application filed October 27, 1903.

The insulator is made up of an enameled top plate and an enameled base plate, with a body of glass, stone, slate or insulating composition.

762,318. Conductor and Collector for Electric Railways or Tramways. Donald Kempt, Buenos Aires, Argentina. Application filed March 11, 1903.

Conductors and collectors for electric railways consist of a frame yieldingly secured to the car, staves hinged to the frame, wheels carried by the staves, a conducting bar secured to the frame and normally out of contact with the staves, and means for bringing the staves into contact with the bar.

762,319. Contact-box and Conductor for Electric Railways or Tramways. Donald Kempt, Buenos Aires, Argentina. Application filed September 23, 1903.

Contact boxes for transmitting electric current from the main conductor to conductors on electric-railway vehicles are made up of a casing and a sliding top plate.

762,331. Electric Signal. William D. Marks, Westport, N. Y. Application filed March 12, 1903.

A series of boxes or stations are connected by two wires of different polarity or potentiality leading from each station, one into the block ahead of the station, the second into the block behind the station. A branch of the first is led into the block behind the station, so that between each station are three parallel wires, two of the same and one of opposite polarity, for operating the signals.

762,336. Signaling Apparatus for Telephone Switchboards. Frank H. McBerty, Evanston, and James I. McQuarrie, Chicago, Ill., assignors to the Western Electric Company, Chicago, Ill. Application filed February 20, 1902.

Combined with a plug and spring-jack switch is an annunciator magnet and an armature therefor carrying a target. A shield having an opening in which the target is displayed is movable by mechanism actuated by the insertion and withdrawal of the plug, the target and shield co-operating in the indication of visual signals.

762,337. Signal for Telephone Switchboards. Frank R. McBerty, Evanston, and James L. McQuarrie, Chicago, Ill., assignors to the Western Electric Company, Chicago, Ill. Application filed July 2, 1902.

Combined with a movable target is a movable shield normally held in a position to conceal the target when the latter is in its normal position. A magnet is arranged to move the target into a position of display, and a second magnet is arranged to move the shield into a position covering the target in both positions.

762,338. Relay. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed October 27, 1902.

A strip of relays for a telephone-exchange switchboard comprises a flanged horizontal supporting strip of soft iron, a number of electromagnet coils, supported at intervals along the strip, movable magnet levers, one for each coil, vertically supported in sharp bearings in the flange of the supporting strip, and relay contacts operated by the magnet levers. The strip serves to complete the magnetic circuit of all of the magnet levers.

762,341. Earth or Ground-wire Attachment. Joseph J. O'Connell, Chicago, Ill., assignor to the American Telephone and Telegraph Company, New York, N. Y. Application filed March 10, 1904.

A wire-straining device is provided with a saddle piece with feet adapted to bear on a water pipe. It is held in place by a nut piece having terminal loops, and a screw threaded into the nut and having an abutment for its head upon the saddle piece. A ground wire is wound about the pipe and over the terminals.

762,358. Electric Meter. William Stanley, Great Barrington, Mass., assignor to the Stanley Instrument Company, Great Barrington, Mass. Application filed December 6, 1901. Renewed January 11, 1904.

In an oscillating meter are combined means for producing a magnetic field, a needle oscillating therein and magnetized means for preventing the needle from coming to rest in a position parallel to the lines of force of the field.

762,370. Electric Signaling System. Samuel M. Young, New York, N. Y. Application filed January 19, 1903.

A signaling system comprises a source of direct current, a source of alternating current and a common feeder and a common return for both currents. Cars are operated by the direct current and signaling devices are actuated by the alternating current. Means controlled by the movement of the cars control the movement of the signaling devices.

762,379. Trolley Wheel. John S. Briggs, Los Angeles, Cal. Application filed April 25, 1903.

A trolley wheel comprises a circular body having a concave periphery, the center of the periphery having a groove. Resilient means guided by the groove are adapted to contact with the trolley wire.

762,391. Telephone Fire-alarm System. William L. Denio, Rochester, N. Y., assignor of one-half to Hobart F. Atkinson, Rochester, N. Y. Application filed May 11, 1903.

A spring co-operates with a wheel to give a comparatively short series of makes and breaks in the circuit. A second wheel in the same train and electrically connected with the first wheel has a larger number of make-and-break devices. A spring co-operates with the second wheel to make and break the alarm circuit several times each time the first-mentioned spring is in contact with a tooth of the first wheel.

762,409. System of Motor Control. George H. Hill, Glenridge, N. J. Application filed June 25, 1902. Renewed November 3, 1903.

Successively acting magnets are supplied with means for effecting their automatic progression. A master switch and circuits controlled by the master switch, adapted to arrest the progression of the magnets and to maintain the magnets already actuated, are the other operating parts.

762,410. Safety Apparatus for Use with Overhead Electric Conductors. Herbert F. Hill, London, England. Application filed June 10, 1903.

Associated with an electric conducting wire and supports is a safety wire, a conducting frame connected to the conducting wire at a number of points, and a bar extending from the frame above and across the safety wire.

762,425. Electrical Battery. John R. Lord, San Francisco, Cal. Application filed June 5, 1903.

An electrical battery consists of an anode, electrolyte and cathode in a containing vessel. The anode is placed in such position in the electrolyte that any solids chemically precipitated from the electrolyte may fall upon or in electrical proximity to the anode. Such precipitated solids form additional anode active material.

762,430. Electromagnetic Signal. Frank R. McBerty, Evanston, and Frederick H. Loveridge, Chicago, Ill., assignors to the Western Electric Company, Chicago, Ill. Application filed May 9, 1902.

Together with two electromagnets having opposing pole pieces is a movable armature for each magnet, each armature normally tending to occupy an unattracted position. The armatures are mounted back to back between the opposed magnet poles and arranged to oppose one another, one of the armatures normally overbalancing the other and forcing it into an attracted position.

762,432. Supervisory Signal for Telephone Switchboards. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed May 9, 1902.

The supervisory signal comprises an indicator, an armature connected with the indicator, and a magnet acting on the armature adapted to conceal the indicator when excited. A mechanical device independent of the armature is also adapted to conceal the indicator and a second electromagnet controls the device.

762,503. Electric Arc Lamp. Geza Szuk and Wenzel Hackl, Budapest, Austria-Hungary. Application filed June 3, 1903.

Mechanism for feeding and regulating the carbons comprises a solenoid, a core, a plate, perforated to receive the upper carbon, hinged to a lower part of the lamp and connected to the solenoid core. A sliding clutch plate of insulating, refractory material rests on the hinged plate and is bored concentrically with the axis of the carbon in such manner that when the solenoid attracts its core the clutch seizes and lifts the carbon.

762,509. Electric Block-signal System. Louis C. Werner, Dryden, N. Y. Original application filed December 12, 1901. Divided and this application filed August 14, 1902.

A pair of blocks, a signal, a pair of motors, one of which moves the signal a greater distance than the other, connections between the signal and the motors, and track circuits associated with the blocks and each controlling one of the motors, are the features of the invention.

762,534. Indicator for Barber Shops or the Like. George E. Jones and Harry L. Slusser, Columbus Grove, Ohio, assignors of one-half to Charlie H. Jones and George W. Core. Application filed February 16, 1904.

Indicating disks are operated by toothed wheels, which in turn are operated by electromagnetic devices.

762,535. Electric Plug or Socket Extension. William H. Kelsey, Cambridge, Mass. Application filed October 9, 1902.

A coupling for joining an electric plug or socket to the main electric terminal casing is described.

762,574. Electrical Sparking Igniter for Explosive Engines. Arthur J. Bradley, Oakland, Cal. Application filed April 7, 1903.

The igniter contains a fixed and a rocking electrode.

762,620. Pump Controller System. Arthur C. Eastwood, Cleveland, Ohio. Application filed February 13, 1903.

Connecting mechanism between the motor and the pump includes an electrically operated clutch, a main switch in the same electrical circuit as the clutch, a secondary switch and actuating means for the secondary switch constructed to be operated by variations in the condition of the fluid treated by the pump. Electrical mechanism in circuit with the secondary switch operates the main switch to cause the clutch to connect or disconnect the pump and the motor. (See cut on next page.)

762,621. Magnetically Operated Switch. Arthur C. Eastwood, Cleveland, Ohio. Application filed July 27, 1903.

The switch is operated through the pull of an electromagnet.

762,622. Magnetic Clutch. Arthur C. Eastwood, Cleveland, Ohio. Application filed March 5, 1904.

Members of a clutch have projecting portions and each is provided with a series of rings. A magnet causes the rings to be clamped between the projecting portions, and means are provided for adjusting the distance between the portions.

762,623. Magnetic Clutch. Arthur C. Eastwood, Cleveland, Ohio. Application filed April 1, 1904.

A magnetizing winding, a driving member of magnetic material made in two parts and a driven member of non-magnetic material placed to be gripped by the parts when the winding is energized are the essential features of the clutch.

762,644. Electric Key Selecting and Striking Mechanism. Andrew J. Leonard, Denver, Colo. Application filed February 21, 1902.

Rotatably mounted and longitudinally movable key-striking pins are arranged in a framework. Electric means for striking a pin are operated by rotation of the pin.

762,669. Insulated Rail Joint. George A. Weber and Percy Holbrook, New York, N. Y., assignors to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed November 13, 1903.

The meeting ends of a pair of rails are joined together by longitudinal filling bars, insulation being placed between.

762,670. Automatic Street-car Indicator. Frank H. Wehrmann, St. Louis, Mo., assignor to the American Automatic Indicator Manufacturing Company, St. Louis, Mo. Application filed October 27, 1903.

An electromagnet, through a series of levers, actuates a dial which makes the indications.

762,671. Automatic Potential Regulator. William S. Andrews, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 1, 1902.

A potential regulator contains a fixed magnetizing coil and a movable coil in series, with the fixed coil and movable within the field produced by the fixed coil. A pivoted lever carries the movable coil and means urge the movable coil in opposition to the force exerted between the movable coil and the field of the fixed coil.

762,675. Multiple-pole Voltmeter Switch. Charles C. Badeau, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 27, 1901.

A multiple-pole switch consists of a block of insulation having semicircular [illegible] flanges. Shields of insulation are situated between the segments and fo[illegible] pairs of segments. [illegible] the flanges are adapted to bridge the several pairs of segments in order. [illegible] the movable contacts.

762,684. Connector. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company. Application [illegible]

This connector has [illegible] socket terminals with [illegible]

to engage, one of the plug terminals being provided with a projection which is adapted to coact with a slot in one of the socket terminals and which prevents the plug terminal from entering the other socket terminal.

762,686. Electric Railroad-crossing Signal. Thomas C. Clark, Cambridge, Ohio. Application filed December 29, 1903.

In an electric railroad-crossing signal are an electromagnet and its armature lever and contacts. A motor-driven commutator is provided with contact mountings, made adjustable to permit the substitution of a larger or smaller commutator disk to vary the time during which the signal is made to operate.

762,697. Reactance Coil. John J. Frank, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 16, 1902.

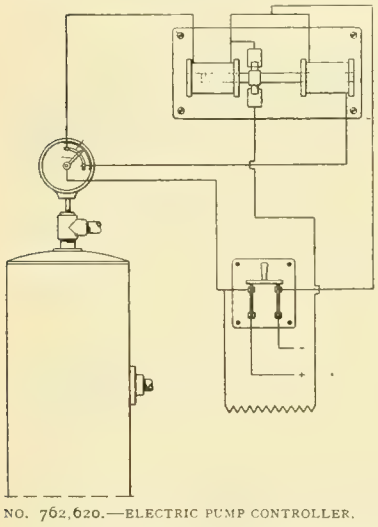
A three-phase reactance coil contains a laminated core. Laminæ consist of a single piece of material having three pairs of conductor-receiving openings formed therein and having formed between each pair of the openings a number of small distributed air gaps.

762,709. Electric Motor. Gaylord C. Hall, New York, N. Y. Application filed March 7, 1901.

Combined with a main circuit containing a motor and a resistance is a shunt circuit containing the starting switch. A positive-action circuit is shunted about the motor and is closed and broken by the shunt circuit.

762,711. Photographic Shutter-operating Mechanism. John H. Hammer, Marquette, Mich. Application filed August 18, 1903.

A photographic apparatus comprises an electric controller, an alarm device in electric circuit with the controller, means for operating the controller and a bulb operating or compressing device, connected with the alarm device and brought into compressing action by the closing of the circuit between the controller and the alarm.



NO. 762,620.—ELECTRIC PUMP CONTROLLER.

762,715. Electrical Battery. Julius E. Haschke, Chicago, Ill., assignor to Feodor G. Haschke, Austin, Texas. Application filed February 8, 1904.

Bipolar active plates separate the cells from each other and unipolar negative-pole plates constitute the exterior side plates of the end cells. An odd number of supplemental plates of alternating polarities are placed in the end cell, in which both side plates are negative-pole electrodes, the supplemental plates in the cell including one positive-pole plate in excess of the number of negative-pole plates. The plates of like polarity in the cell are electrically connected. (See cut.)

762,720. Portable Electric Light. Conrad Hubert, New York, N. Y. Application filed January 25, 1904.

A small portable casing contains a number of cells, which furnish current for a small incandescent lamp.

762,738. Automatic Regulator for Motors. Hans S. Meyer, Rugby, England, assignor to the General Electric Company, Schenectady, N. Y. Application filed September 4, 1902.

An induction motor operated by the current from the secondary coils of a transformer contains automatic means controlled by the speed of the motor for varying the ratio of transformation between the primary and secondary coils so as to increase the ratio as the speed of the motor increases and to decrease the ratio as the speed of the motor decreases. (See cut.)

762,744. Means for Regulating Dynamo-electric Machines. Charles R. McKay, Cincinnati, Ohio, assignor to the General Electric Company. Application filed November 23, 1901.

The field winding of a generator is excited by direct current and an electrodynamometer with relatively movable coils supplied with current from alternating-current leads is connected to the machine with means controlled by the electrodynamometer for varying the field strength of the generator.

762,749. Trolley. Rowley K. Ortt, Reading, Pa. Application filed November 4, 1903.

The trolley wheel is mounted in a horizontally oscillating head.

762,751. Separating Cylinder for Magnetic Separators. Clarence Q. Payne, Stamford, Conn. Application filed August 15, 1901.

Transversely laminated separating surfaces are formed by a series of magnetizable plates having toothed edges.

762,752. Apparatus for Magnetic Separation. Clarence Q. Payne, Stamford, Conn. Application filed August 30, 1901.

A separating cylinder is movable between two opposing pole pieces. Means are supplied for retaining the material in close proximity to the cylinder along a considerable segment of the cylinder below its horizontal diameter and within the magnetic field.

762,753. Apparatus for Magnetic Separation. Clarence Q. Payne, Stamford, Conn. Original application filed February 2, 1902. Divided and this application filed October 3, 1903.

Combined with a separating cylinder provided with a number of transversely disposed magnetizable laminæ, a series of whose outer edges project radially beyond those of their adjacent laminæ, are two opposing pole pieces placed approximately concentric with the cylinder and between which the cylinder is arranged to revolve.

762,759. Magnetic Grapple. Wolfgang Reuter, Wetter, Germany. Application filed February 16, 1904.

In an engaging device and magnetic-lifting contrivance for cranes is an electromagnet with means for raising and lowering the electromagnet.

762,768. Rail. Louis Steinberger, New York, N. Y. Application filed December 16, 1903.

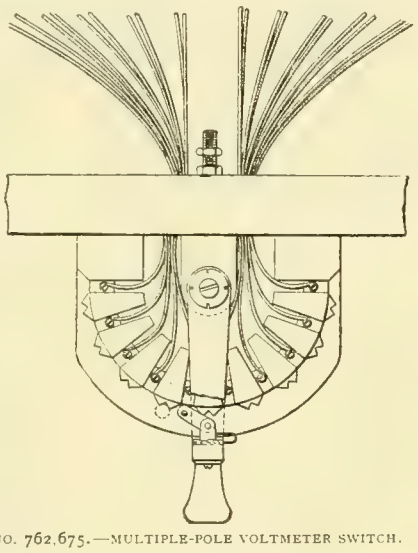
A third rail comprises a supporting member of insulating material provided with a cat-head. A metallic member has a portion engaging the cat-head for the purpose of securing the members rigidly together; a rail section engages the metallic member and is movable relatively thereto.

762,769. Support for Rails. Louis Steinberger, New York, N. Y. Application filed February 11, 1904.

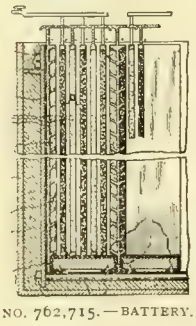
Insulating material is placed between the support and the rail.

762,770. Door-opening Apparatus. Henry S. Stewart, Chicago, Ill. Application filed March 24, 1904.

An electromagnet releases a weight which opens the door.



NO. 762,675.—MULTIPLE-POLE VOLTMETER SWITCH.



NO. 762,715.—BATTERY.

762,776. Induction-coil Vibrator. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company, Providence, R. I. Application filed January 22, 1904.

A vibrator is adapted to interrupt the primary circuit of an induction coil and be moved in one direction by the magnetic attraction of the coil. A continuously energized electromagnet acts upon the vibrator in opposition to the induction coil.

762,791. Trolley Hanger. Montraville M. Wood, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 15, 1902.

A supporter has a shoulder having a notch extending therethrough. A cap is connected with the supporter and provided with interior ratchet teeth and a locking device adapted to engage the notch and ratchet teeth.

762,792. Electric-railway Apparatus. Granville T. Woods, New York, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 12, 1901.

Four coils are arranged in connection with the circuits and a number of switches are adapted to act in sequence in obedience to the energy received by the coils so that the first coil receiving energy controls the circuit of the second coil, and so on. The third coil sustains the act of the first coil and the fourth coil controls the circuit of the first coil.

762,798. Railway Signaling System. Marion A. Born, Lawrenceville, Ga., assignor of part to Milton H. Loudon, Kansas City, Mo., and Narcissa Hayes and Emma Byles, Washington, D. C. Application filed November 7, 1902.

Continuous bare conductors are laid parallel with the roadbed and a source of electrical energy is carried by each train. A main circuit on each train has its terminals connected respectively to the conductors, an adjustable resistance and lamps are connected in the main circuit. A relay and resistance are connected in shunt with the main circuit, and an electromagnetically actuated controlling means is disposed in a circuit controlled by the relay.

762,803. Electrical Accumulator. Alfred J. B. M. Colletas, Paris, France. Application filed September 12, 1901. Renewed April 22, 1904.

A battery contains a negative-pole electrode of porous material electrically conductive but unattackable by sulphuric acid, the electrode containing hydride of copper in combination with a bath of sulphuric acid.

762,812. Electric Signaling System. John Dianovszky, Passaic, N. J., assignor of one-half to Michael Lujanovitz, Passaic, N. J. Application filed July 18, 1903.

An electric signaling system for railroad trains comprises a sectional conductor along the track, a contact on the locomotive, in engagement with the conductor, a clock-controlled commutator, an alarm controlled by one current from the commutator, a steam-shutting-off mechanism controlled by the other current from the clock-controlled commutator, for shutting off the steam, and a brake-applying mechanism for applying the brakes, controlled from the steam-shutting off mechanism.

762,820. Electric Telephone. Ernst Gundlach, Berwyn, Ill., assignor to the American Telephone and Telegraph Company, a corporation of New York. Application filed February 5, 1904.

The essential parts are a diaphragm, magnet and coil and an elastic-pressure device mounted behind the diaphragm and constantly exerting pressure upon the inner surface of the diaphragm, in a circle or zone, between the center and periphery, thereby tensioning the diaphragm.

762,823. Trolley Wheel. Stewart J. Hamlin, Allegheny, Pa. Application filed March 29, 1904.

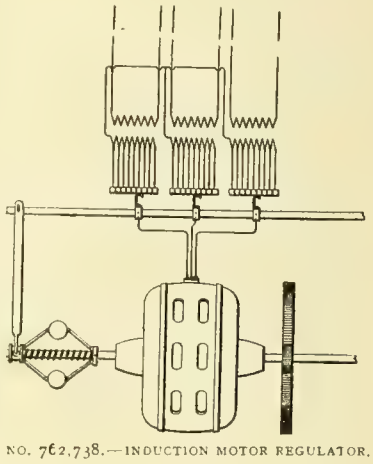
Details are described.

762,824. Fuse Plug. Rudolf Hundhausen, Wilmersdorf, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. plication filed November 24, 1899.

A main and supplemental fuse are arranged in a fuse chamber and extend through apertures in its walls.

762,829. Receiver for Wireless Telegraphy. Oliver Lodge, Birmingham, Alexander Muirhead, Shortlands, and Edward E. Robinson, Birmingham, England. Application filed July 28, 1902.

Two conducting surfaces and a film of fluid-insulating material between such surfaces are embodied in the receiver. A rotary body, to which one of the conducting surfaces is attached, and means to rotate the body, whereby the continuity of the film is restored after having been broken down by an ethereal wave, are the other features.



NO. 762,738.—INDUCTION MOTOR REGULATOR.

762,831. Trolley Base. Peter D. Milloy, Buffalo, N. Y., assignor of one-half to Washington L. Altee, Buffalo, N. Y. Application filed October 27, 1902. Renewed March 29, 1904.

A revoluble base plate carries the trolley pole.

762,840. Feed-wire Connection. George L. Osborn, Boston, Mass. Application filed September 2, 1902.

A soldered connection for the feeder of a third rail is described.

762,847. Storage Battery. Max Schneider, Dresden-Plauen, Germany, assignor of one-half to Julius Beisbarth, Nuremberg, Germany. Application filed September 4, 1903.

Downwardly converging lead grid cones put one above the other and fastened by melting to a central lead core form the positive electrodes, the lead grid cones and most of the lead core up to a point near its upper end being vertically and radially divided into parts. A hollow cylinder of active material forms the negative-pole electrode, enclosing the positive-pole electrode.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on June 21, 1904:

365,040. Electric Valve Mechanism for Water Mains. George B. Bassett, Watertown, N. Y.
365,059. Printing Telegraph. Samuel V. Essick, Alliance, Ohio.
365,103. Automatic Telegraphy. Charles Selden, Baltimore, Md.
365,116. Apparatus for Transforming Electric Currents. Louis Bollmann, Vienna, Austria-Hungary.
365,159. Incandescent Lamp Socket and Cut-out. Merle J. Wightman and Herman Lemp, Hartford, Conn.
365,240. Trolley Track. Lemuel Coburn, Holyoke, Mass.
365,189. Incandescent Lamp Socket and Cut-out. Hermann Lemp and Merle J. Wightman, Hartford, Conn.
365,339. Guide Truck for Electric Railways. Benjamin F. Hamilton, Boston, Mass.
365,340. Swivel Truck for Electric Railways. Benjamin F. Hamilton, Boston, Mass.
365,341. Tramway for Elevated Electric Railways with Means for Insulating the Rails. Benjamin F. Hamilton, Boston, Mass.
365,345. Electric Railroad Signal. Malcolm W. Long, Harrisburg, Pa.
365,351. Incandescent Electric Lamp. James Smith, New Albany, Ind.
365,359. Electric Battery. Pierre Germain, Clermont Ferrand, Puy-de-Dome, France.

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Western Electrician

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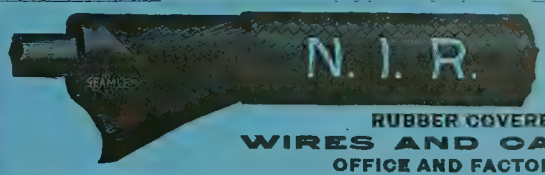

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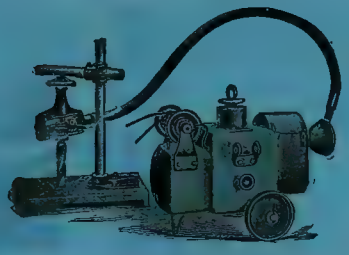
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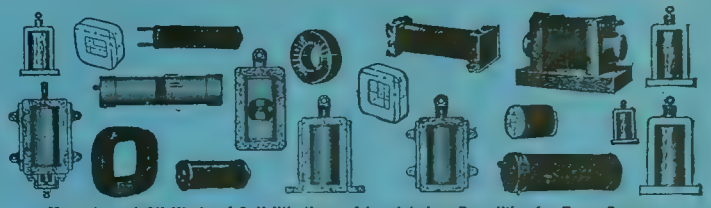
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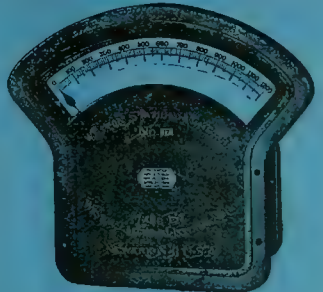
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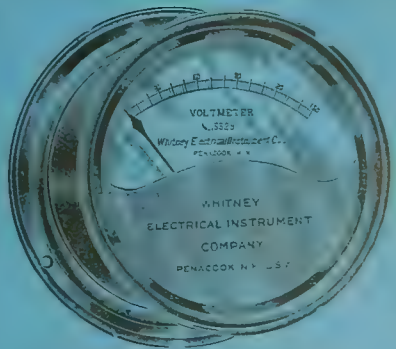

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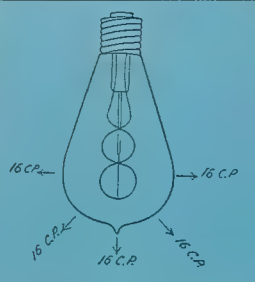

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6 Sterling Special Lamps to give an average of
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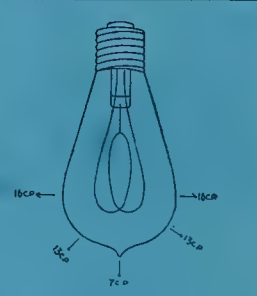

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Side	16	Candle Power
Angle	13	" "
Tip	7	" "
AVERAGE	12	" "

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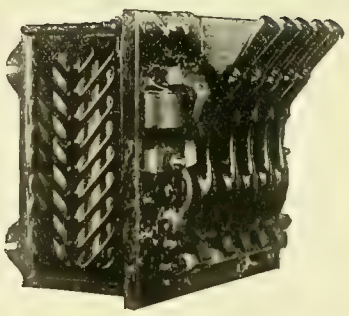

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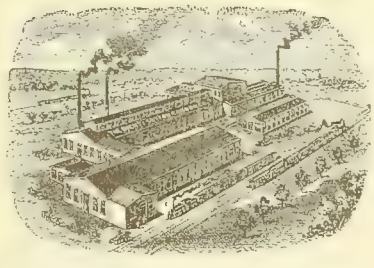

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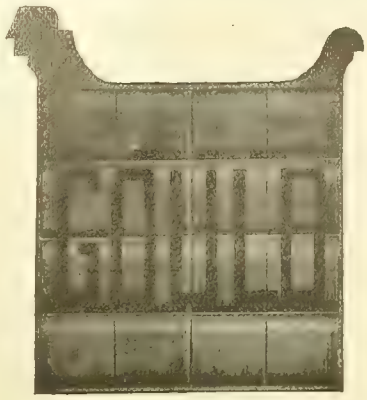

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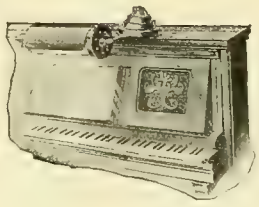

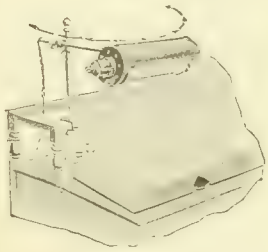

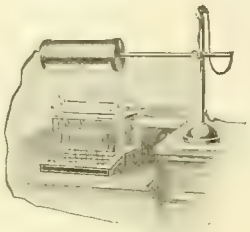

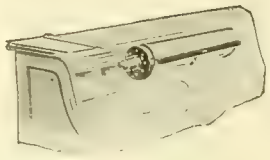

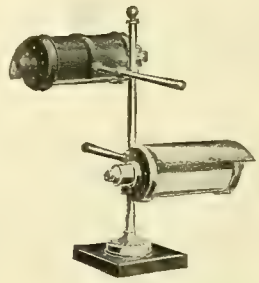

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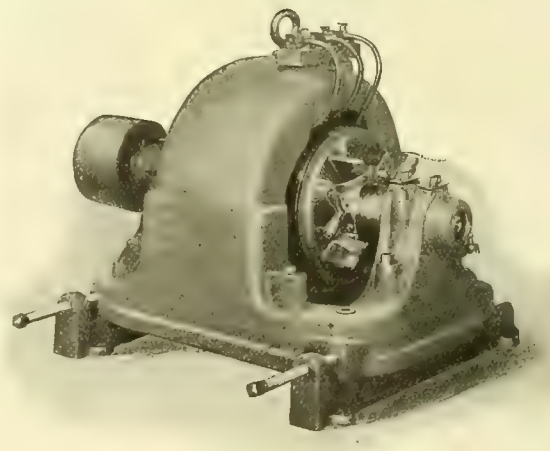
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

Central Station Managers Don't Be Afraid of the Gas Plant

Work up a Motor Load



WE CAN FURNISH YOU

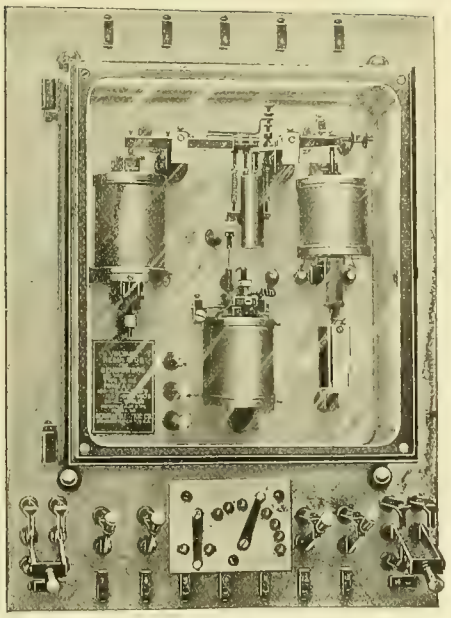
Single Phase MOTORS

That will start under full load in sizes ranging from 1-8 to 35 H. P.

Wagner Electric Mfg. Co.

St. Louis, Mo., U. S. A.

The General Electric Company's Voltage Regulators For Generators



Type TA—125 Form A Voltage Regulator for A. C. Circuits

Can be furnished for any voltage.

Operate automatically.

Require no attention after first adjustment.

Prolong the life of lamps 30 to 60%.

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Principal Office: Schenectady, N. Y.

Chicago Office: Monadnock Block Sales Offices in all Large Cities

The Best Lamps on the Market are the Easiest to Get

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Julius Andrae & Sons Company.

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National Electric Supply Company.

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Barrett Electric Company.

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The Chas. F. Sloane Company.

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The Chas. F. Sloane Company.

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Berry Electrical Mfg. Company.

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H. W. Johns-Manville Company.
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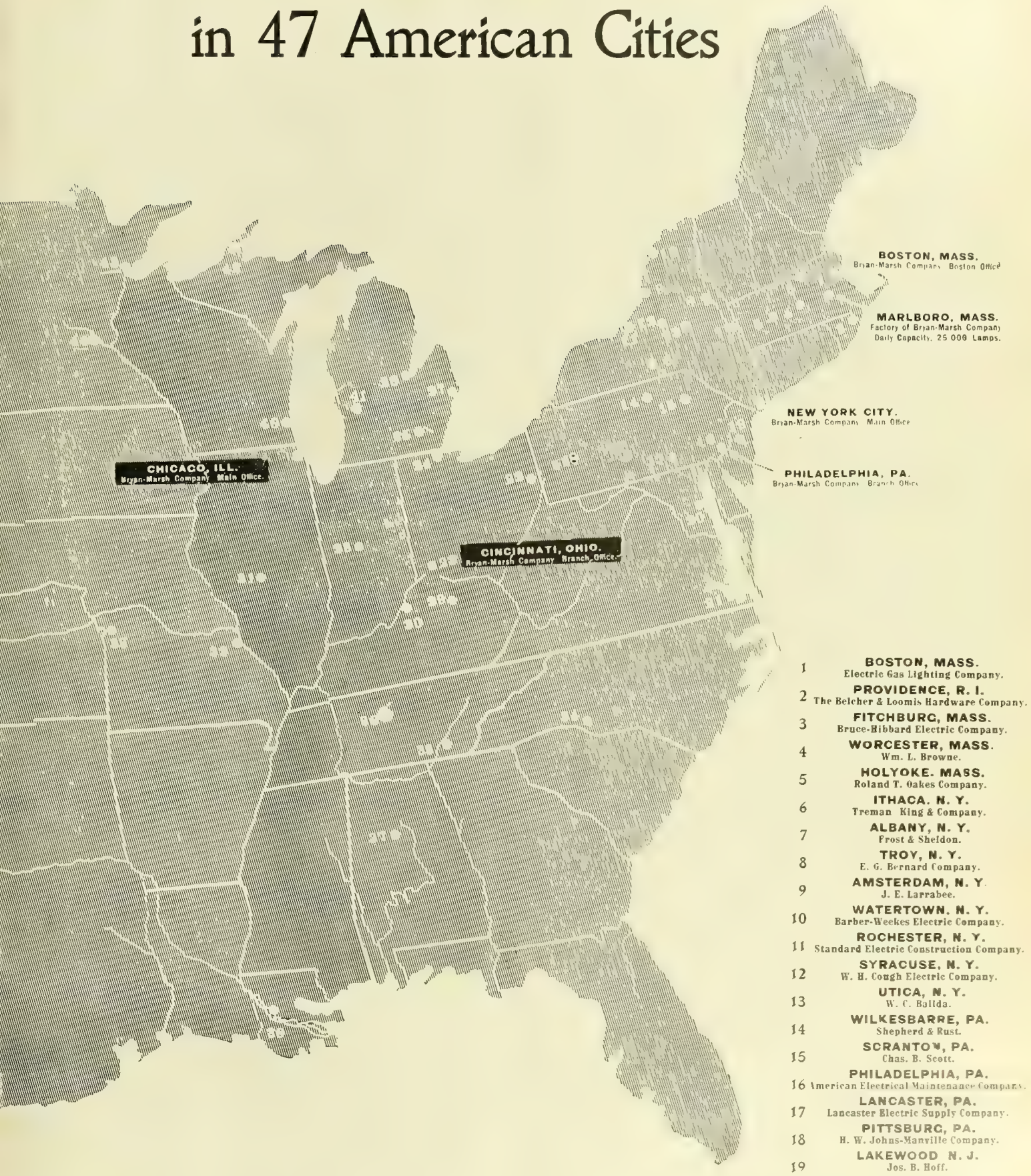
39 **WICHITA, KANS.**
Sumpton Electric Company.

Stocks of Bryan-Marsh Lamps are carried in 47 American Cities



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Electric Gas Lighting Company.

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The Belcher & Loomis Hardware Company.

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Bruce-Hibbard Electric Company.

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American Electrical Maintenance Company.

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Lancaster Electric Supply Company.

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CROCKER-WHEELER
COMPANY
MANUFACTURERS
of
GENERATORS AND MOTORS
and
ENGINEERS
for
ELECTRICAL EQUIPMENTS
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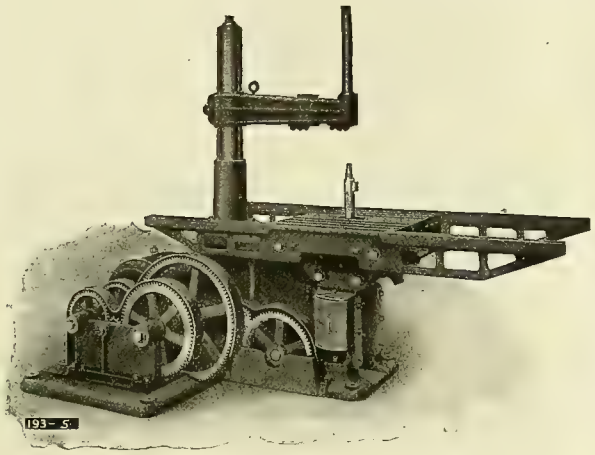
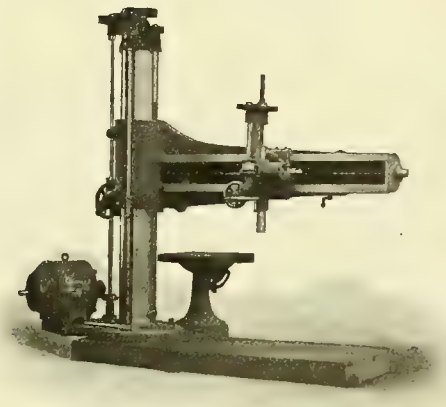
BULLOCK ELECTRIC MANUFACTURING CO.

CINCINNATI, OHIO, U. S. A.

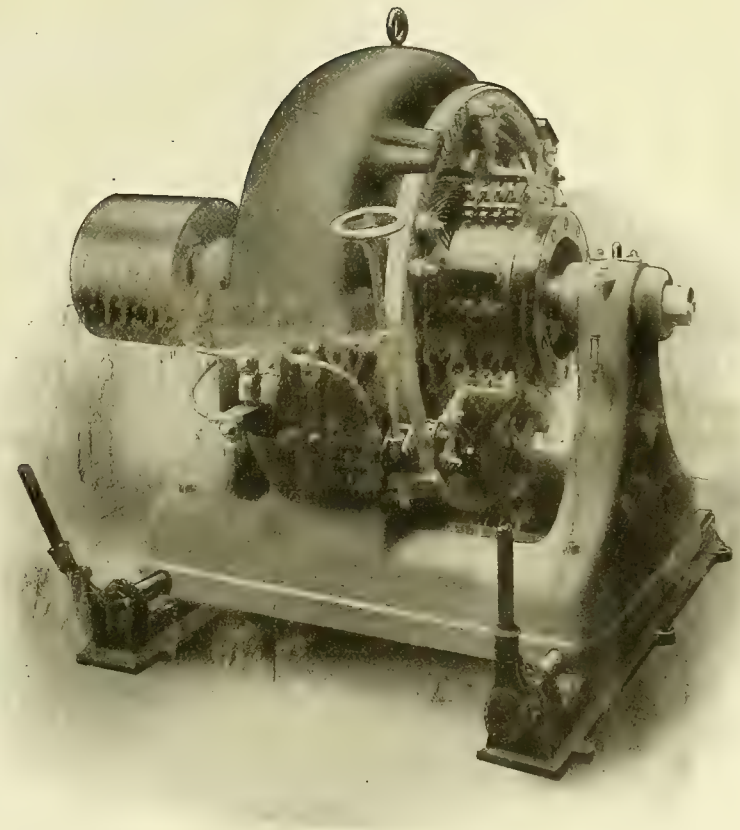


Keyseater driven by Bullock Type "N" Motor.

Bullock Type "N" Motors are especially adapted for driving machinery requiring variable speeds using the Bullock Multiple Voltage System.



Radial Drill Driven by Bullock Type "N" Motor.



SMALL SIZE "TYPE L" BELTED
WESTERN ELECTRIC MACHINE

GENERATORS and MOTORS

COMPLETE
LIGHTING
SYSTEMS

BULLETINS ON REQUEST

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CALIFORNIA ELECTRICAL WORKS
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AMERICAN ELECTRIC COMPANY
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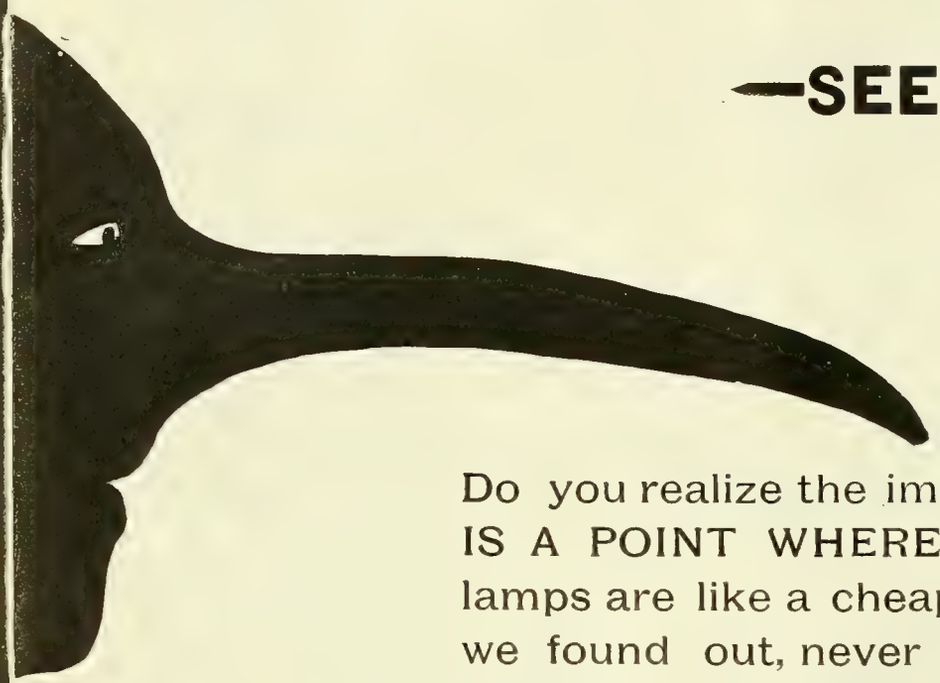
STANDARD ELECTRIC COMPANY
CINCINNATI

"NOSE IN"—
AND FIND

—SEE THE "POINT?"



FACTS (not fancies!)

Do you realize the important fact in the manu
IS A POINT WHERE TO ADD TO THE COST
lamps are like a cheap bicycle—they are harder
we found out, never mind how, that we could
thing on the market, no matter what its price
our output last year about 27 per cent. over
less profit per lamp—at all events we can save
is simple—we'll give you more actual service
don't believe it? No? Well, we'll send you a

TO LET YOU PRO

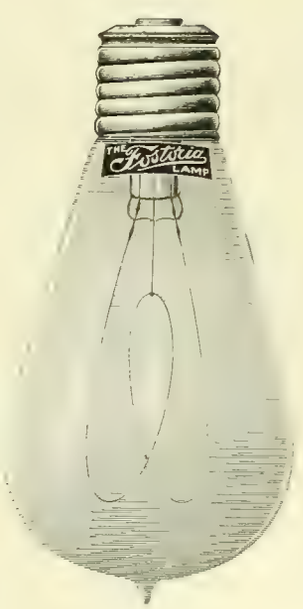
THE FOSTORIA INCAND

MAIN OFFICE AND WO

P. S.—We are like the good matter-of-fact jeweler—we do NOT try to explain all

OUT ABOUT "FOSTORIA"

facture of incandescent lamps, THAT THERE CANNOT ADD TO THE QUALITY? Cheap to push and they break down sooner. BUT make and sell for 17c a lamp equal to any- may be—perhaps it was because we increased previous year or possibly we are satisfied with you money—that's what you want. The process per dollar invested than anybody else. You man with instruments



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ESCENT LAMP CO.

RKS, FOSTORIA, OHIO.

the details of watchmaking, but we DO give you the best "JEWELED PRODUCT."

JUST "A LINE OR TWO"

ABOUT

FOSTORIA Inner Globes

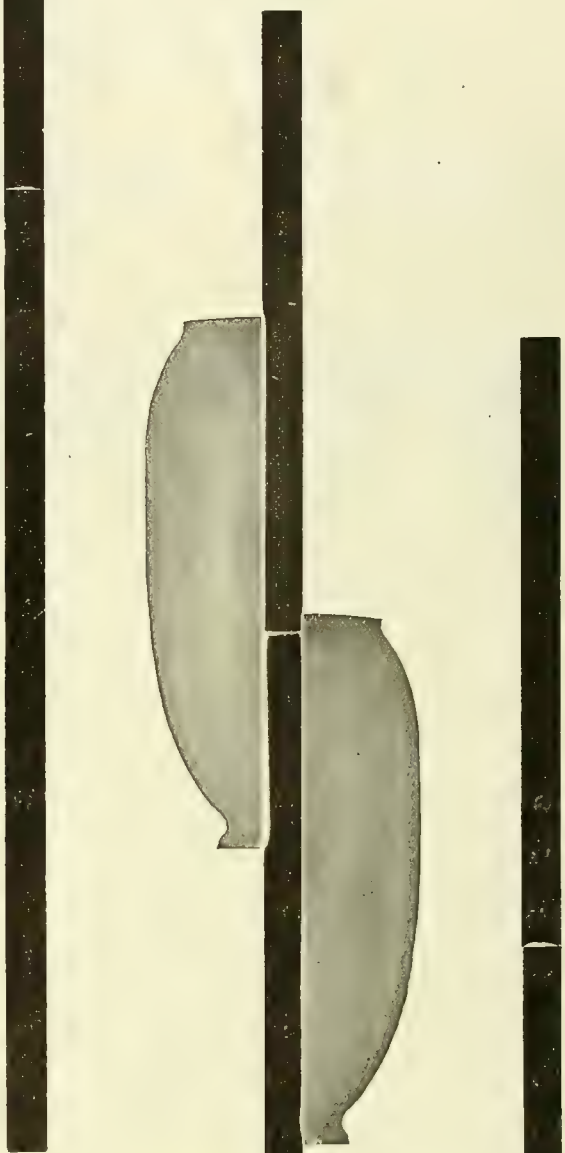
SUPPOSE YOU TOOK YOUR PENKNIFE AND

SPLIT A GLOBE IN HALF

BUT YOU KNOW YOU COULDN'T DO THAT—
YOU CAN, THO',

LOOK INTO IT

ANOTHER WAY—



YOU WOULD FIND THAT THERE ARE THINGS ABOUT A SIMPLE LITTLE INNER GLOBE THAT NONE BUT AN EXPERT CAN APPRECIATE—WE ARE EXPERTS.

We manufacture nothing but inner globes in our glass works, and we have made a specialty of them, therefore it is but natural that our goods should be more perfect than those of a manufacturer who makes a general line of glass and a specialty of no particular kind.

The seats of FOSTORIA GLOBES are so ground that it is practically impossible to nick them sufficiently to admit air to the globe without breaking them.

Each FOSTORIA GLOBE is accurately gauged and passes rigid inspections for all defects and perfect parallelism of "seats."

Our glass upon test has shown higher heat-resisting quality than that of any other maker.

WE HAVE NOW A HIGH-HEAT RESISTING GLOBE THAT WILL STAND SUDDEN MAXIMUM CHANGES OF TEMPERATURE.

THE FOSTORIA INCANDESCENT LAMP CO.

FOSTORIA, OHIO.

P. S. SEND FOR OUR PAMPHLET, "THINGS THE TRIMMER SHOULD NOT FORGET."

"ELECTRA" HIGHEST GRADE NUERNBERG

CARBONS

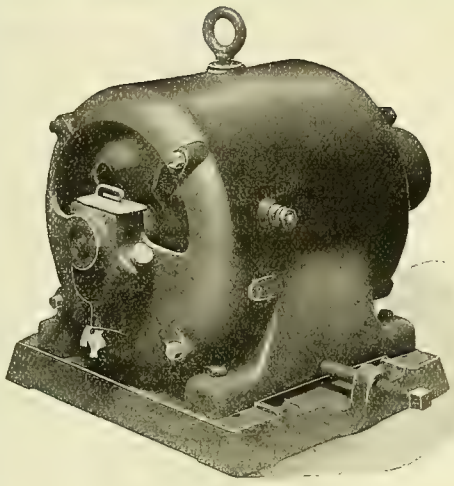
BEST LIGHT LONGEST LIFE

STEADIEST LIGHT LEAST DUST

•TRADE MARK•

REMAIN THE STANDARD OF THE WORLD FOR ALL ARC LIGHTING SYSTEMS, BECAUSE they cannot be equaled in QUALITY or EFFICIENCY, producing the highest standard of candlepower in proportion to the current consumed.

HUGO REISINGER, Sole Importer, - - 11 Broadway, NEW YORK.



3 H. P. 104 Volt 60 Cycle Motor.

INCREASE YOUR EARNINGS

THIS YEAR BY PROMOTING THE USE OF OUR LINE OF

SINGLE-PHASE SELF-STARTING

A. C. MOTORS

AND

CEILING FANS

We Build Them for All Practical Frequencies and Voltages.

Now is the Time to Place your Order for Fans for Future Delivery and Avoid the Rush, Which Will Soon Occur.

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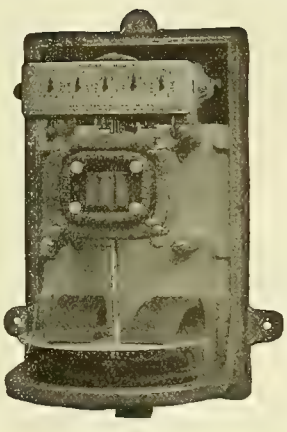
PHILADELPHIA: 1617 Real Estate Trust Bldg.

NEW YORK: 120 Broadway.



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NO CONSTANTS
SENSITIVE
GOOD MAGNETS
LARGE DIAL

DUNCAN INTEGRATING WATTMETER

FOR

DIRECT CURRENT LIGHTING AND POWER.

MOST ACCURATE AND UP-TO-DATE METER UPON THE MARKET.

DUNCAN ELECTRIC MFG CO.,

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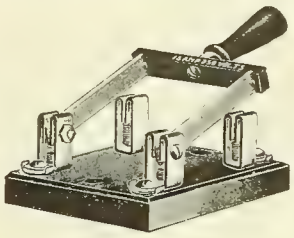
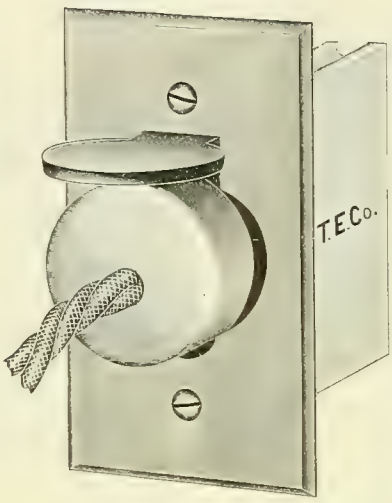
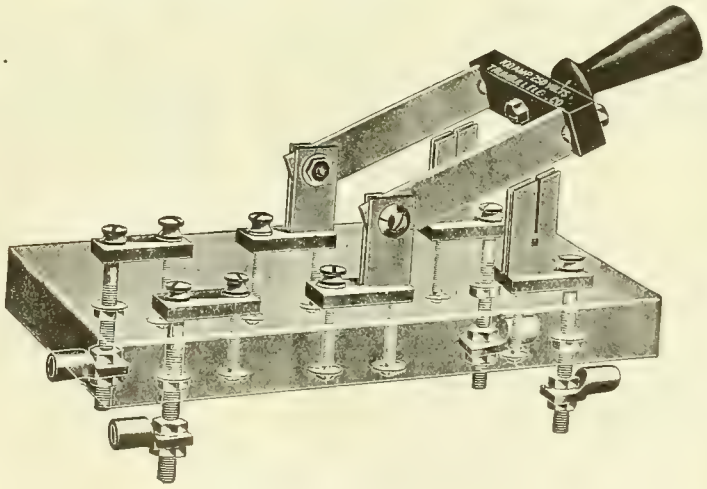


Type B. 15 Amp. 250 Volts.

Type A. Single Pole.



Weatherproof Sockets. Edison or T. H. Base.



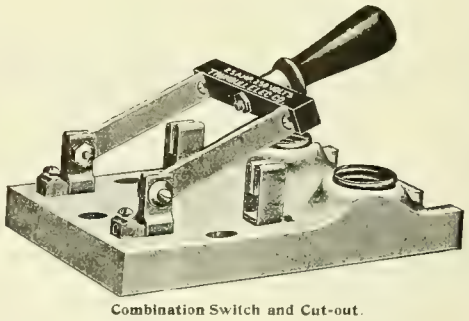
Type A. Back Connected Switch.

Cleat Style Rosette. Standard Package 250.

No. 1935.

Plug Cut-Outs,

ALL STYLES,
ALL GOOD.



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Let us
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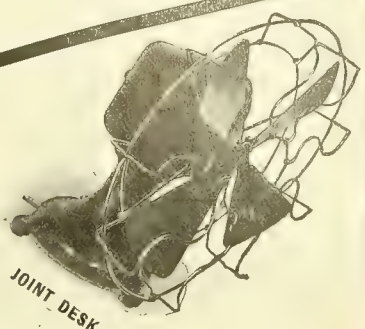

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is not aimed at the users of

for they know the perfect reliability of this make,

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We

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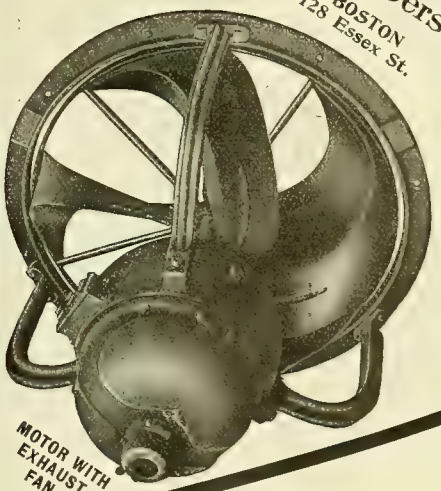

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X—Counter EMF.
XI—Hysteresis and Eddy Currents.
XII—Armature Reaction.
XIII—Sparking.
XIV—Winding of Dynamos and Motors.
XV—Proper Method of Connecting Dynamos and Motors—Self Excitation.
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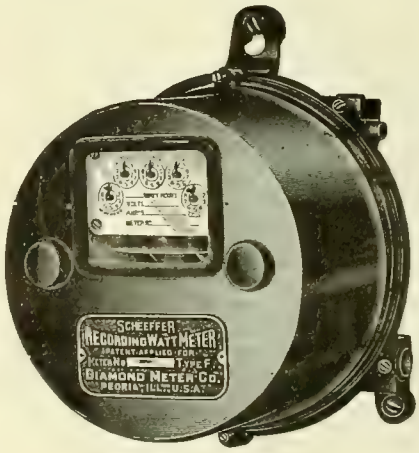

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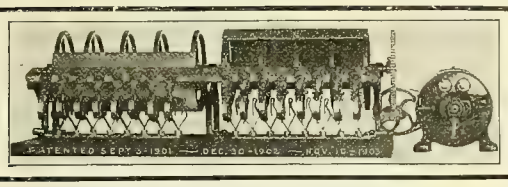

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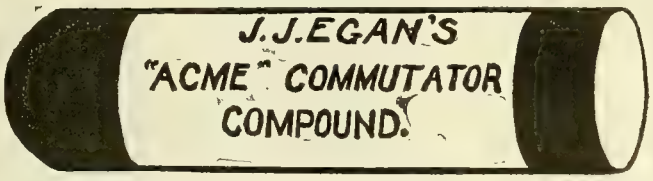

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MANUFACTURED BY

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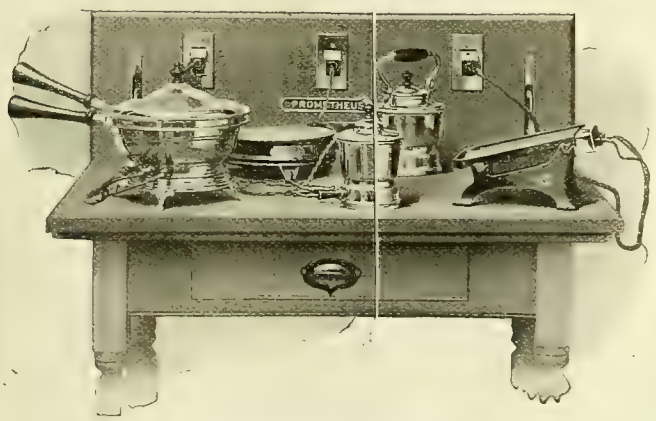

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EDISON MINIATURE LAMPS

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For use in portable lighting devices—electric candle sticks, pocket lanterns, carriage and bicycle lamps, clock lights for bed rooms, ruby lanterns for photography and for optical, dental and surgical instruments.

All types supplied—
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EDISON DECORATIVE & MINIATURE LAMP DEPT.,
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You Who are Troubled with Sparking and Cutting of Commutators to Use

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

K. McLENNAN & CO.,
Sole Manufacturers,
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Eclipse Pocket Ammeter
For General Battery Testing. 0 to 15 Amperes.

"Ready for use," with flexible cord attached and contact spur in case, which is drawn back into case, when carried in pocket. Used in any position, and works in either direction of current. Size of watch, and very light weight. Pivots hardened and polished. Ask your jobber. Eldredge Electric Mfg. Co., Springfield Mass.

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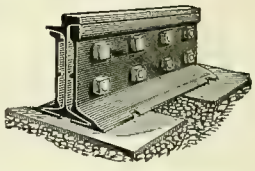
Over FIFTEEN THOUSAND (15,000) miles in use. Received the highest award in its class at Paris Exposition, 1900 and Pan-American, Buffalo, 1901.



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VOLT - AMMETERS,
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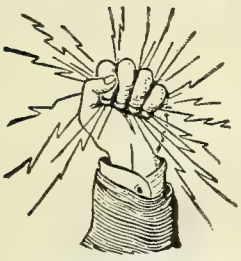

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DID IT EVER STRIKE YOU THAT
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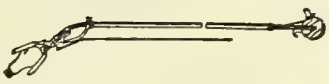

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ARE THE BEST. Send for descriptive Circular.
Absolutely Non-Infringing. Protection Guaranteed.
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THE HIGHEST ACHIEVEMENT IN FLEXIBLE CONDUIT CONSTRUCTION.
SEND FOR DESCRIPTION AND PRICES.
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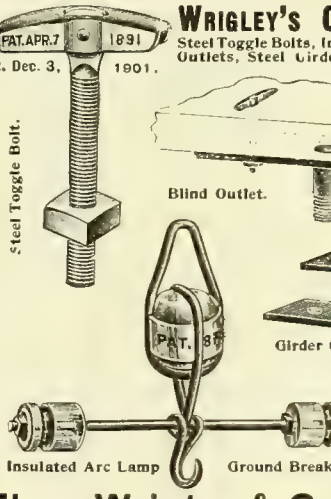

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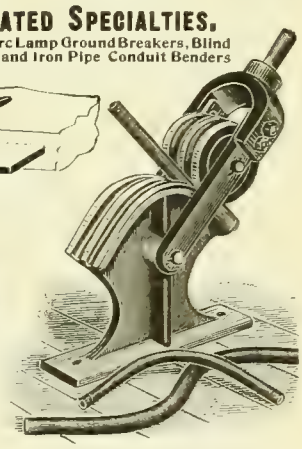
Steel Toggle Bolts, Insulated Arc Lamp Ground Breakers, Blind Outlets, Steel Girder Clamps and Iron Pipe Conduit Benders



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"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

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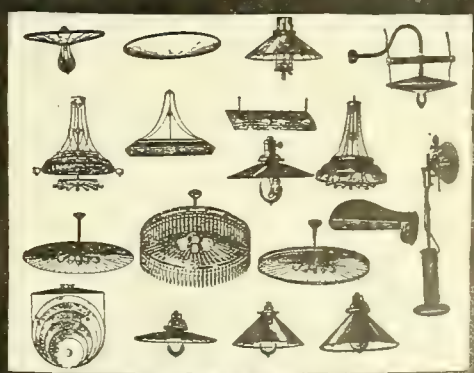

AMERICAN REFLECTOR & LIGHTING CO. CHICAGO

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

Would like position as superintendent or general manager of good power, lighting or water works plant. Thirty-eight years of age, married and have had very wide experience building, overhauling and operating such plants. Am looking for permanent position with good future prospects, with salary to start not less than $1,500 per year. Address BOX 287, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Superintendent for electric plant with these qualifications: Age, over 30 and temperate. Five years' experience operating a plant; thoroughly understand A. C. current, steam engines, power machinery and line work. Must gain good results and be willing to work. Wages are $75 per month, with lights and telephone free. Rents and living are very reasonable. This is a good permanent position for the right man. Address BARNES ELECTRIC LIGHT & POWER CO., Maquoketa, Iowa.

WANTED.

A reliable manufacturer is desirous of manufacturing and marketing some Electrical Specialties. Practical men the country over are constantly evolving schemes which save them time and money and which would be valuable to every man in the business. We want to acquire the right to manufacture and market some of these, of course, compensating the inventor in a way to be arranged satisfactorily to both parties. If you have something good, write us. Address BOX 288, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

One single phase alternating current, 125 cycle, 1000 V. 120 K. W. or over dynamo, either General Electric, Westinghouse or Stanley make. State price and condition of dynamo. Address, BOX 285, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Three experienced incandescent lamp salesmen, by an old and well-established company not in the trust. Applicants will please state age, experience and salary wanted. Address BOX 199, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

At a bargain, one 34x60 left-hand Corliss Engine in excellent condition. Also one 650-lb Morgan & Williams Steam Drop. DAVENPORT MACHINE WORKS, Davenport, Iowa.

FOR SALE.

6 K.W. Edison 220-volt motor; 5 H. P. Eddy 220-volt motor; 1 H-P Crocker-Wheeler 220-volt motor. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

Electric light plant in town of 1,000 population. In fine shape and on sound financial basis. I did not want to take it but was obliged to and now want to sell it. New generator and thoroughly overhauled since taking possession. E. E. SECOR, Buffalo Center, Iowa.

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At a bargain. One 40-Lt. 9.6 Amp. Westinghouse arc machine, complete with pulley, switchboard instruments, marble panel, etc. Also 25 Standard and Westinghouse lamps for same, all in A-1 operating condition. Address BOX 289, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

Electric Light Plant near St. Louis in Illinois. Population, 3,000; 10-year city contract, 28 new A. B. arcs, new Ideal engine, boiler and heater. Everything in first-class shape. Address BOX 292, care Western Electrician, 510 Marquette Bldg., Chicago Ill.

FOR SALE.

Complete new apparatus embodying all the most recent improvements in machinery employed in the manufacture of incandescent electric lamps. Will guarantee lamp manufacturers results as to cost and quality. Address BOX 274, care Western Electrician, 510 Marquette Bldg., Chicago.

Telephones for Sale

I have about 600 high grade telephones left, which I will sell from $3.00 to $5.00 each. They are good as new. Call or address

JOHN T. BOYLE,
FOND DU LAC, WIS.

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, January 12, 1904, and publicly opened immediately thereafter, to furnish at the Navy Yards, Portsmouth, N. H., and Boston, Mass., a quantity of lead and fibrous covered cable, galvanized crucible steel wire, white pine, oars, pipe and fittings, cast iron bell and spigot pipe, gate valves, hydrants, chain hoists, electric motors, steam capstan, various machine tools, tee rails, and erection of forges, pressure and exhaust system. Blank proposals will be furnished upon application to the Navy Pay Offices, Portsmouth, N. H., and Boston, Mass. H. T. B. HARRIS, *Paymaster General, U. S. N.* 12-17-03

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, January 12, 1904, and publicly opened immediately thereafter, to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of lighting wire, electrical supplies, hand scrub brushes, corn brooms, molding sand, brick, fire brick, fire clay, screws, brass wire, miscellaneous hardware, wrought-iron screens, lenses, lacing and rigging leather, Oregon pine, cedar, oak, sheet brass, pig lead, bar steel, galvanized sheet steel, American and Norway bar iron, pig iron, scrap iron, magnesia pipe covering, brass pipe, copper pipe, iron pipe, valves, pipe fittings, special castings, hydrants, gasoline, rotten stone, laundry soap, safety matches, cotton waste, foundry facings, electric deck winch, electro galvanizing plant, and driving a number of piles. Blank proposals will be furnished upon application to the Navy Pay Offices, San Francisco, Cal., and Seattle, Wash. H. T. B. HARRIS, *Paymaster General U. S. N.* 12-7-03

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE

at a bargain if taken immediately:

- 1-400 K. W. Westinghouse Alternator.
- 1-200 " Stanley Alternator.
- 2-150 " General Electric Alternators.
- 3-120 " " "
- 2-150 " Westinghouse 500 V. Railway Generators.

Largest stock of second-hand electrical apparatus in this country. Send for our monthly Bargain sheet with complete list and net prices. Everything fully guaranteed.

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New net prices on all goods contained in our 550-page catalogue No. 14. Send for it.

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NICKEL PLATE.
The New York, Chicago & St. Louis R.R.

Offers Three Express Trains

Every Day between

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Through Sleeping Cars
Day Coaches and Dining Cars

Individual club meals, ranging in price from 35c to $1.00; also service a la carte. Midday luncheon, 50c.

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JOHN Y CALAHAN, GENERAL AGENT
113 Adams Street, Room 298, CHICAGO

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FOR SALE CHEAP.

CORLISS ENGINE—One 18x42 inches R-H Weisel & Vilter; shaft 8¾ inches diameter by 9 feet long. Wheel is in halves and is 12 feet diameter by 27½ inches face. Engine is free from defects of any kind, and is in first-class operative condition.

BOILERS—Two 66 inches by 18 feet John Mohr & Sons 2 Sheet Design Tubular Boilers; complete with heavy full fronts and all trimmings including Steam Drum 18 inches in diameter by 15 feet 10 inches long; connected with Copper Goose Necks, used 4 years only. Hartford Insurance Co. allows 90 lbs. steam.

Four 60 inches by 16 feet National Boiler Works, 2 ring design complete with heavy full fronts and all necessary trimmings, including Hawley Down Draft Furnaces, which are in good condition; used 4 years only. Hartford Insurance Co. allows 90 lbs. steam.

GAS OR GASOLINE ENGINE—One 54 H. P. Fairbank-Morse & Co. Late Type; used 2 years only. Is in excellent condition and guaranteed practically as good as new.

LIGHT WEIGHT WROUGHT IRON PIPE—16,000 ft. 4½ in., 50,000 ft. 4 in., 20,000 ft. 3½ in., 25,000 ft. 3 in., 10,000 ft. 2½ in. We will quote some exceptionally low prices on this Pipe in carload lots.

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WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
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220 V. DIRECT CURRENT.	500 V. DIRECT CURRENT.
80 H. P. Westinghouse, 400 R. P. M.	25 H. P. Crocker Wheeler, 750 R. P. M.
20 H. P. Eddy, 1450 R. P. M.	15 H. P. Detroit, 1000 R. P. M.
7½ H. P. General Electric, 900 R. P. M.	10 H. P. General Electric, 1350 R. P. M.
5 H. P. General Electric, 1820 R. P. M.	10 H. P. Simpson, 2000 R. P. M.
5 H. P. Paragon, 900 R. P. M.	7½ H. P. Crocker-Wheeler, 1575 R. P. M.
3½ H. P. Paragon, 1000 R. P. M.	7½ H. P. Card, 775 R. P. M.
2 H. P. General Electric, 1025 R. P. M.	6 H. P. C. & C., 1030 R. P. M.
2 H. P. Simpson, 2100 R. P. M.	5 H. P. Westinghouse, 1050 R. P. M.
1½ H. P. General Electric, 1800 R. P. M.	5 H. P. C. & C. 1600 R. P. M.
1 H. P. Lundell, 1200 R. P. M.	3 H. P. Jenny, 1600 R. P. M.

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Summitville Ind. Nov. 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the one issue. As I have already received about 40 answers to same. Send me your bill and I will remit same to you. Thanking you very kindly for your promptness

I am Yours Resp.

A. R. Kaufman
Clerk.

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76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

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FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

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Electrical and Steam Machinery

G. E. 1000 RAILWAY MOTORS.

One Hundred G. E. 1000 (35 H. P.) Street Railway Motors, all in excellent second-hand condition and complete with gears, pinions and gear cases. Write for prices.

ALTERNATORS

One 200 K. W. Ft. Wayne "Wood," 1,100 volts, 140 cycles, single-phase.
One 180 K. W. General Electric, 2,300 volts, 60 cycles, single-phase.
One 180 K. W. Westinghouse, 2,300 volts, 60 cycles, single-phase.
One 150 K. W. Stanley, 1,100 or 2,200 volts, 133 cycles, two-phase.
One 120 K. W. General Electric, 1,040 volts, 125 cycles, single-phase.
One 120 K. W. General Electric, 2,080 volts, 125 cycles, single-phase.
One 120 K. W. Westinghouse, 1,100 volts, 133 cycles, single-phase.
One 90 K. W. General Electric, 2,300 volts, 60 cycles, single-phase.
Two 75 K. W. General Electric, 2,100 volts, 60 cycles, two-phase.
One 60 K. W. Westinghouse, 2,200 volts, 60 cycles, two-phase.
One 60 K. W. Westinghouse, 1,100 volts, 133 cycles, single-phase.
One 60 K. W. General Electric, 1,040 volts, 125 cycles, single-phase.
Three 35 K. W. Thomson-Houston, 1,040 volts, 125 cycles, single-phase.

RAILWAY GENERATORS, 500-550 VOLTS.

Two 500 K. W. General Electric, 6-pole, speed, 300 R. P. M.
Two 300 K. W. General Electric, 4-pole, speed, 400 R. P. M.
One 200 K. W. Westinghouse, 6-pole, speed, 510 R. P. M.
Two 200 K. W. General Electric, 4-pole, speed, 425 R. P. M.
One 180 K. W. Westinghouse, 4 pole, speed, 535 R. P. M.
One 150 K. W. Fort Wayne, 6-pole, speed, 550 R. P. M.
One 110 K. W. Eddy, 4-pole, speed, 600 R. P. M.
One 100 K. W. General Electric, 4-pole, speed, 650 R. P. M
One 100 K. W. Walker, 4-pole, speed, 750 R. P. M.
Two 100 K. W. Edison, bi-polar, speed, 620 R. P. M.
One 90 K. W. Thomson-Houston, 4-pole, speed, 700 R. P. M.
One 80 K. W. General Electric, 4-pole, speed, 700 R. P. M.
Three 62 K. W. Thomson-Houston, Type D, speed, 900 R. P. M

DIRECT-CONNECTED UNITS, 125 AND 250 VOLTS.

One 60 K. W. Eddy, 4-pole, 125-volt generator, with 13x12 Buffalo Forge engine Brand new.
One 60 K. W. Bergmann, 6-pole, 125-volt generator, with 12x14 Watertown engine.
One 50 K. W. Commercial, 6-pole, 125-volt generator, with 8½-13x12 Armington & Sims tandem compound engine.
One 50 K. W. unit, consisting of two 25 K. W. General Electric, 4-pole, 125-volt generators, with one triple Expansion vertical engine.
One 25 K. W. General Electric, 6-pole, 125-volt generator, with 9½x10 Armington & Sims engine.
Two 25 K. W. Westinghouse, 6-pole, 250-volt generators, each with 9x10 Ball & Wood engines.

ENGINES.

One 22 and 40x60 Watts-Campbell Corliss cross-compound, 600-800 H. P.
One 20 and 36x48 Wheelock cross-compound, 500-700 H. P.
One 14 and 17x36 and 42 Slater, twin, 400-500 H. P.
One 24x48 Hamilton Corliss, 450 H. P.
One 23x48 Harris Corliss, 400 H. P.
One 18x48 George H. Corliss, 250 H. P.
One 16x42 Providence Greene, 200 H. P.
Two 18 and 30x16 Westinghouse Compound, 250 H. P. each.
Three 18½x18 Armington & Sims, 250 H. P. each.
One 16x16 Erie Ball, 175 H. P.
Two 14x13 Armington & Sims, 150 H. P. each.
One 12x34 Brown, 100 H. P.
One 10x14 Straight Line, 75 H. P.

This is not a complete list. Send for Bulletin or write for quotation on anything you intend purchasing.

We have a large stock of direct-current generators and motors of all voltages. Also alternating-current motors and arc generators,

Babcock & Wilcox and return tubular boilers.

Transformers, arc lamps, street railway cars and equipment.

Let us make you a proposition for the purchase of any apparatus you may have for disposal.

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This means

YOST SOCKETS

meet all

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Do you appreciate the importance of this?

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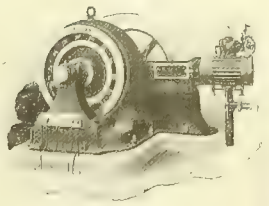
The

Yost Electric Mfg. Co.

Toledo, Ohio - U. S. A.

Warren Alternator



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We Guarantee What We Sell

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Sell What We Guarantee

Warren Electric Mfg. Co.

Sandusky, O.

You Can Play Tennis in California

all the year around. Outdoor sports that are elsewhere abandoned Christmas are most popular there throughout the winter.

Nowhere except in California can one behold such opposites. Millions of roses bloom in midwinter at the foot of some gray old mountain, the summit white with its perpetual crown of snow. The sunset tints fall softly upon luxuriant foliage in the valley and touch with golden shafts of light the hilltop's canopy of frost. In this land of summer the sting of the North King is forgotten, but his handiwork glitters in the California sunshine. It is none too early to plan your trip now. California is easily accessible from Chicago. The trip can be made quickly and comfortably and at comparatively slight expense by any of the three through trains of the

Chicago, Milwaukee and St. Paul and Union Pacific Line

Complete information will be furnished by any of these offices: 369 Washington St., Boston; 200 Ellicott Sq. Bldg., Buffalo, N. Y.; 95 Adams St., Chicago; 12 Carew Bldg., Cincinnati; 217-218 Williamson Bldg., Cleveland; 32 Campus Martius, Detroit; 402 E. Water St., Milwaukee; 381 Broadway, New York; 818 Chestnut St., Philadelphia; Room D, Park Bldg., Pittsburg; 365 Robert St., St. Paul; 8 King St., East, Toronto, Canada. **F. A. Miller, General Passenger Agent, Chicago.**

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FIELD CLAY CONDUITS

Order now for your 1904 requirements and assure *prompt delivery and favorable* prices.

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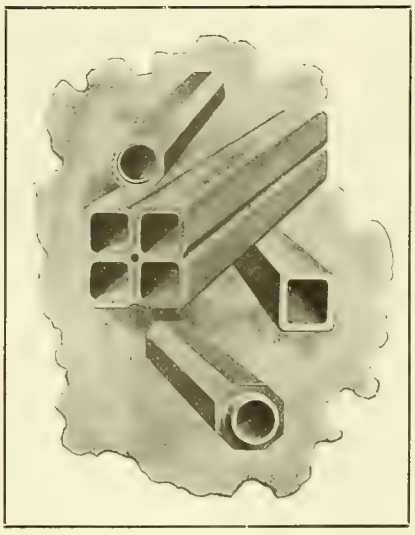

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Our *Conduits* are *Manufactured* at that *Celebrated* Clay Center,

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Also in OHIO, PENNSYLVANIA and NEW JERSEY.

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GENERAL OFFICES, - - - 29 BROADWAY, NEW YORK.

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W. G. NAGEL ELECTRIC CO.
TOLEDO, OHIO.

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How to prevent the action of

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The problem that confronts every engineer and electrician.

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The only conduit sold with a guarantee. It is water, gas and electrolysis proof.

The safeguard in the construction of underground electric light, power, telegraph, telephone and street railway systems.

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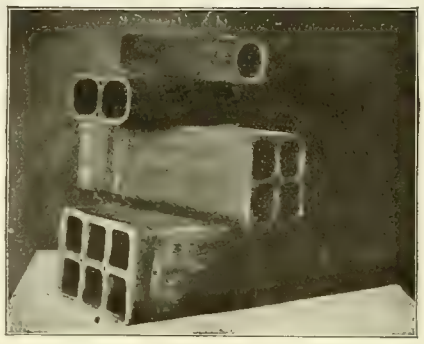

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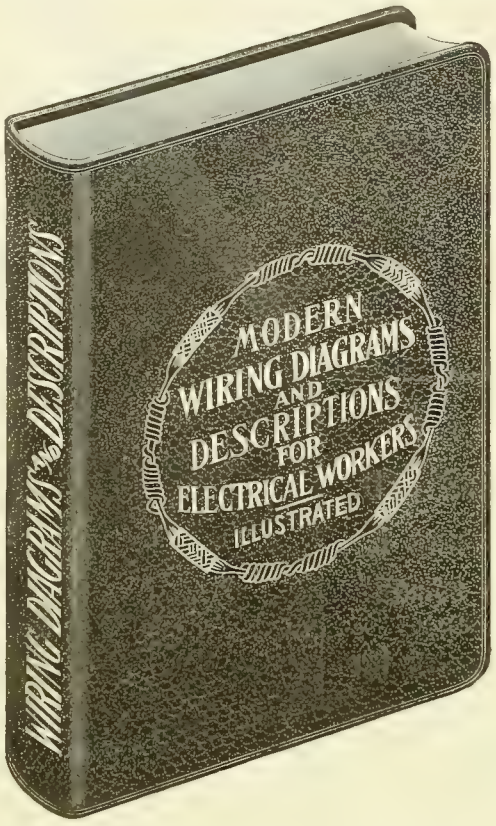

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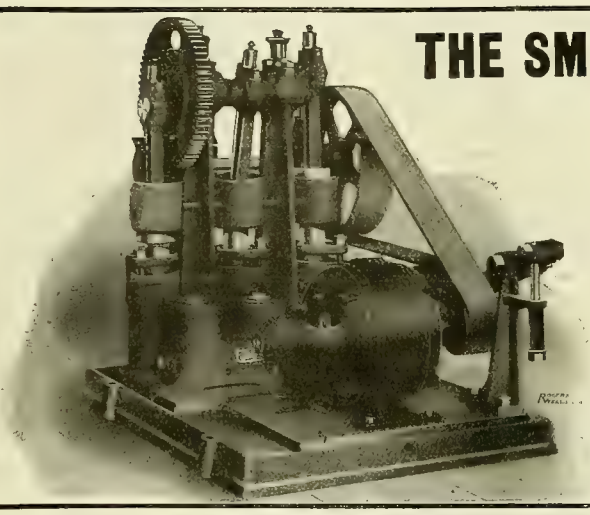

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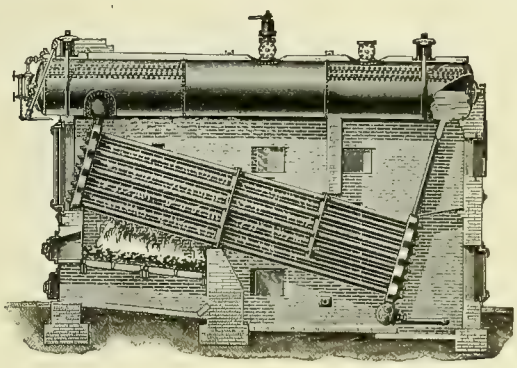

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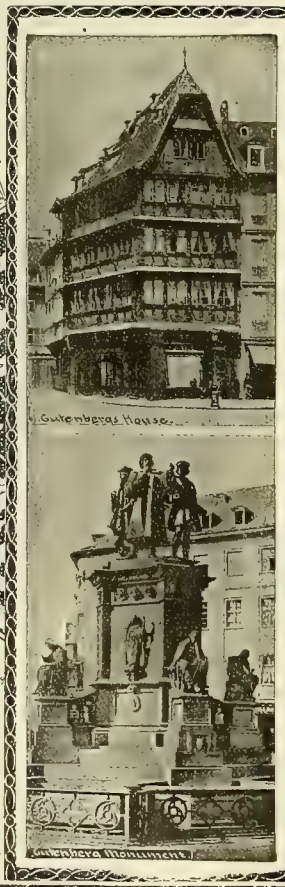

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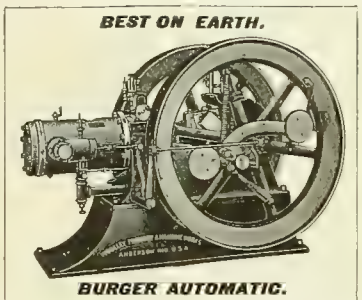
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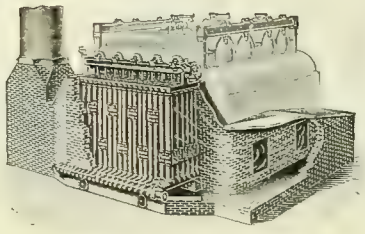
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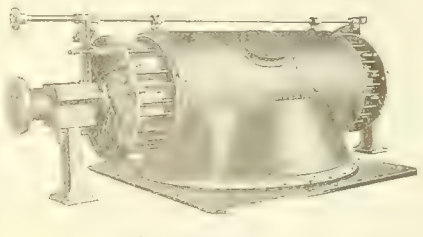
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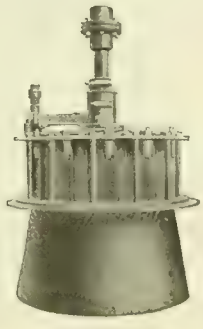

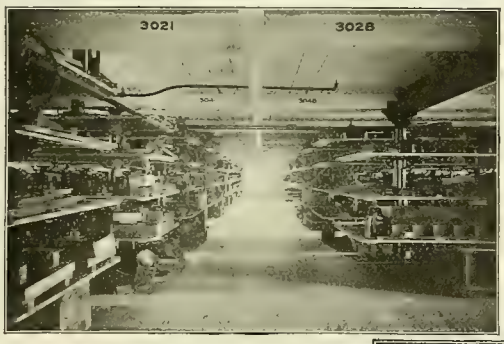

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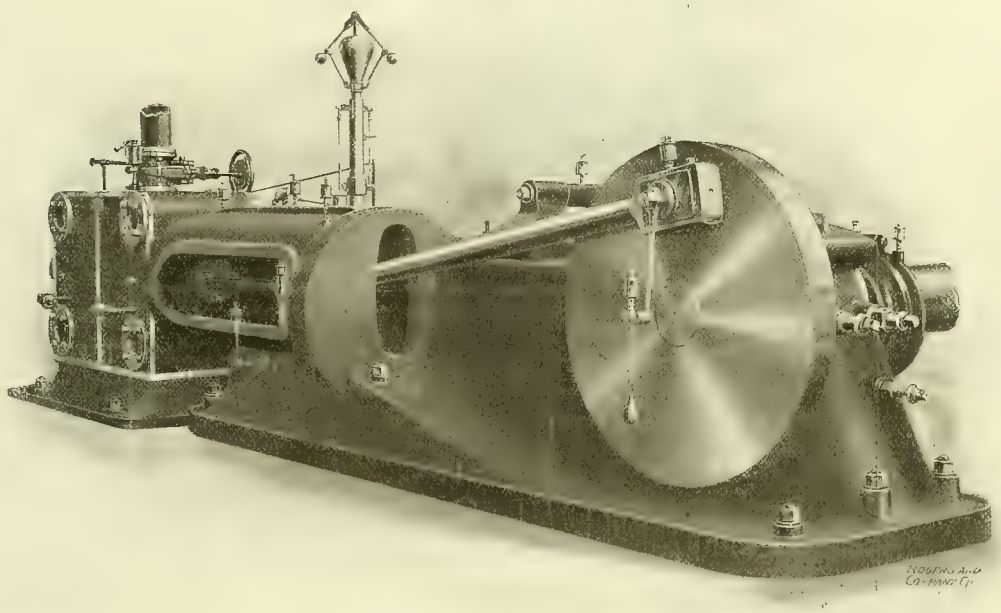

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XX. Early Development of the Polyphase Motor.

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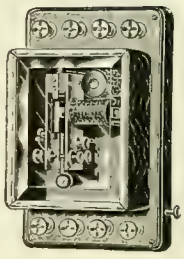

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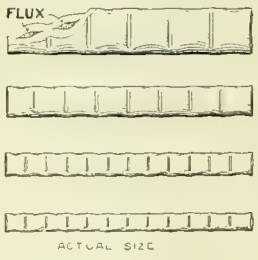

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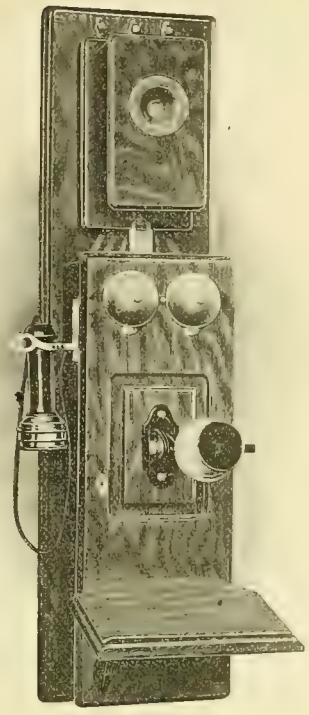

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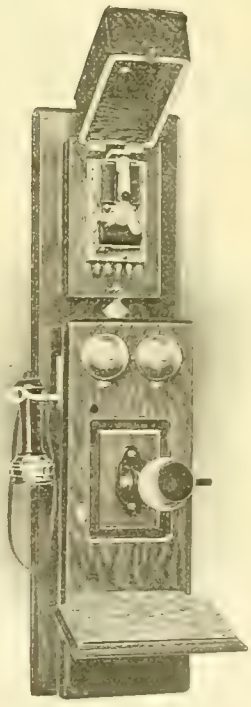

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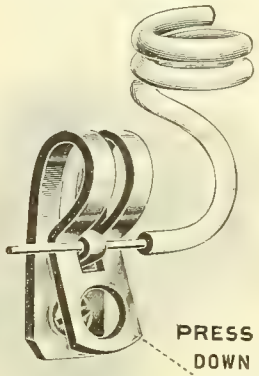

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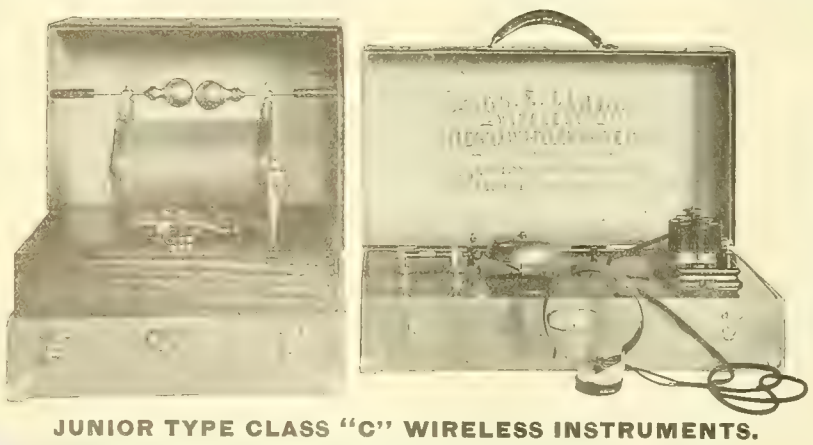

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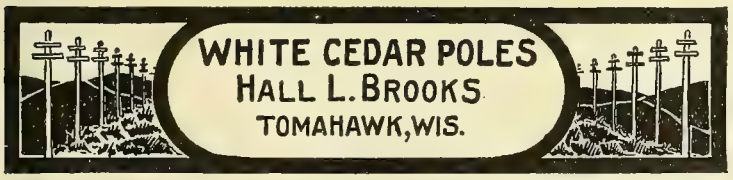

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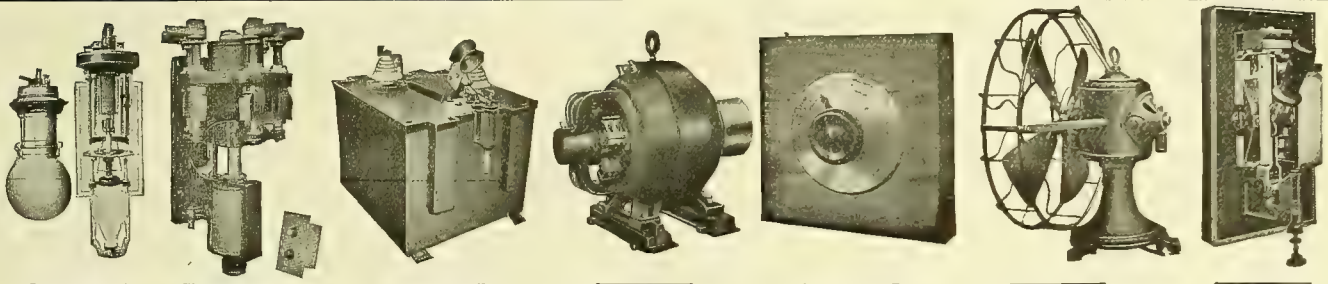
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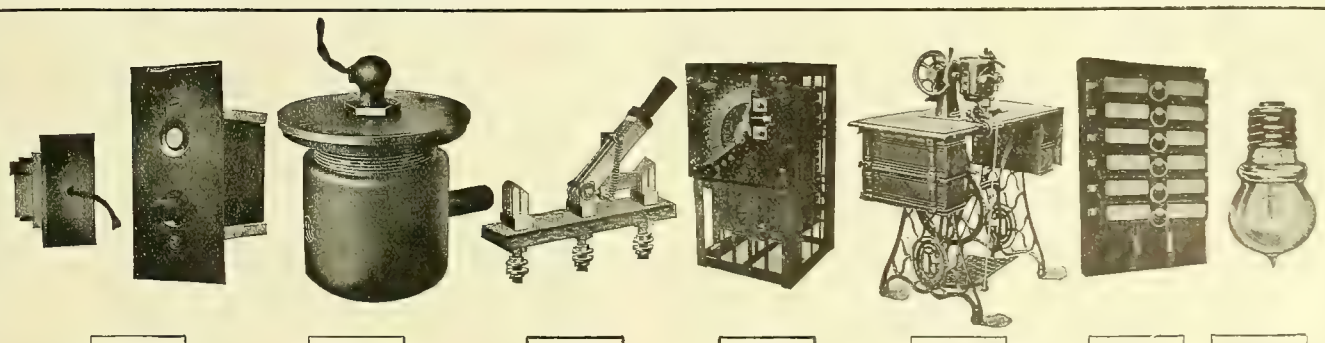
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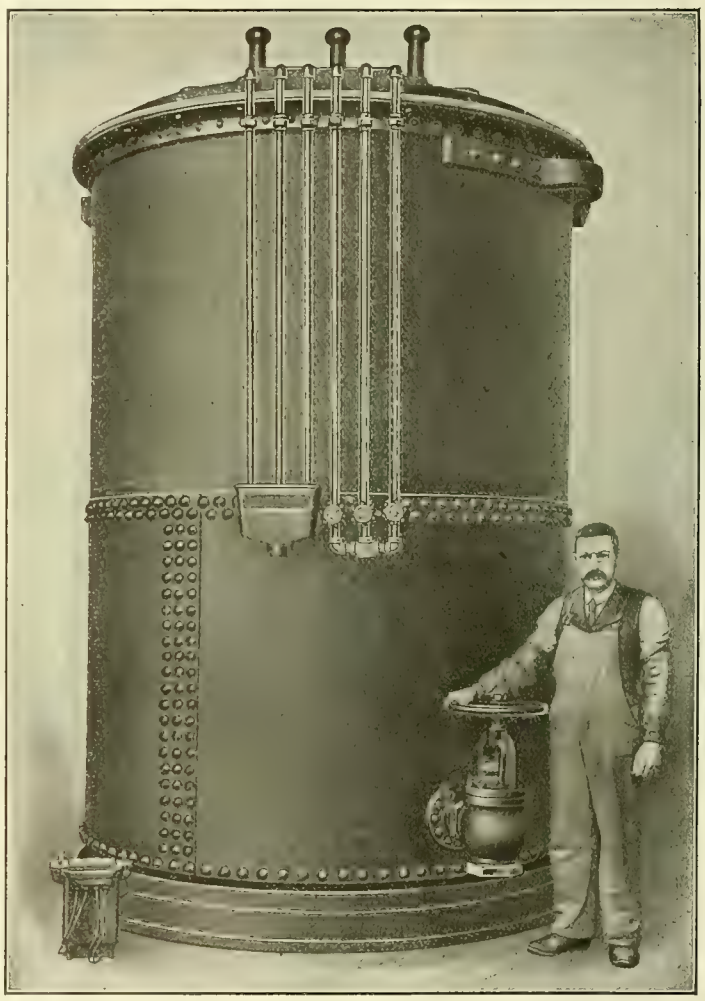

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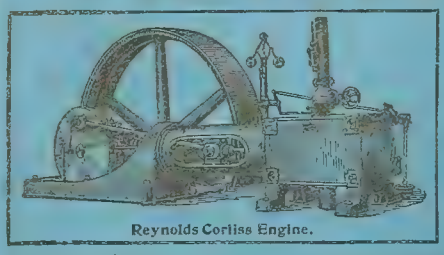
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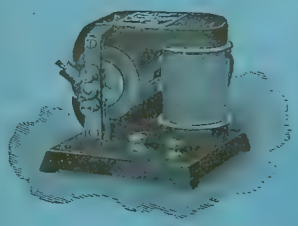
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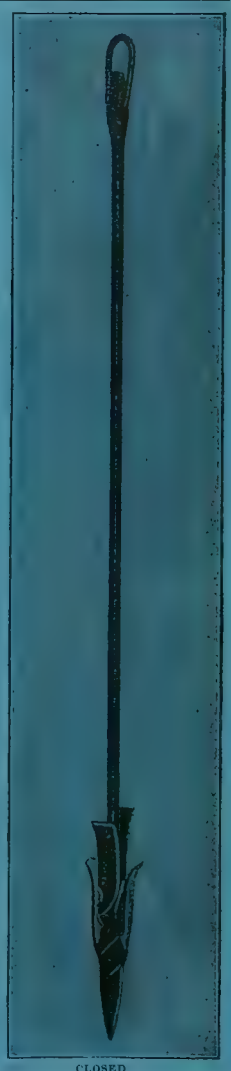
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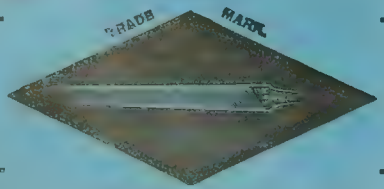

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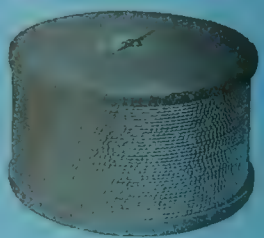

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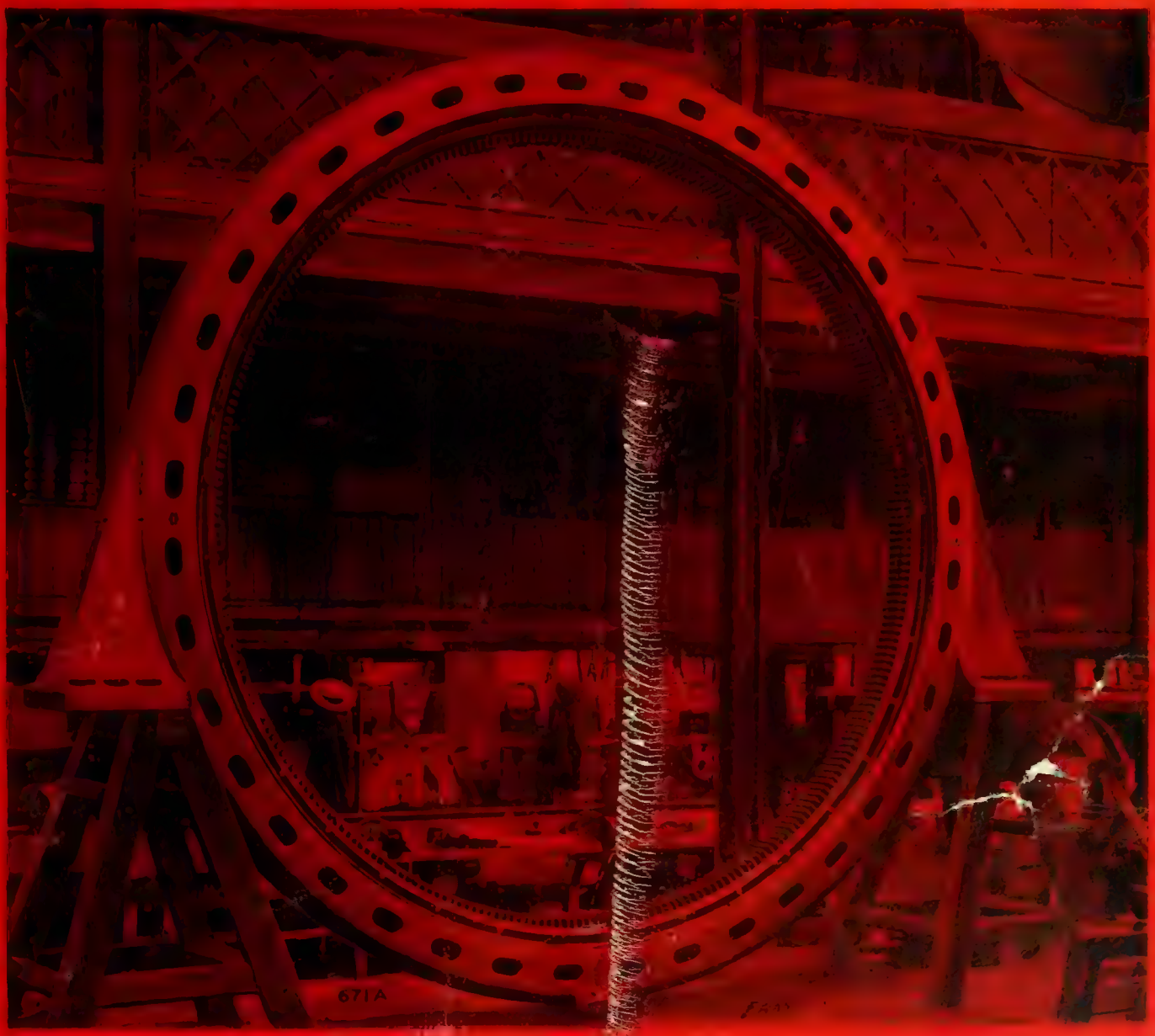

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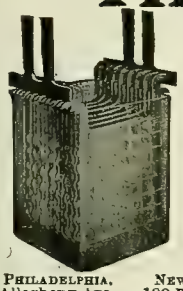

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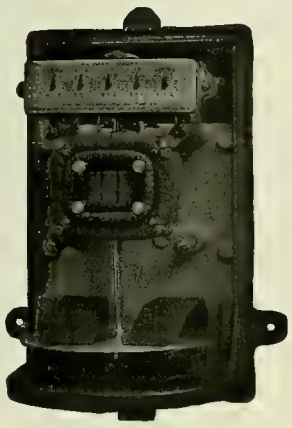

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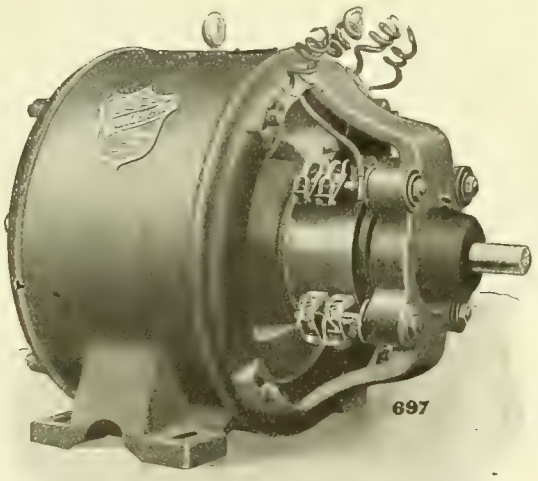

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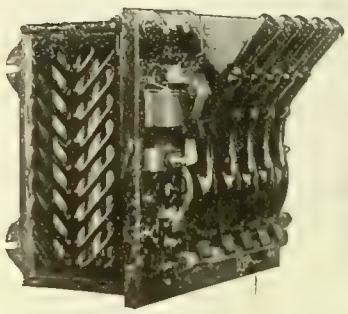

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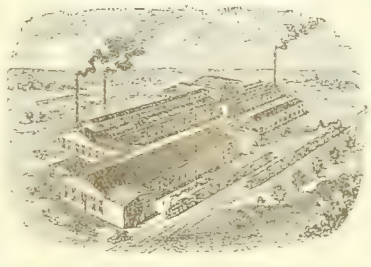

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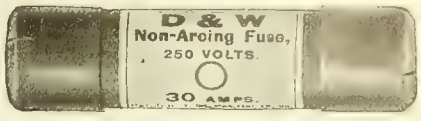

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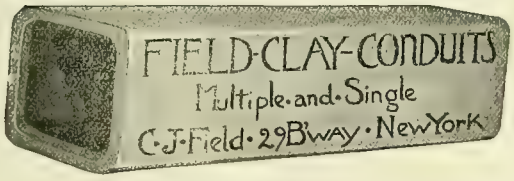

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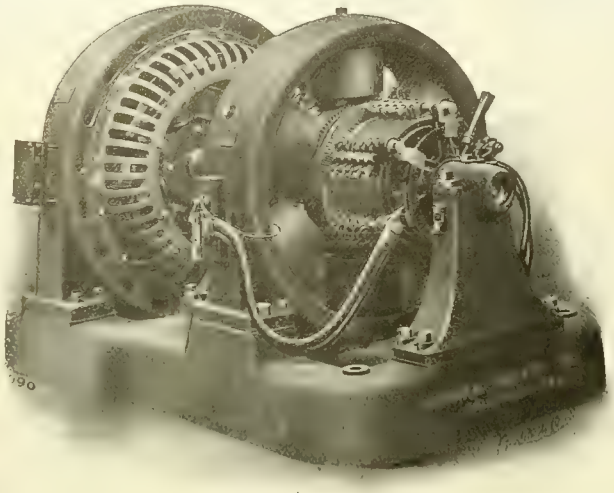

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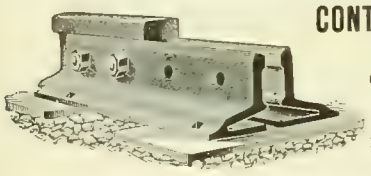

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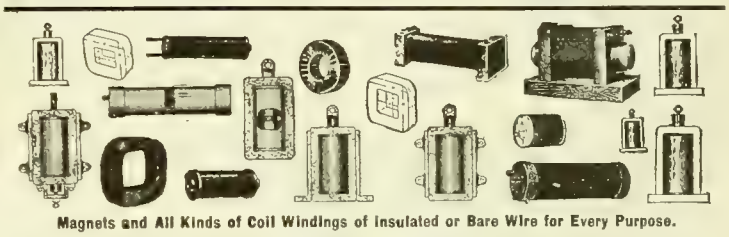

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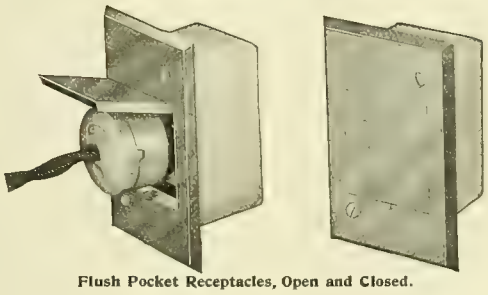

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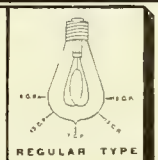

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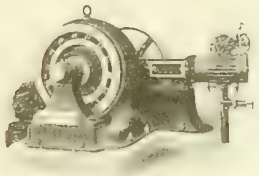

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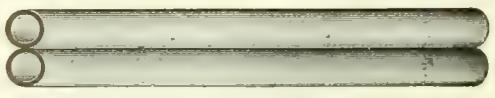

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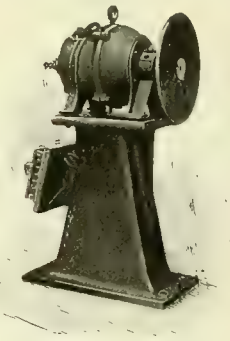

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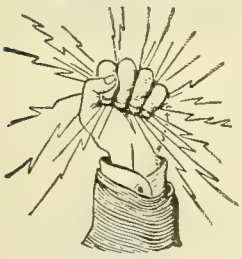

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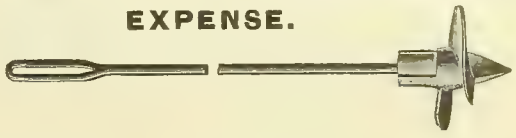

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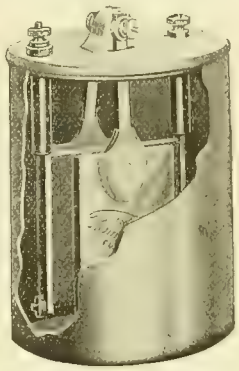

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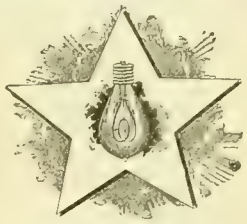

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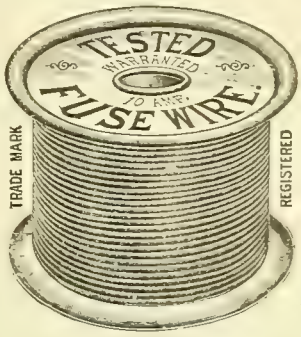

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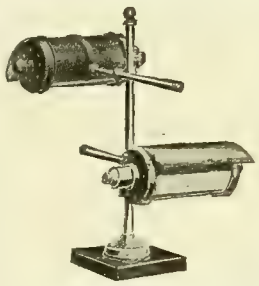

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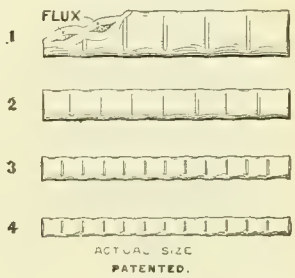

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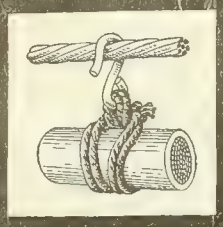

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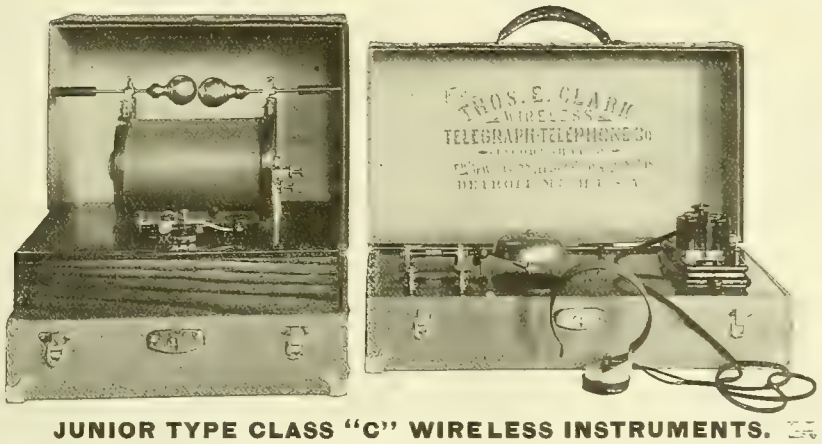

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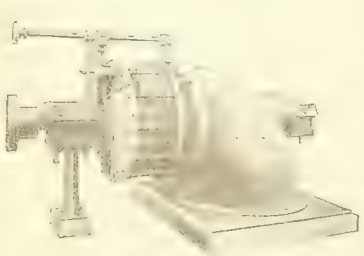
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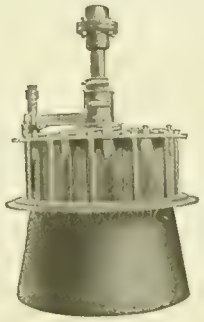

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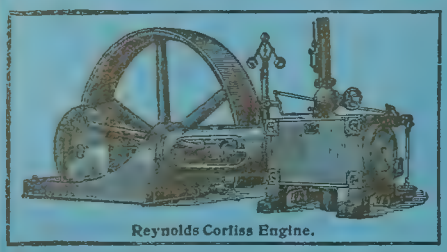
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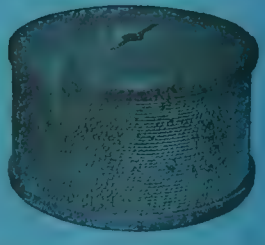

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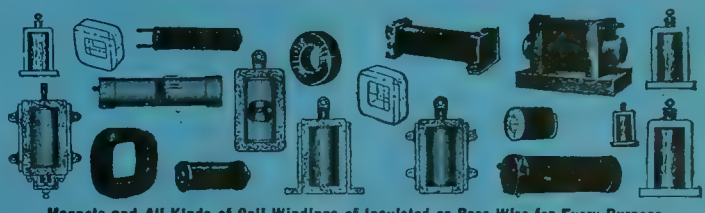
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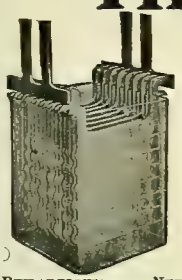

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Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

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MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

Improved American Joint

INJUNCTION ISSUED

Circuit Court of United States of America

NORTHERN DISTRICT OF ILLINOIS
NORTHERN DIVISION

Chicago Die & Electric Company
vs.
American Electric Fuse Company

The American Electric Fuse Company were commanded to absolutely resist and refrain from infringing upon the exclusive rights unto said Chicago Die & Electric Company, complainant, under any one or more of the claims of said Letters Patent No. 655,905, dated August 14, 1900, for improvements in Wire Joints and methods of manufacturing the same, now owned by said company.

WITNESS: The Honorable Melville W. Fuller, Chief Justice of the Supreme Court of the United States of America in said District this 30th day of December, in the year of our Lord one thousand nine hundred and three, and of our Independence the one hundred and twenty-eighth year.

NOTICE

The American Electric Fuse Company having made satisfactory settlements and arrangements with us, we have granted them license to manufacture and sell the "Improved American Joint" under above patent.

The above Company have the exclusive license to manufacture and sell the above Joint. Any other party or parties doing so will be prosecuted as infringers and made to account to us for the same.

Eclipse Pocket Ammeter
For General Battery Testing.
0 to 15 Amperes.

"Ready for use," with flexible cord attached and contact spur in case, which is drawn back into case, when carrying in pocket. Used in any position, and works in either direction of current. Size of watch, and very light weight. Pivots hardened and polished. Ask your jobber. Eldredge Electric Mfg. Co., Springfield Mass.

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Western Electrician
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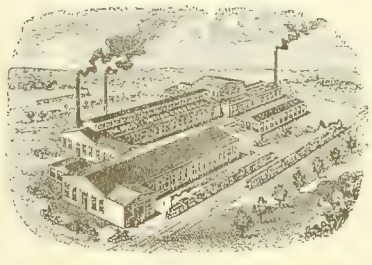
ELECTRICIAN PUB. CO.,
CHICAGO.



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FOR OPEN AND ENCLOSED ARC, ALL SYSTEMS.
THE DICKEY-SUTTON CARBON COMPANY,
LANCASTER, O.
OUR ENCLOSED ARC CARBONS ARE STRAIGHT, CORRECT AS TO DIAMETER, MAKE SMALLEST POSSIBLE DEPOSIT ON GLOBES, AND GIVE A STEADY WHITE LIGHT; NOT VIOLET RAYS. ON REQUEST WILL MAIL SAMPLES.

THE WIRE THAT'S MADE TO LAST

OKONITE WIRES AND CABLES

OKONITE TRADE MARK

OKONITE TAPE MANSON TAPE

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

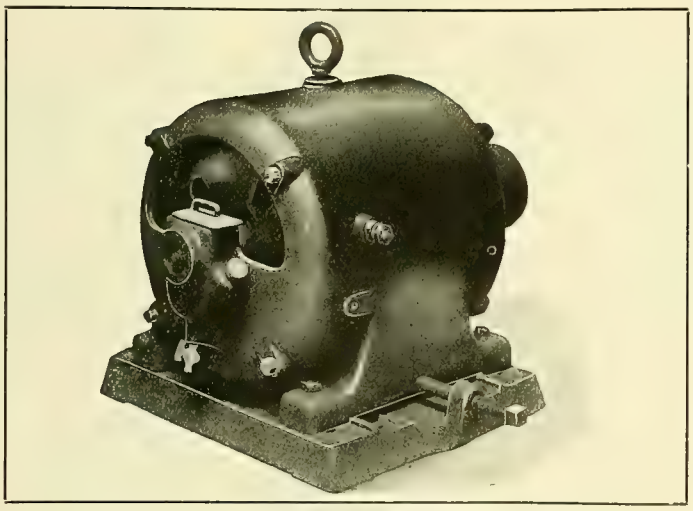
ELECTRICAL SUPPLIES.

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

Single Phase, Self-Starting Power Motors

Will start under full load. A double pole knife switch is all the auxiliary apparatus necessary to start them. Can be mounted on side wall, ceiling or floor.



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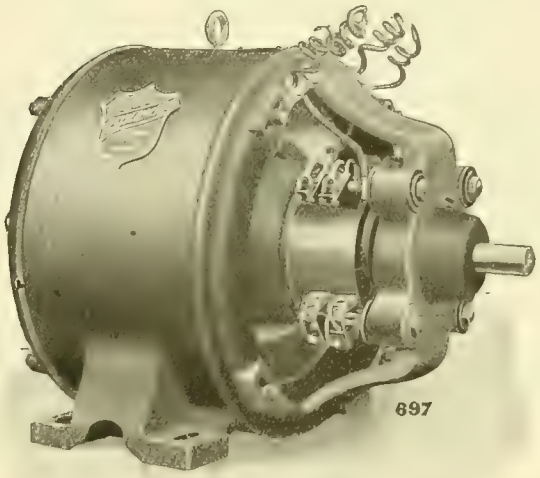

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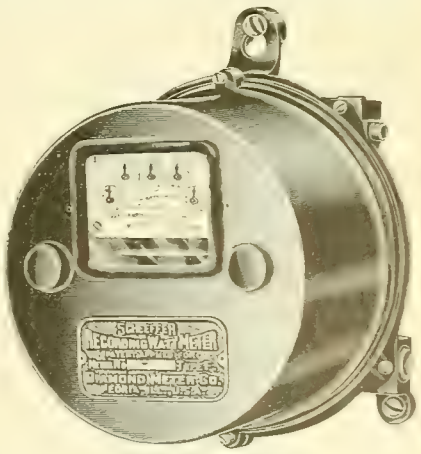
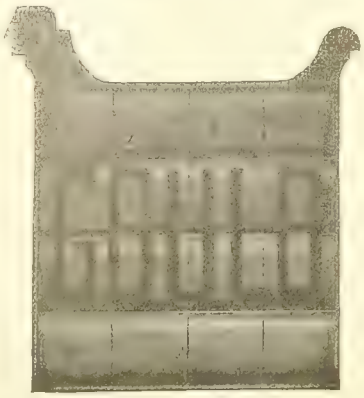


DIRECT CURRENT.



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Johnston, Thomas J.

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Standard Tie Company.
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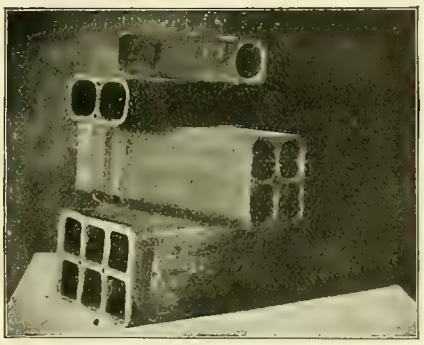

Manufacturers of

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Superior Conduits for underground wires a specialty.

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Makes UNDERGROUND Systems Practical

for electric light, power, telegraph and telephone lines. It is water, gas and electrolysis proof. Easily laid and maintained, the only conduit sold with a guarantee against electrolytic action.

An illustrated booklet free.

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336 Macy Street, Los Angeles

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424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
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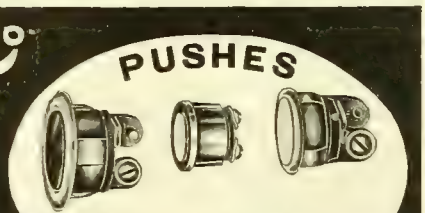

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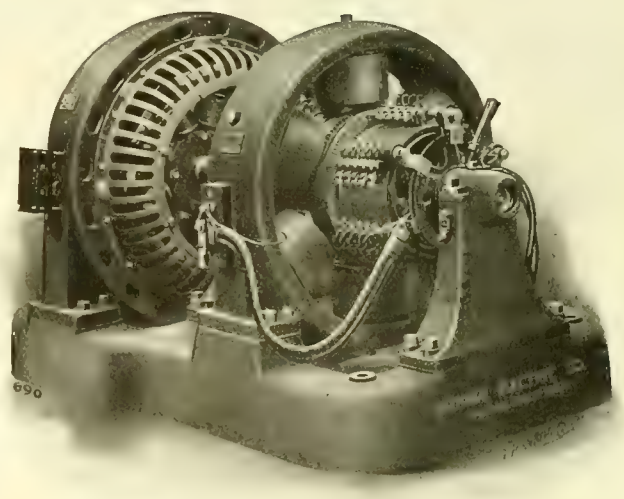

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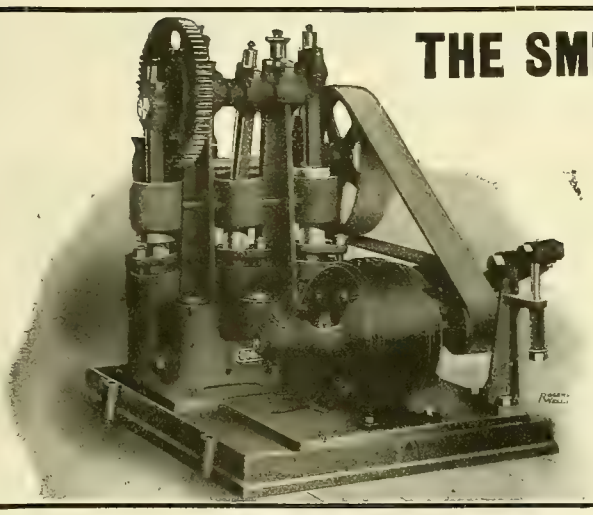

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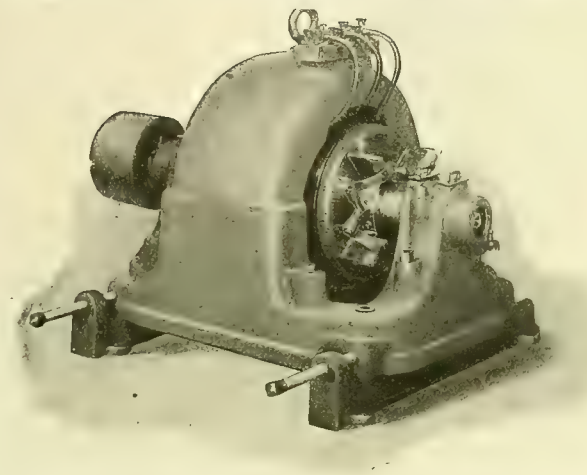

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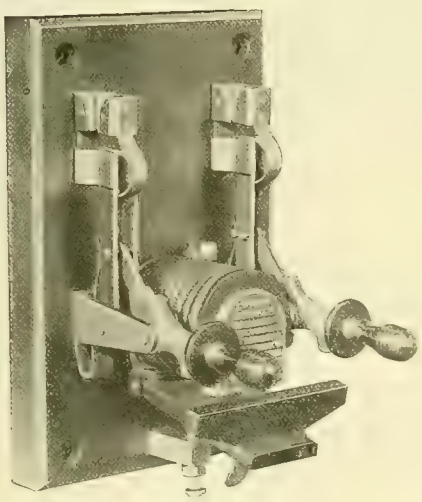

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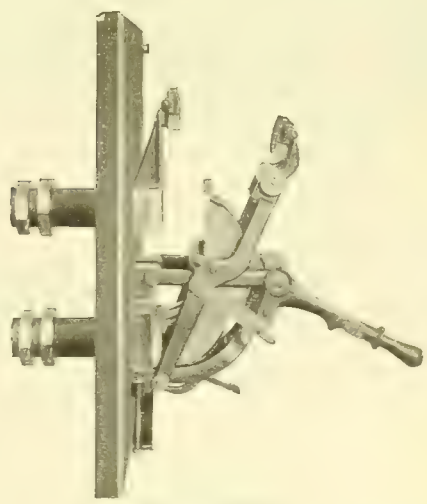

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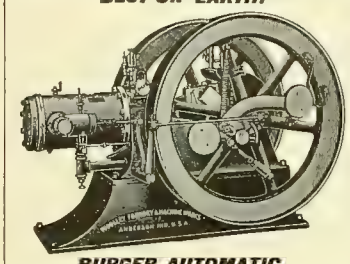
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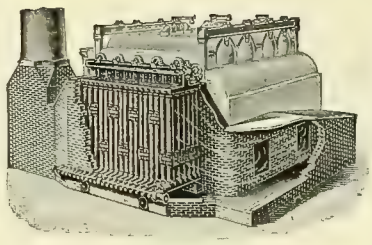
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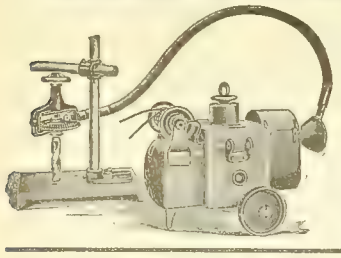
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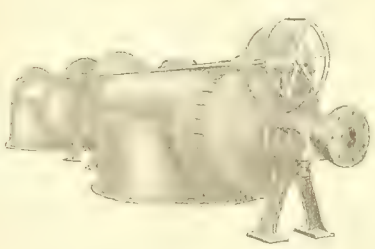
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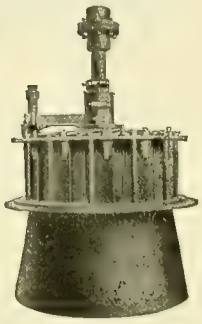
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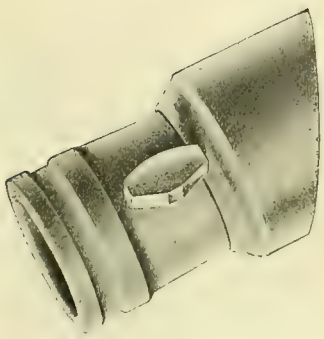

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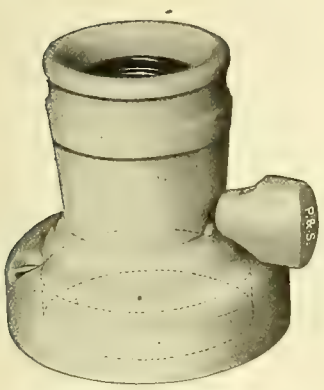

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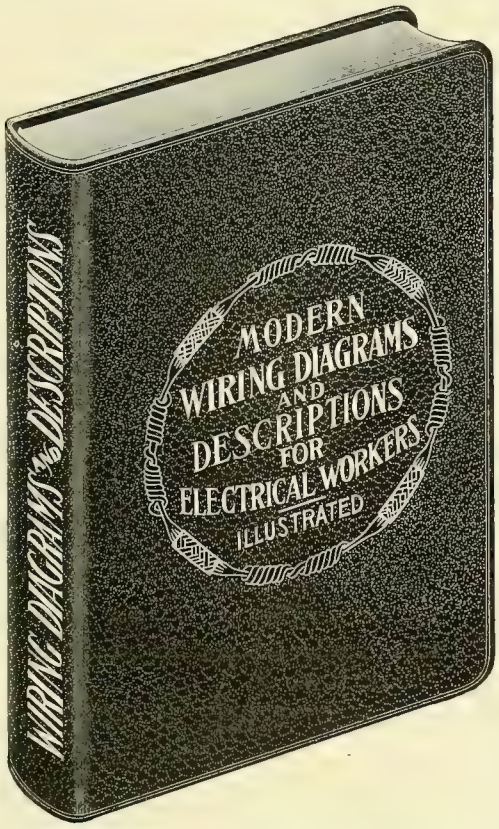

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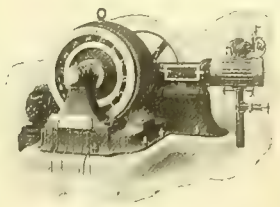

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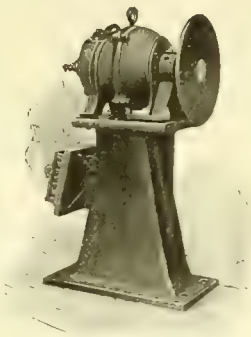

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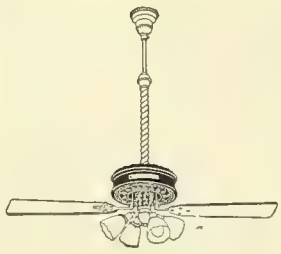

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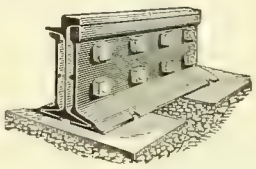

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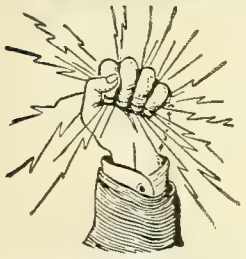

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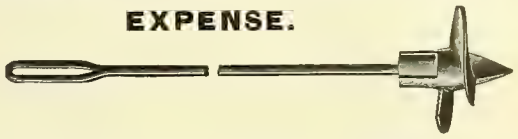

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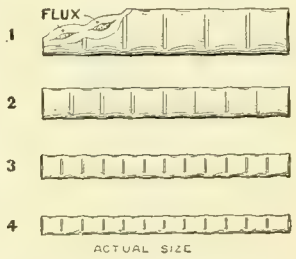

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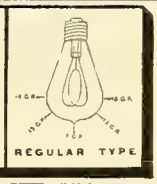

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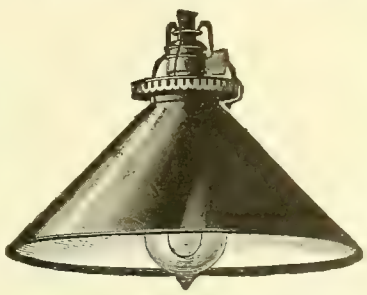

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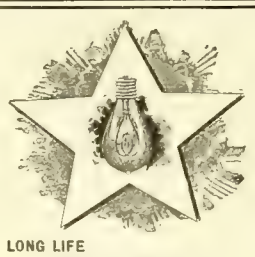

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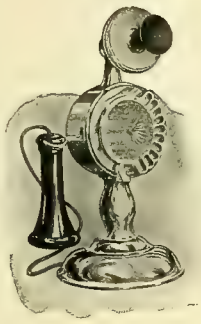

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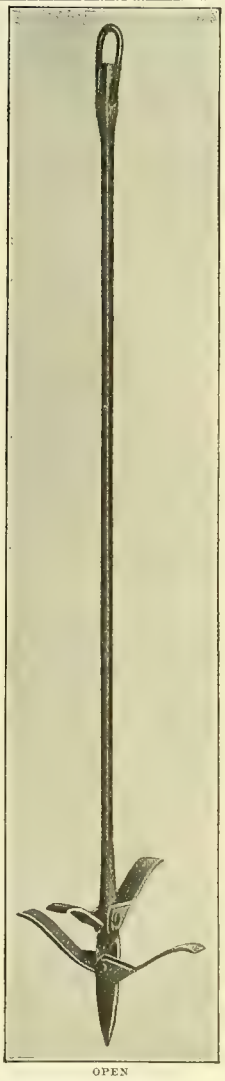
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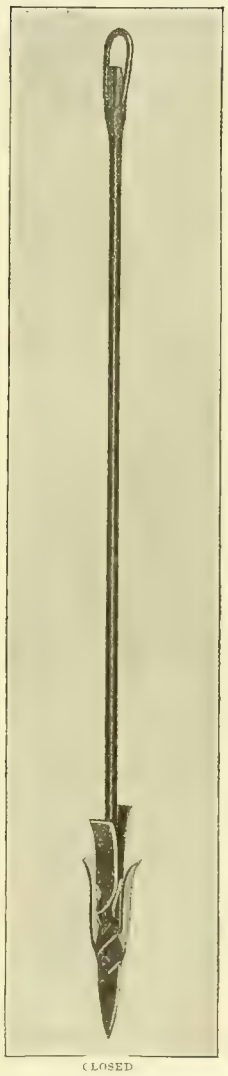
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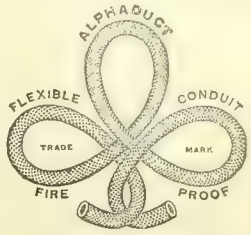

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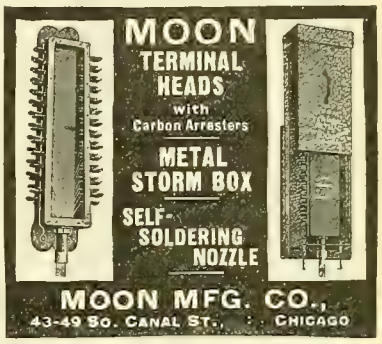

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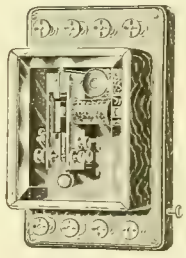

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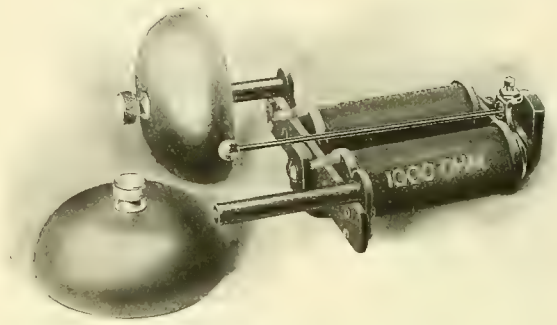

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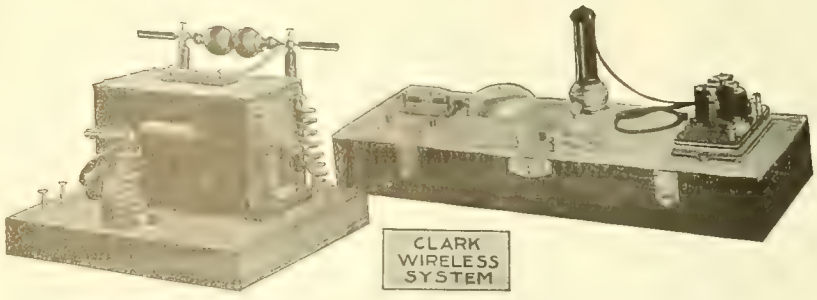

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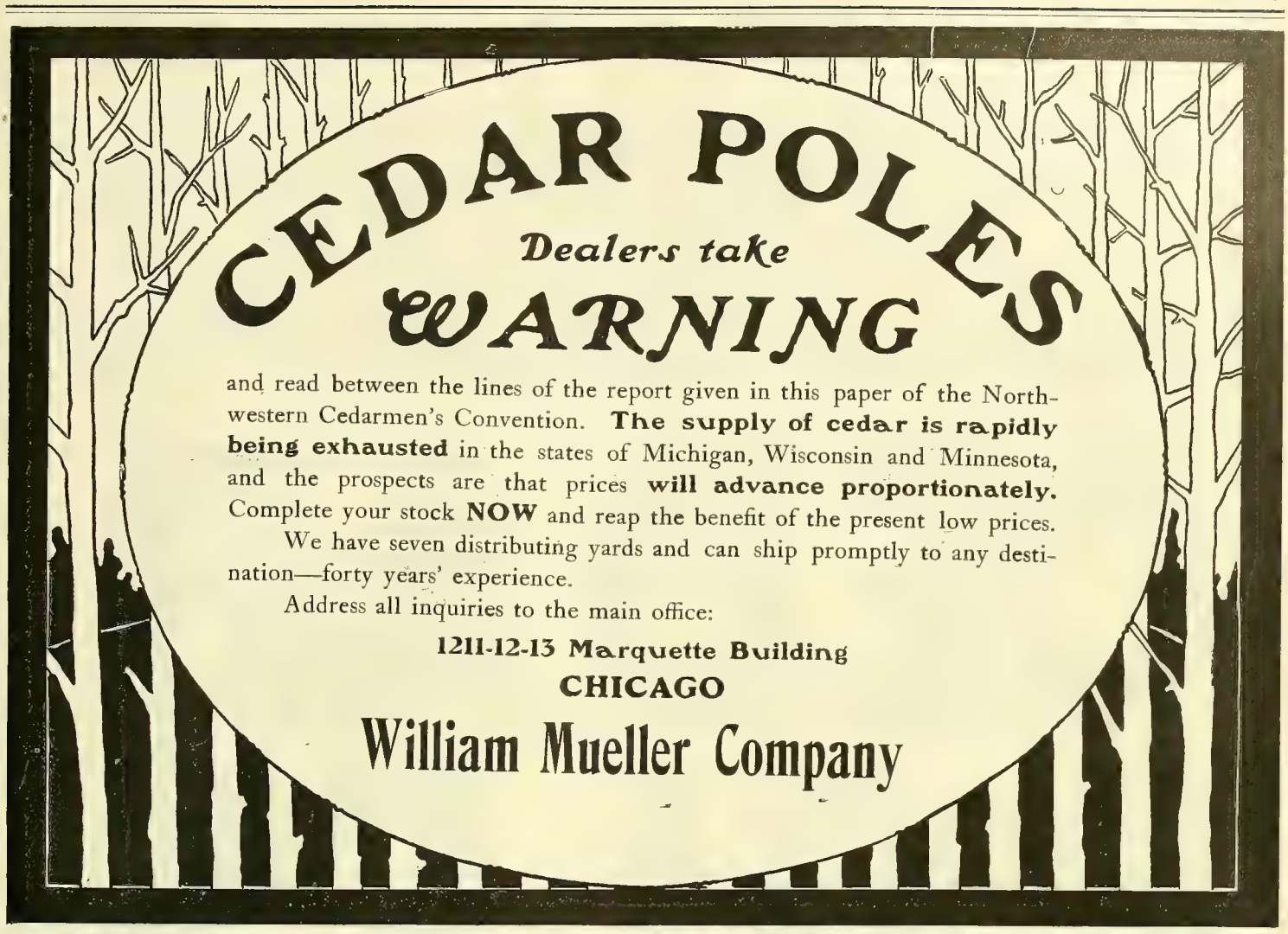

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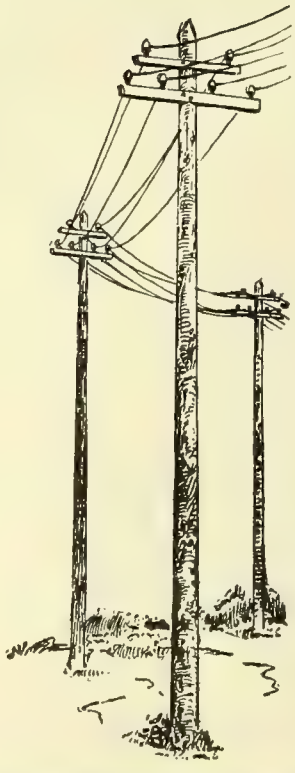

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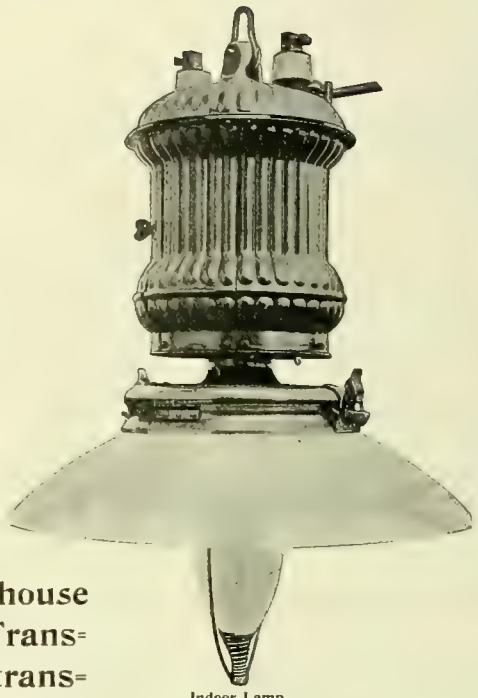

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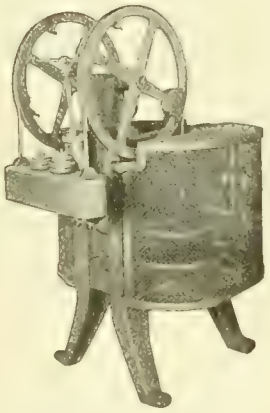

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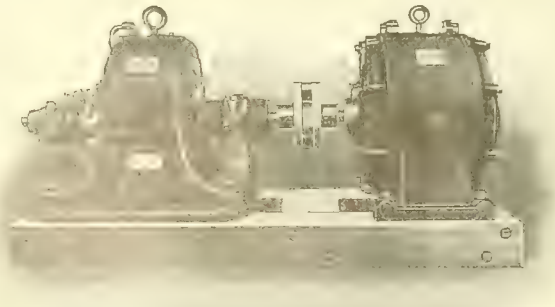

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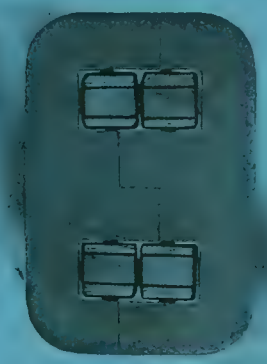

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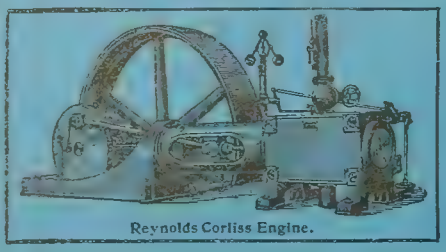
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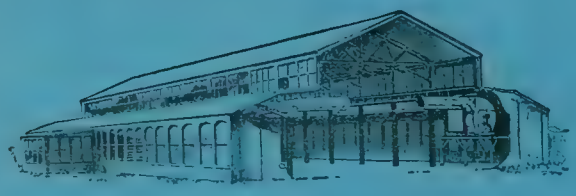

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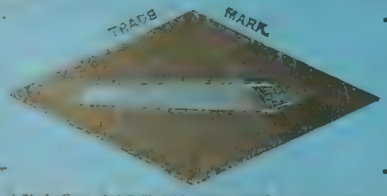

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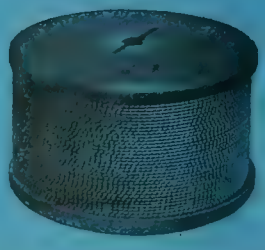

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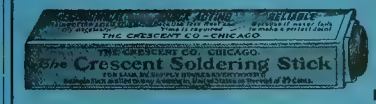

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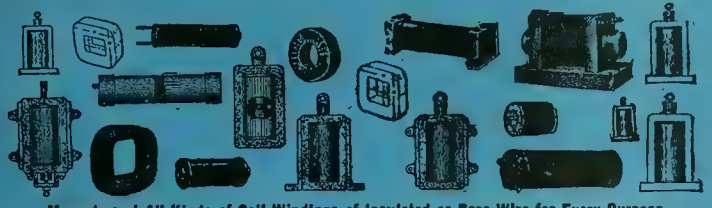

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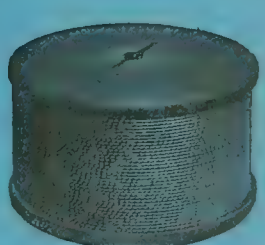

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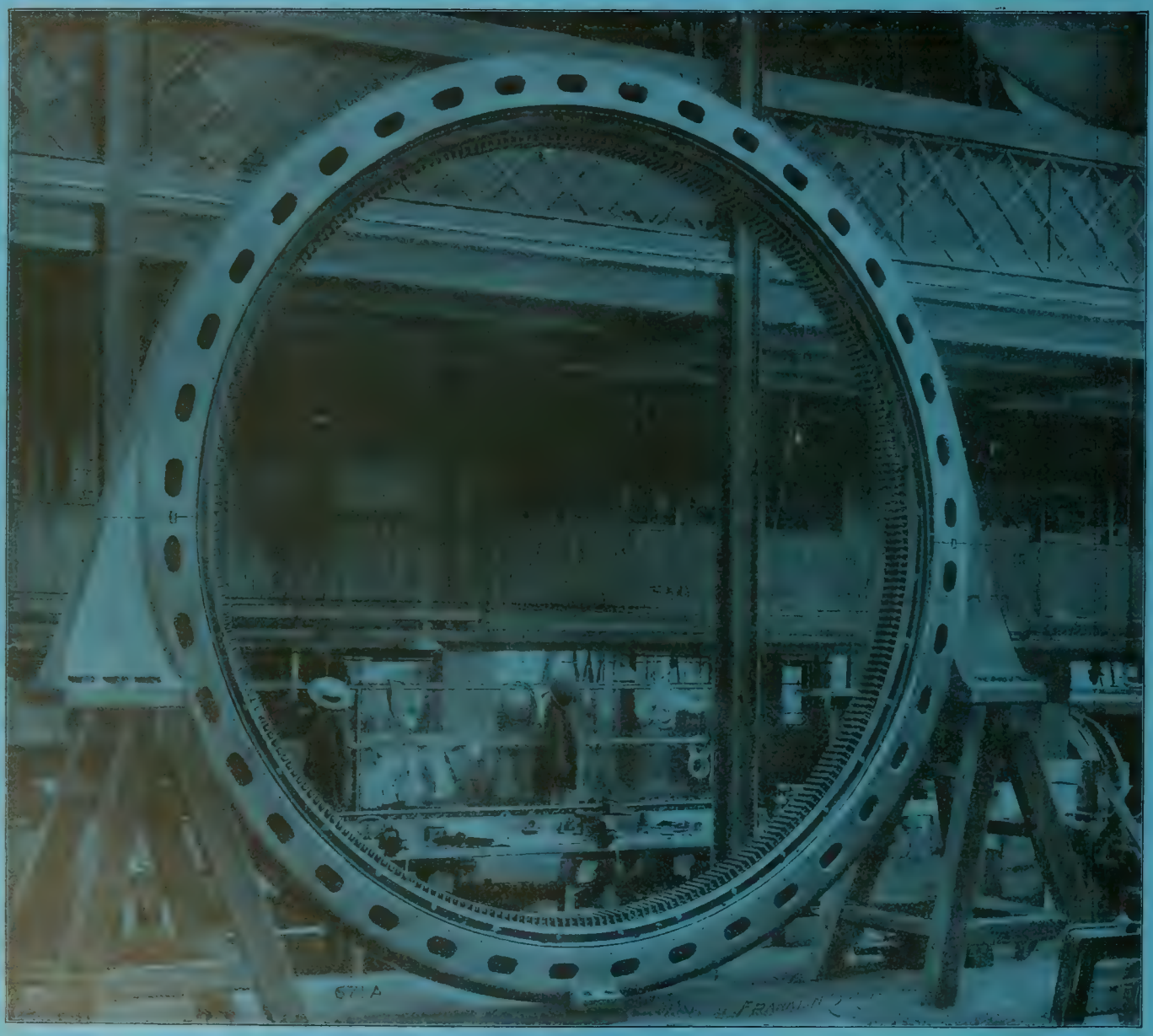

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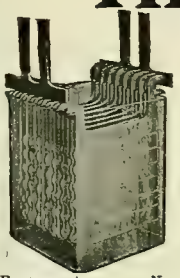

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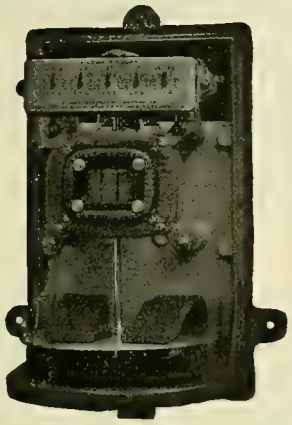

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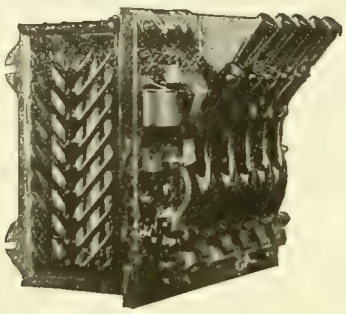

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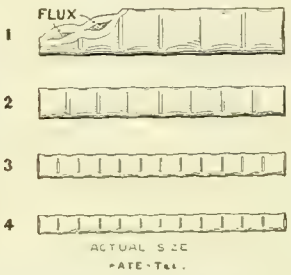

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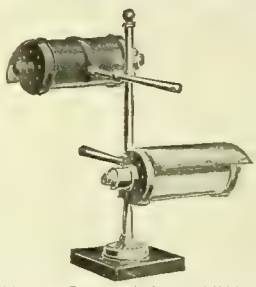

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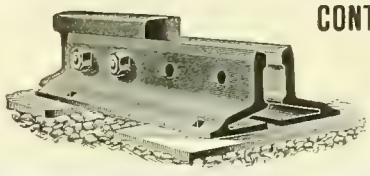

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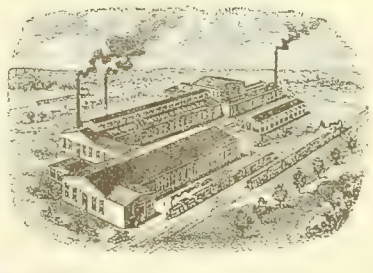

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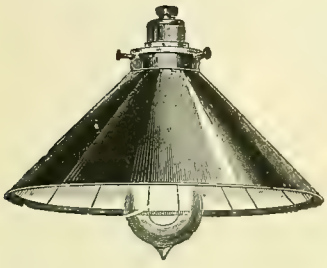

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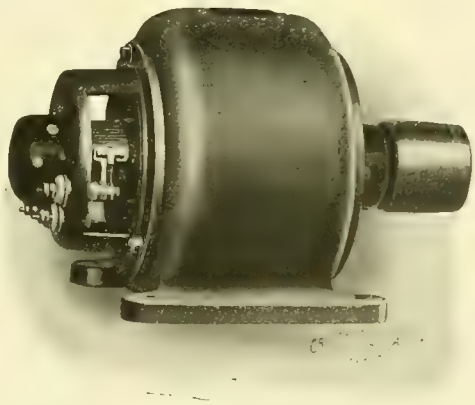

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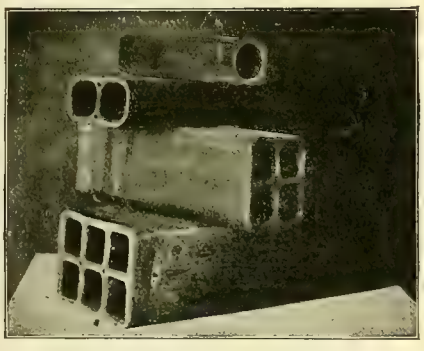

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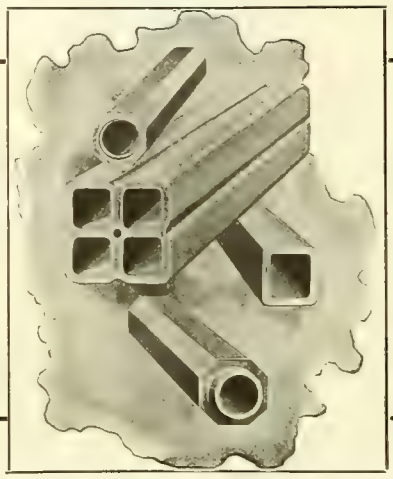

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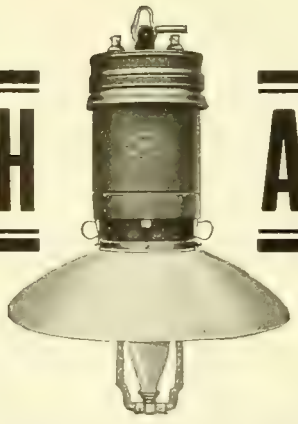

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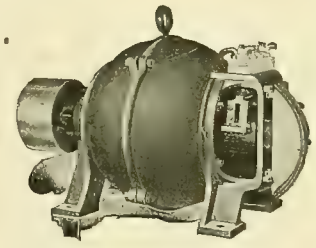

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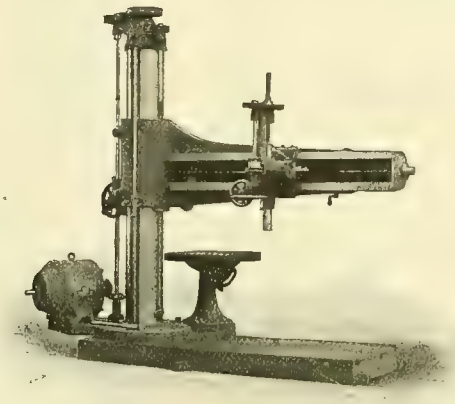

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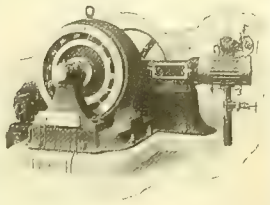

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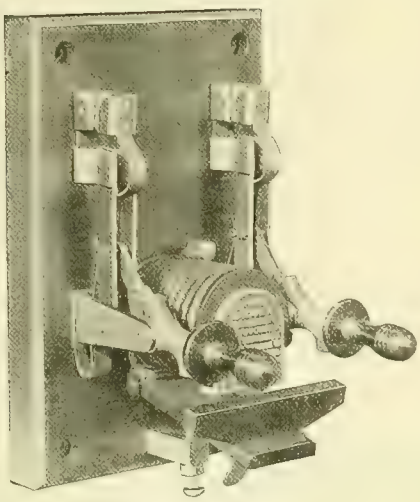

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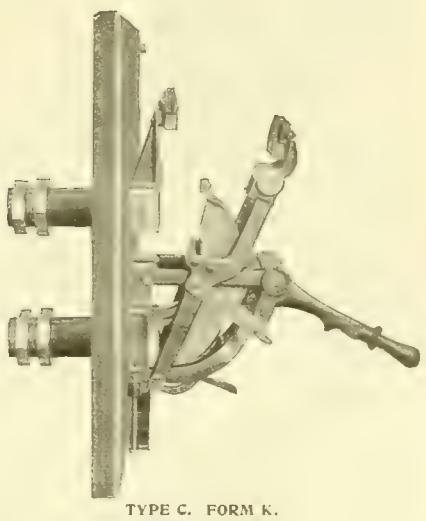

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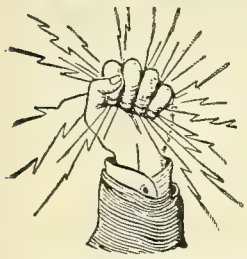

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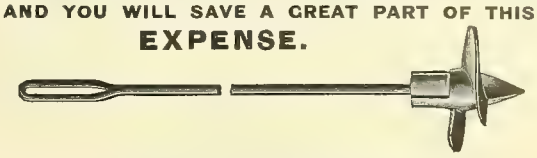

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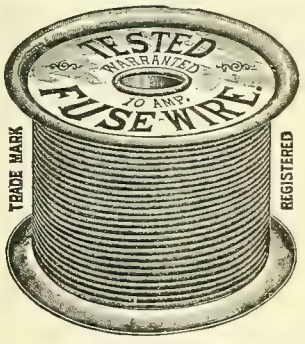

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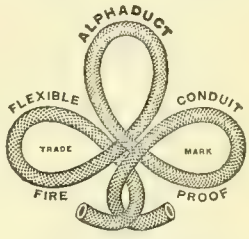

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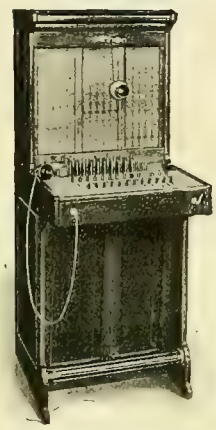

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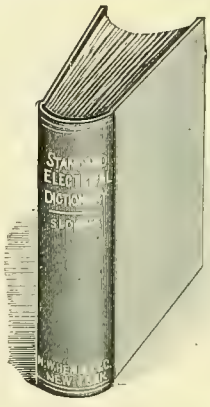

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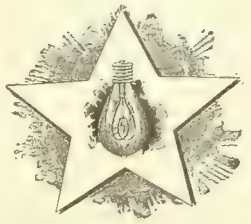

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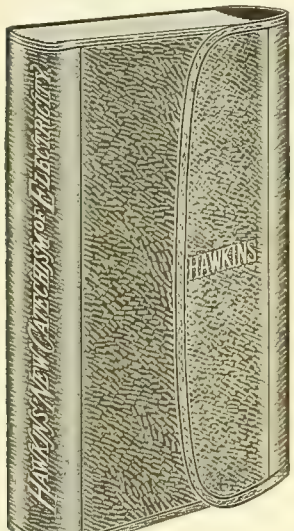

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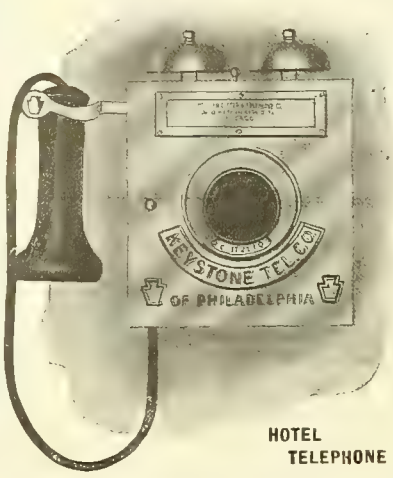

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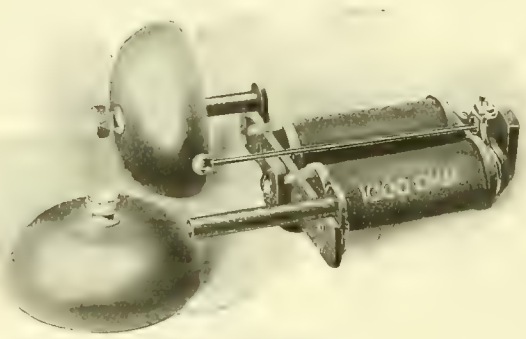

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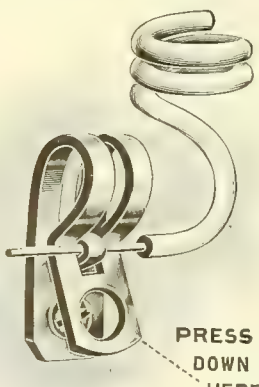

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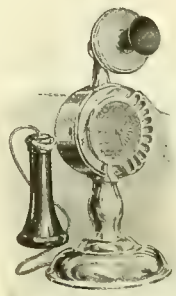

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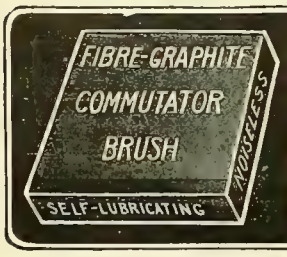

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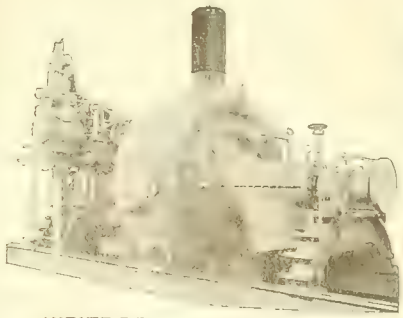
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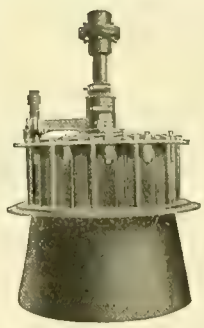

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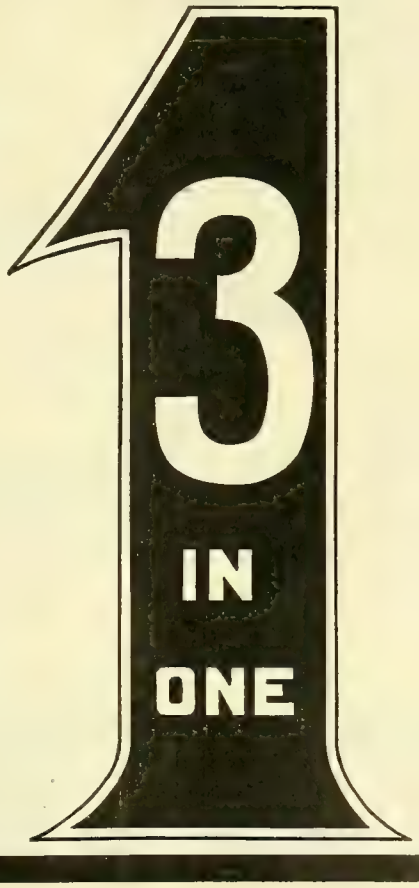

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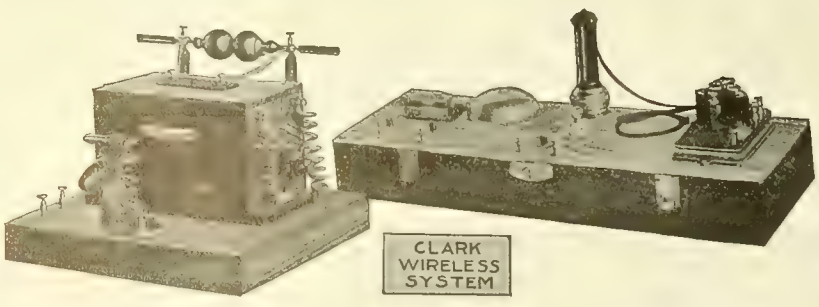

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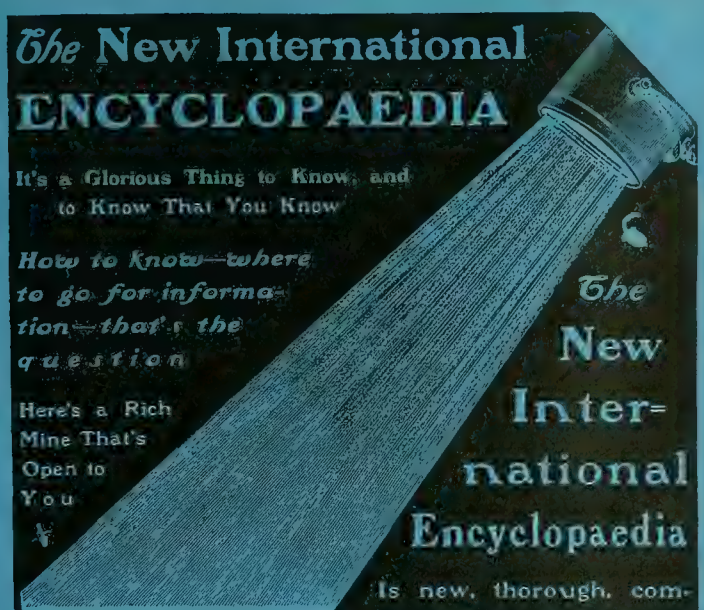

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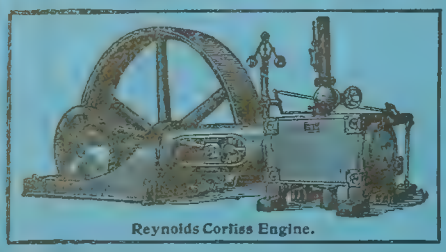
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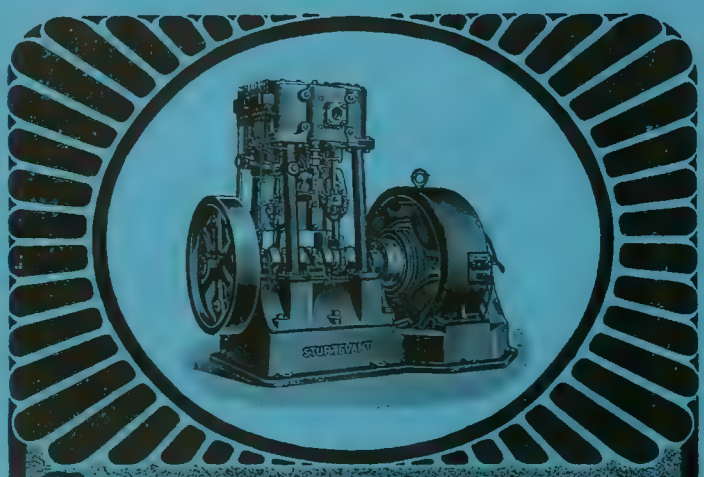

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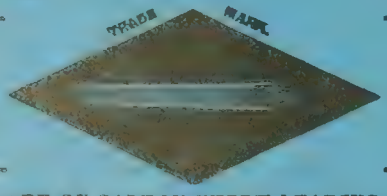

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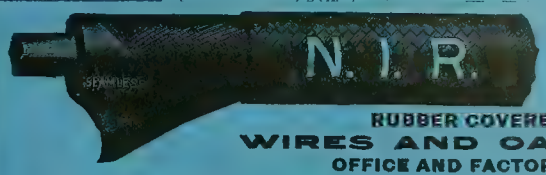

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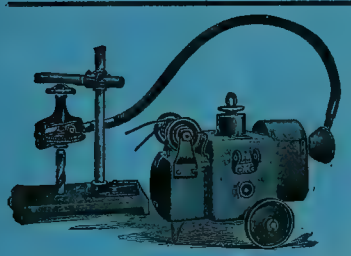

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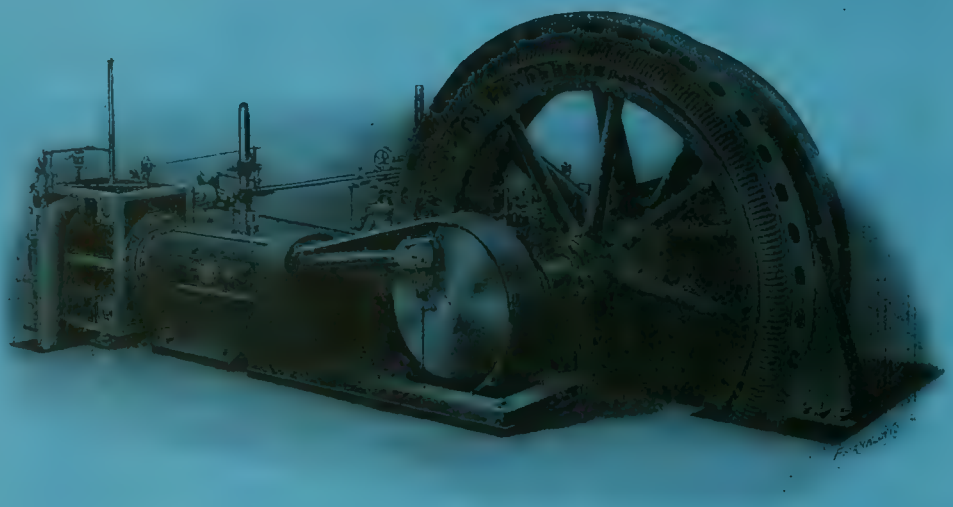

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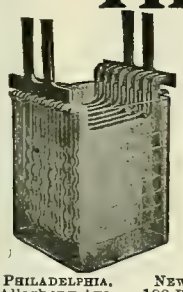

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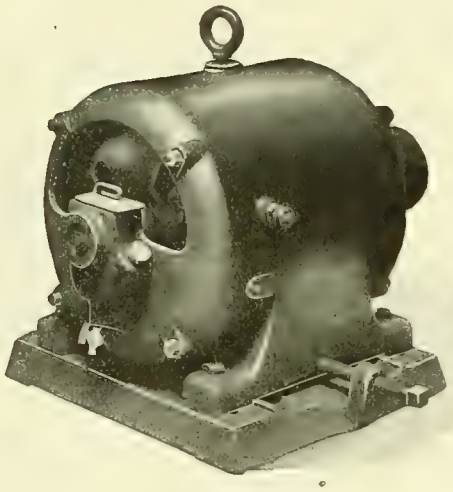

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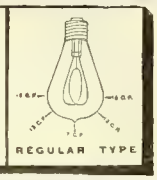

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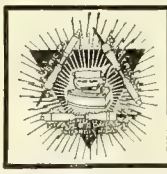

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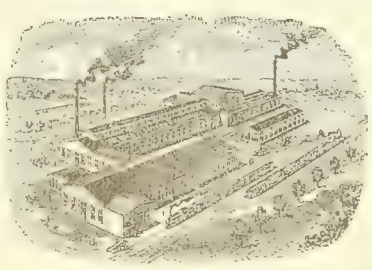

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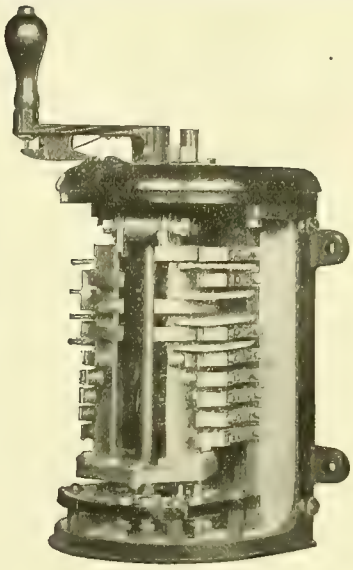

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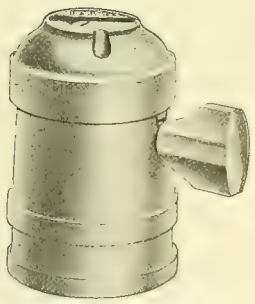

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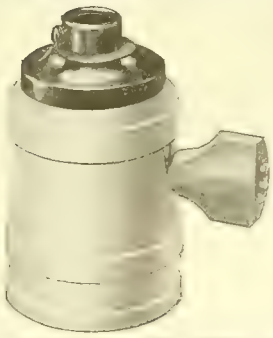

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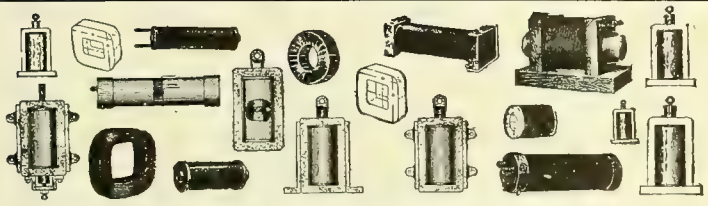

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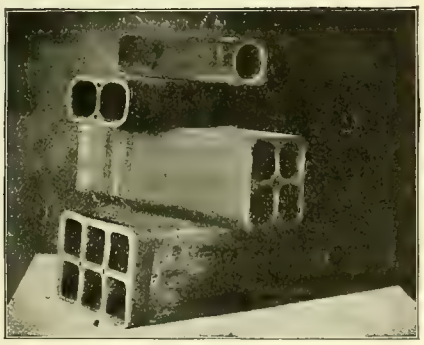

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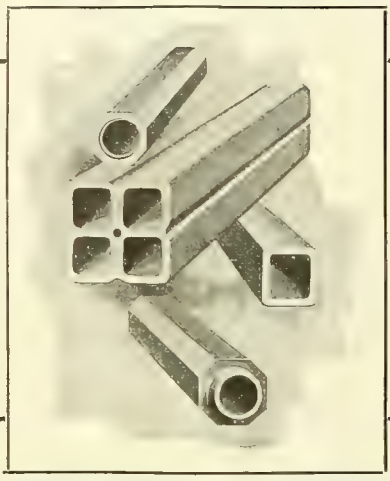

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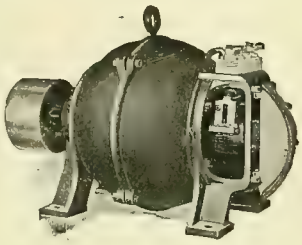

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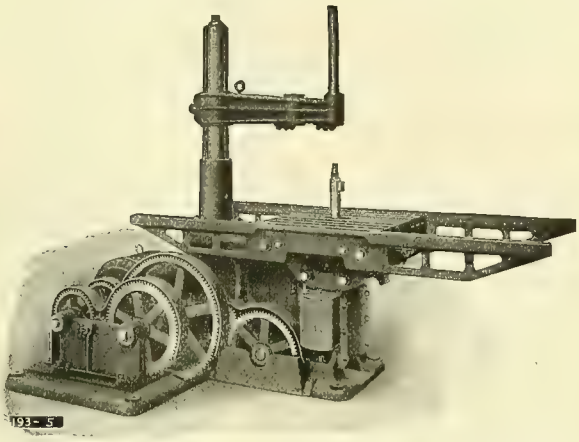

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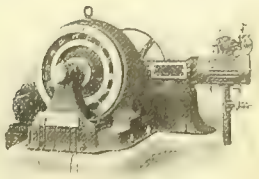

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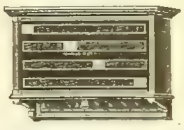

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BEST QUALITY — LOWEST PRICE.

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No Slip, No Abrasion, No Removing socket, Easily attached
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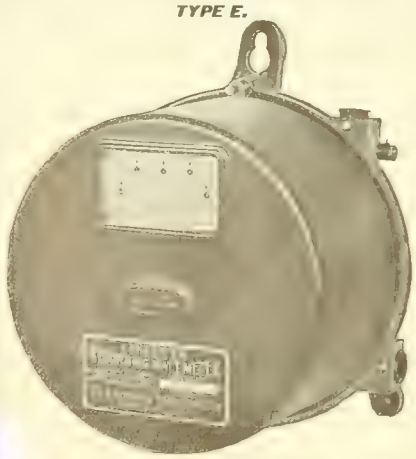
TYPE E.



ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

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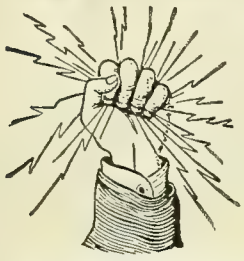

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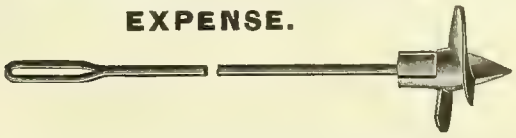

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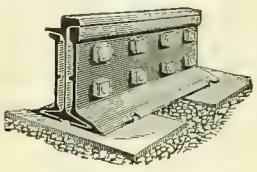

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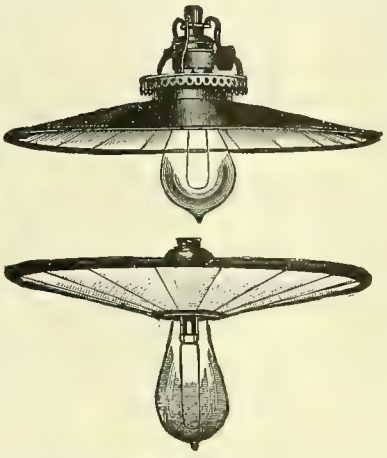

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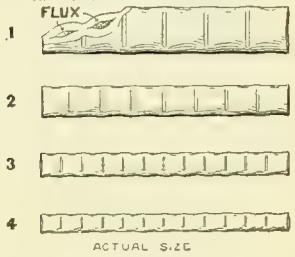

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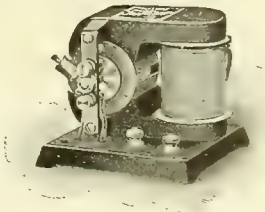

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By a thoroughly competent electrical engineer, preferably as constructing engineer for large corporation, or company contemplating a large transmission installation; qualified to design and handle high tension, long distance transmission propositions. Especially successful in handling large bodies of men to the best advantage. Reference furnished. Address BOX 293, care Western Electrician, 510 Marquette Building, Chicago.

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Would like position as superintendent or general manager of good power, lighting or water works plant. Thirty eight years of age, married and have had very wide experience building, overhauling and operating such plants. Am looking for permanent position with good future prospects, with salary to start not less than $1,500 per year. Address BOX 287, care Western Electrician, 510 Marquette Bldg., Chicago.

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By an electrical engineer to take charge of a power plant. Graduate of electrical engineering. Age 24. Practical experience in three of the largest power plants in this country; also experienced in construction work. References furnished. Address BOX 299, care Western Electrician, 510 Marquette Bldg., Chicago.

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In electric-light plant by experienced steam engineer and graduate of International Correspondence schools in Electric Lighting course. Minnesota state license. Will go anywhere and work reasonable, as I want experience in electrical work. Address BOX 300, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

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PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, February 2, 1904, and publicly opened immediately thereafter, to furnish at the Navy Yard, New York, N. Y., a quantity of water-tight bells, lighting wire, incandescent lamps, electrical supplies, machine screws, ash, cedar, cherry, mahogany, oak, white and yellow pine, poplar, spruce, nickel steel forgings, pipe fittings, radiators, brass condenser tubes, boat hook handles, baseballs, athletic supplies, oars, evaporated apples, prunes, evaporated peaches, tinned ham, salt beef, tinned corned beef, beans, tinned biscuit, butter, tea, and various machine tools, comprising winches, drum hoist, lathes, boring and mortising machines, wire cutting machines, grinders, shaper, planer, drop hammer, etc. Blank proposals will be furnished upon application to the navy pay office, New York. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-11-04

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, February 9, 1904, and publicly opened immediately thereafter, to furnish at the Navy Yards, Portsmouth, N. H., and Boston, Mass., a quantity of wire and cable, conduit and fittings, electrical supplies, bolts, nuts, washers, rivets, miscellaneous hardware and hand tools, drills, hydraulic jacks, files, ratchets, deck winch, traveling cranes, furnaces, ash, white and yellow pine, spruce, brass rod, sheet copper, bar and sheet steel, galvanized sheet steel, solder, sheet lead, bar iron, magnesia blocks and pipe covering, asbestos millboard, hair felting, flax packing, whale oil, engine oil, lard oil, sperm oil, Japan drier, asphaltum varnish, polishing paste, granular sodium carbonate, tallow, gum camphor, brass and copper pipe, lead pipe, iron pipe, valves, brass and iron pipe fittings, lavatories, blank books, pencils, pads, typewriter paper, shipping tags, miscellaneous stationery, toilet paper, laundry and toilet soap, sponges, hair and steel wire brushes, marine cement, oakum, flax twine, plain and khaki cotton twine, lampwick, lacing leather, rigging and bellows leather, buckets, hand and leg irons, squilgees, and emery cloth. Blank proposals will be furnished upon application to the Navy Pay Offices, Portsmouth, N. H., and Boston, Mass. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-14-04

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5 Water driven Turbines of 160 H. P. each, by Gilbert Gilkes of Westmoreland.

5 Alternators of 100 K. W. each, by Siemens Bros & Co.

Switchboard complete with instruments.

A large number of suitable transformers, meters and single-phase motors and other minor plant and apparatus.

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5 Siemens Arc Light Dynamos, each for 35 lamps (7.5 amperes).

4 Circuit switchboard complete with instruments.

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About 120 lanterns for the above.

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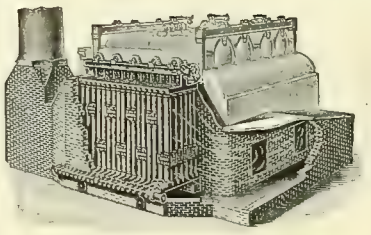

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1 H. P. Lundell, 1200 R. P. M.

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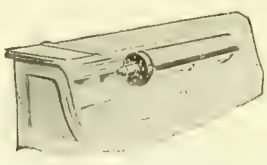

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For General Battery Testing, 0 to 15 Amperes.

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Machine and Carpenter Work of All Kinds Correspondence Solicited.

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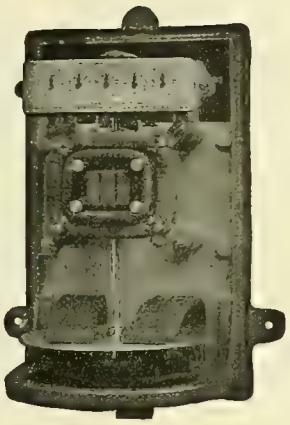

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MOST ACCURATE AND UP-TO-DATE METER UPON THE MARKET.

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NO CONSTANTS
SENSITIVE
GOOD MAGNETS
LARGE DIAL

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One 150 K. W. General Electric, 1,100 volts, 125 cycles, single-phase, monocyclic type.
One 150 K. W. Ft. Wayne "Wood," 1,100 volts, 60 cycles, single-phase, type W. A. L., Class 16-150-450.
One 125 K. W. Westinghouse, 1,100 volts, 60 cycles, single-phase, speed, 600.
One 120 K. W. General Electric, 1,040 or 2,080 volts, 125 cycles, single-phase, type AS, Class 14-120-1070.
Three 120 K. W. General Electric, 2,080 volts, 125 cycles, single-phase, type A, Class 14-120-1070.
Two 120 K. W. General Electric, 1,040 volts, 125 cycles, single-phase, type A, Class 14-120-1070.
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Two 110 K. W. Westinghouse, 2,200 volts, 133 cycles, single-phase, speed 1,375.
Two 100 K. W. Ft. Wayne "Wood," 1,100 volts, 140 cycles, single-phase, speed, 1,050.
One 90 K. W. Westinghouse, 2,200 volts, 60 cycles, two-phase, speed, 515.
One 90 K. W. Warren, 2,200 volts, 60 cycles, single-phase.
Two 75 K. W. General Electric, 2,100 volts, 60 cycles, two-phase, type AQ, Class 8-75-900.
One 75 K. W. Westinghouse, 2,200 volts, 60 cycles, single-phase, speed 720.
One 75 K. W. Ft. Wayne "Wood," 1,100 volts, 133 cycles, single-phase, speed 1,050.
One 60 K. W. Westinghouse, 2,200 volts, 60 cycles, two-phase, speed, 900; in excellent condition, complete with switchboard.
One 60 K. W. Westinghouse, 1,100 volts, 60 cycles, two-phase, speed, 900.
One 60 K. W. Westinghouse, 1,100 volts, 133 cycles, single-phase, speed, 1,600.
Two 60 K. W. General Electric, 1,040 volts, 125 cycles, single-phase, type A, Class 10-60-1500.
One 50 K. W. Ft. Wayne "Wood," 2,000 volts, 140 cycles, single-phase, type WAL, speed, 1,400.
Two 45 K. W. Westinghouse, 1,100 volts, 133 cycles, single-phase, speed, 2,000.
One 37½ K. W. Ft. Wayne "Wood," 1,000 volts, 140 cycles, single-phase, speed, 1,400.
Three 35 K. W. Thomson-Houston, 1,040 volts, 125 cycles, single-phase, speed, 1,500.

A proportionately large stock of Engines, Boilers, Direct Connected Units Direct Current Generators and Motors of all standard voltages, Alternating Motors, Arc Generators, Arc Lamps and Transformers. All in First-Class Second-Hand Condition and so Guaranteed.

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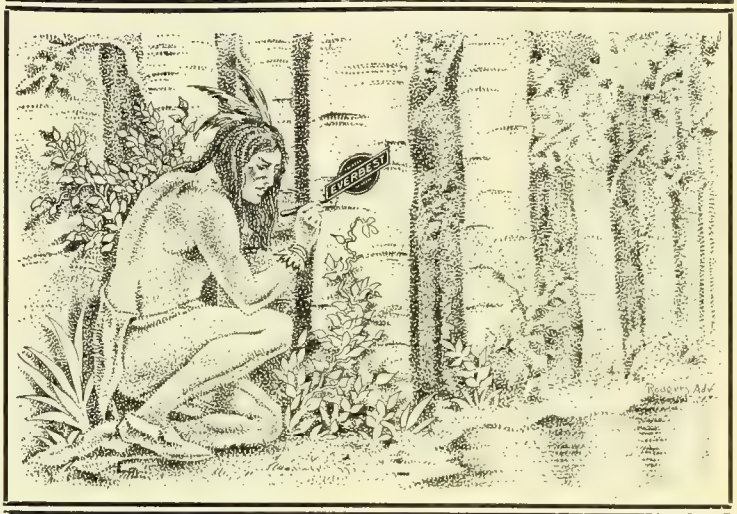
LEAVING HIS MARK



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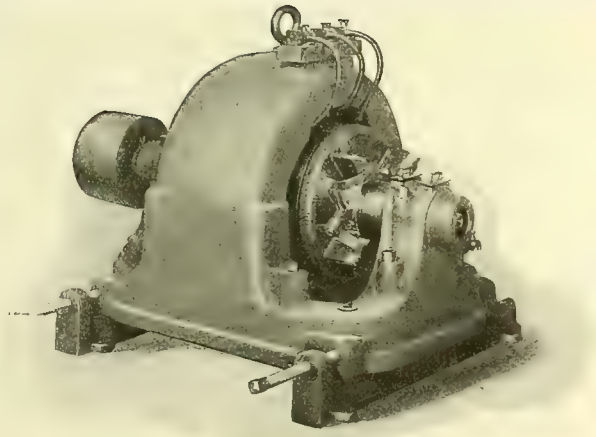

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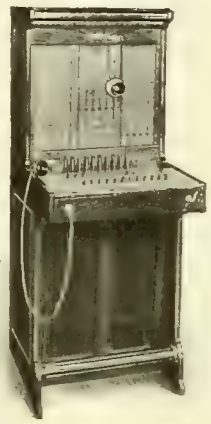

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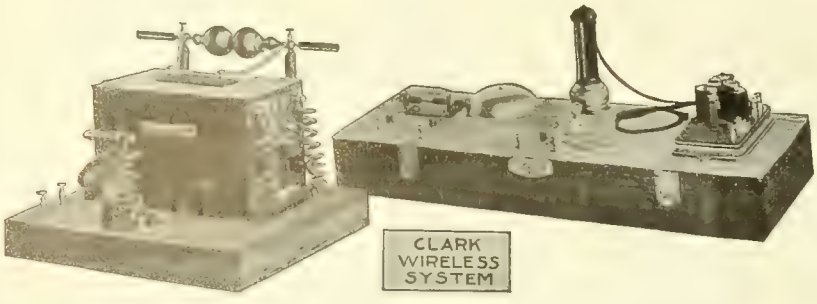

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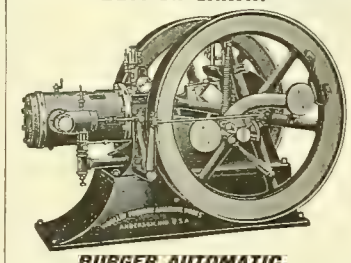
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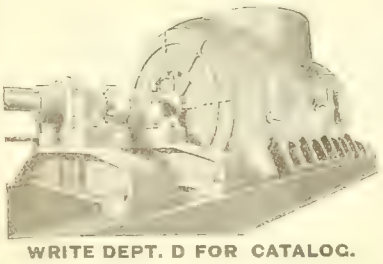
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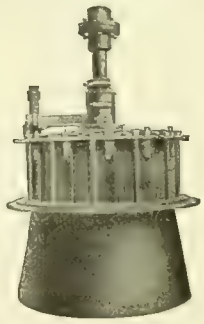
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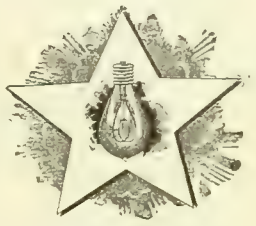

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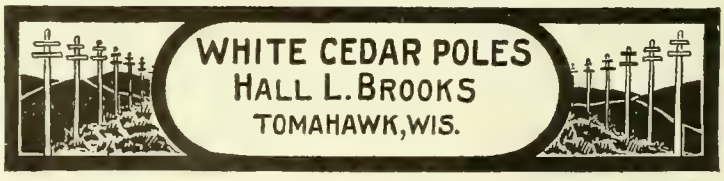

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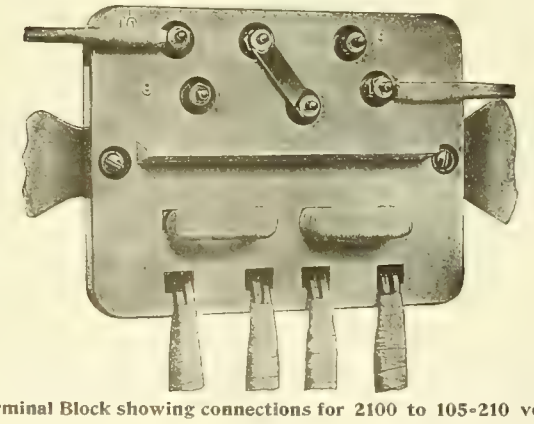

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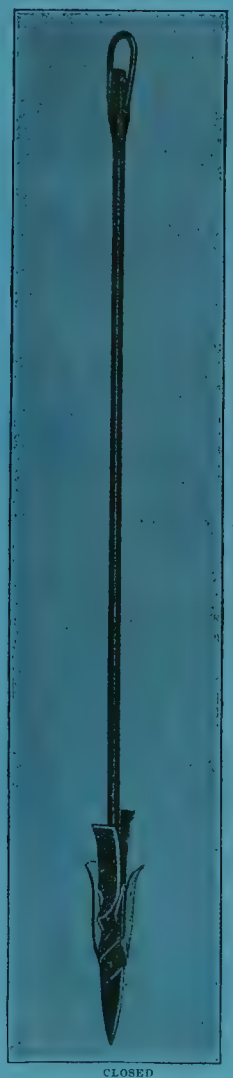
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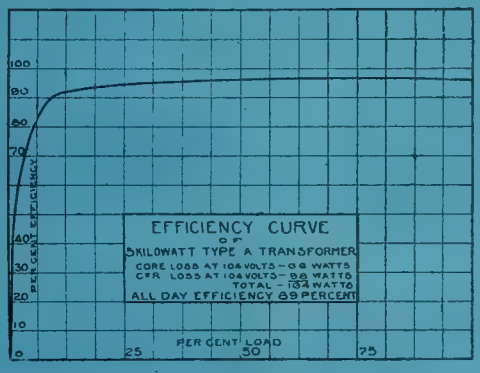

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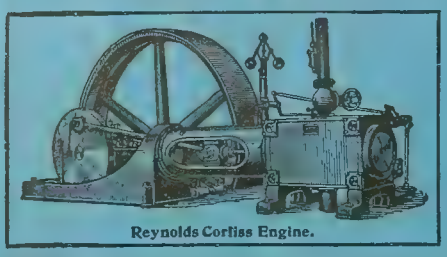
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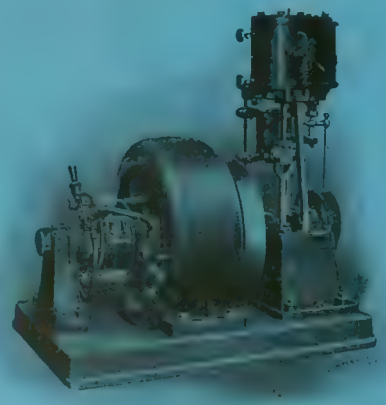

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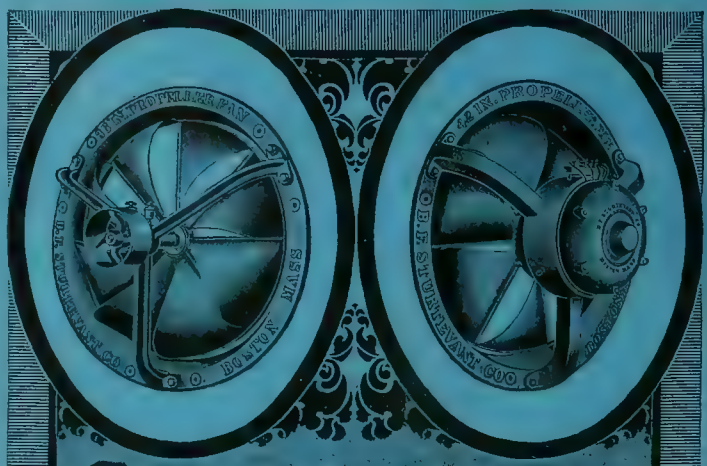

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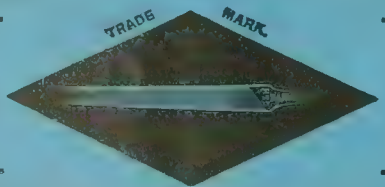

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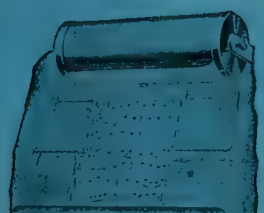

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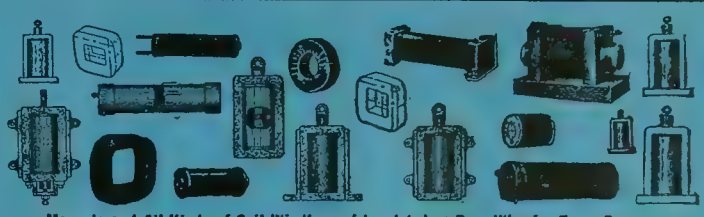

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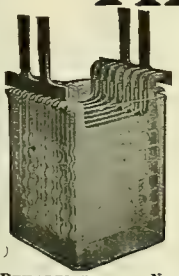

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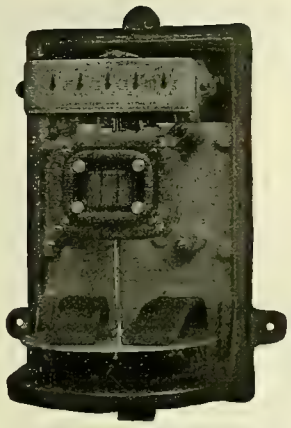

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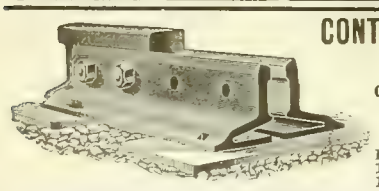

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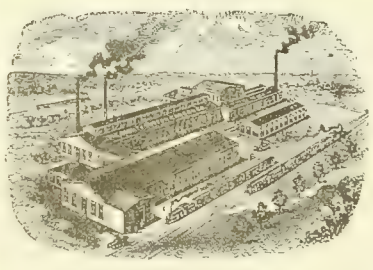

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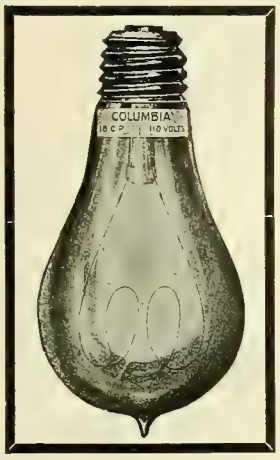

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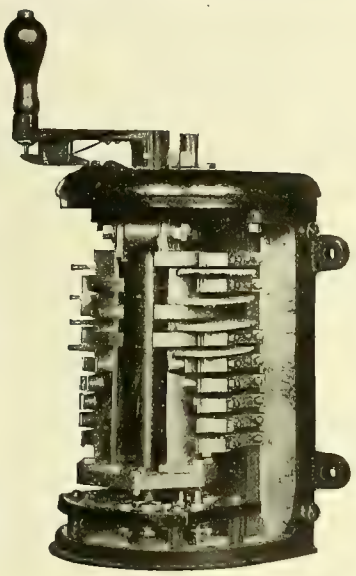

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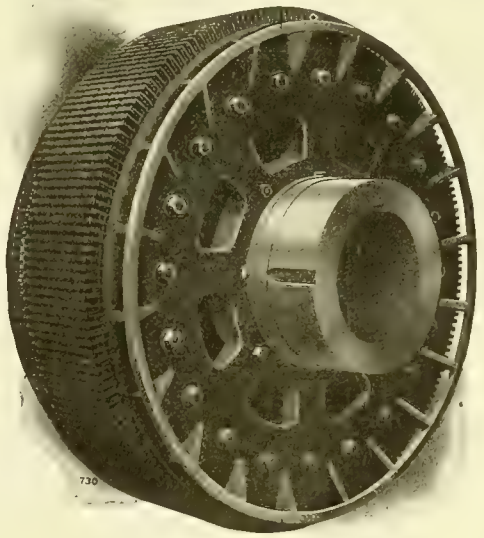

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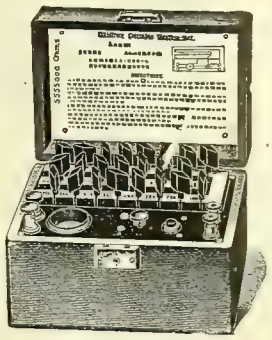

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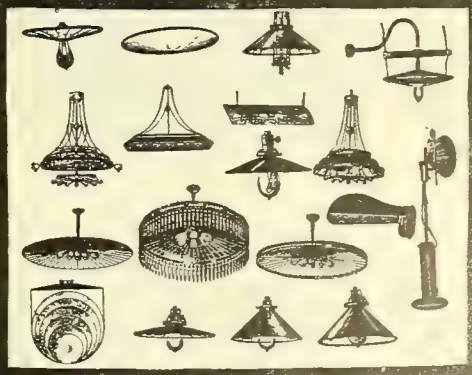

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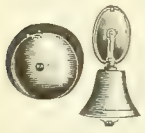

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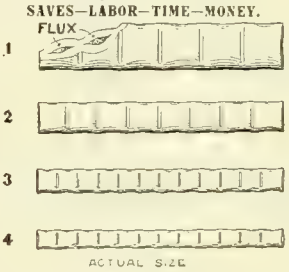

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KESTER ELECTRIC M'F'G CO.,
254 So. Jefferson Street, CHICAGO, ILL.

A PERFECT REFLECTION

Did you ever look over the waters of a clear lake and see mirrored therein the surrounding scenery? Was this not a delightful sensation to know that nature was giving you an opportunity to behold its charms more forcibly and more beautifully?

It is just this kind of reflection that we have been trying to cast from our trade mark and our concern.

We are gratified to say that the reflection from "EVERBEST" has been everbest.

We don't want you to accept our unsupported word for this. We can refer you to thousands of satisfied customers whom we have supplied with electrical goods of every description; concerns in the South, in the West, in the Middle West, and in the North.

We have supplied the right goods at the right prices at the right time; but our Green Book tells you this story, so send for it to-day.

EWING-MERKLE ELECTRIC CO.
ST. LOUIS, U. S. A.

Crown Cord Adjuster
BEST AND SIMPLEST

½ ACTUAL SIZE

PATENTED

No Slip, No Abrasion, No Removing socket, Easily attached
Sample Free
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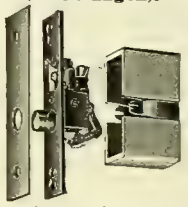
175 Dearborn St., CHICAGO

EDWARDS AND CO.

DOOR SWITCH
(The Lungen).



Porcelain Insulation.
Wire Connections in Front.
Style A—Lights when door is open; out when door is closed.
Style B—Lights when door is closed; out when door is open.
THE ECO DOOR SWITCH OPERATES LIGHTS "EVERY OTHER TIME."
Approved by the National Board of Underwriters.
Western Electric Co., Selling Agents

NEW YORK N.Y.

JEWELL INSTRUMENTS

Jewell Electrical Instrument Co.,

61-63 **UNION PARK COURT,**
CORNER CARROLL AVENUE,
CHICAGO.

Jewell Pocket Portable.

Jewell Portable.

New Soldering Stick
"CRESCENT"
Is Pliable and Plastic, Not Brittle!
Entirely different from any other: no waste; no sputtering; nocorrosion.
CRESCENT CO., 403 OMAHA BLDG., CHICAGO.

SCIENTIFIC METHODS
OF ACCOUNTING.

Our Interchangeable Leaf Systems.

Time and money savers for any and every business. Let us show you how we can improve *yours*. Write for free booklet: "Labor Saving Systems."
We do not sell through the stationery trade, but have our special force of trained representatives who devote their entire time to our work.

JONES PERPETUAL LEDGER CO., Suite 545 N.Y. Life Bldg., CHICAGO.

GUARANTEED WORK **NORTHWESTERN ELECTRIC CO.** AT LOWEST COST
71 W. Washington Street, CHICAGO.
DYNAMOS AND MOTORS
REPAIR WORK A SPECIALTY

Kilfyre DRY POWDER COMPOUND

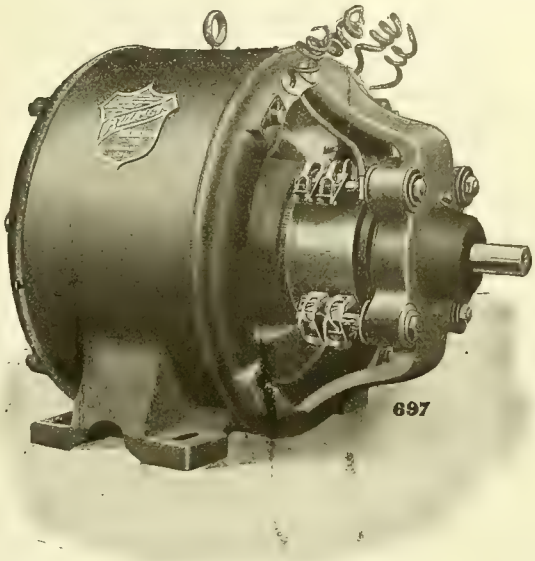
IDEAL FIRE PROTECTION FOR ALL ELECTRICAL APPARATUS.

Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.

MONARCH FIRE APPLIANCE CO.,
247-249 Pearl St., New York City.

Bullock Electric Manufacturing Co.

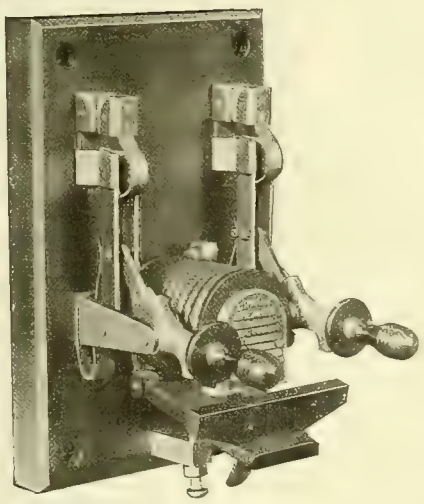
CINCINNATI, OHIO, U. S. A.



Type N Bullock Open Motor

Especially adapted for driving machinery requiring variable speeds using the BULLOCK Multiple Voltage System.

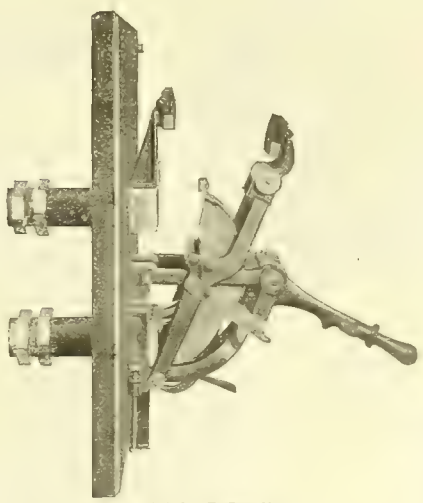
GENERAL ELECTRIC COMPANY'S
Carbon Break Circuit Breakers



TYPE C. FORM G.
1 to 75 Amps.

1 to 10,000 Amps.
250 and 650 Volts.

Built for hard service.
For full information apply to



TYPE C. FORM K.
(Open) 800 to 10,000 Amps.

GENERAL ELECTRIC COMPANY
Schenectady, N. Y., U. S. A.

Chicago Office Monadnock Block. Sales Offices in all Large Cities.

OUR CUSTOMERS SAY SO

It is not only the price of an arc lamp—that's not the end Repairs, delays, inferior results, increased expense in maintaining and in operation—these all add to the cost.
The A-B is simple and correct in its mechanism—is a perfected and practical arc lamp.

IT CUTS OUT THE TROUBLE AND SAVES MONEY

ELECTRIC APPLIANCE COMPANY,
92 AND 94 W. VAN BUREN ST., CHICAGO.

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World

and are to-day more largely used than all other makes combined.

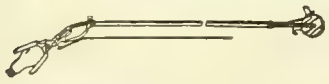
Serviceable, Economical, Reliable.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICANITE CLOTH

HIGH INSULATOR FOR ARMATURES, ETC.
NON-ABSORPTIVE, FLEXIBLE and STRONG.
MICA INSULATOR CO.
"ORIGINATORS."
CHICAGO. NEW YORK.



The Incandescent Lamp Replacer and Cleaner replaces and cleans any c.p lamp at any height or angle.
Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

MICA and MICABOND.

WE PUT THE MICA-POOL OUT OF BUSINESS.
CHICAGO MICA CO, VALPARAISO, IND.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

GASOLINE MOTOR CASTINGS
—FOR—
BICYCLES, AUTOMOBILES, AND LAUNCHES.

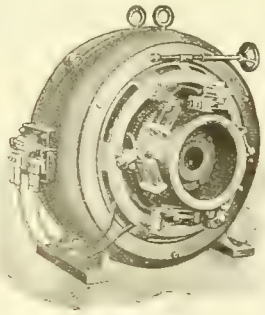
LOWELL MODEL CO.,
NORTH CHELMSFORD, MASS.

153
NORTHERN APPARATUS
DIRECT CURRENT
DYNAMOS AND MOTORS
Compact, Simple, Trustworthy, Economical in Operation
Superior
Get Generator Bulletin No. 2530
Northern Electrical Mfg. Co., Madison, Wis., U. S. A.
ENGINEERS :: MANUFACTURERS

Crowe Metal Mfg. Co. CHICAGO.
WHAT? NAME PLATES
BEST QUALITY — LOWEST PRICE.

BEARDSLEE CHANDELIER MFG CO. 256 AND 257 S. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER.

DIRECT CURRENT
GENERATORS
For Light and Power



SUPERIOR
in every respect, our generators have a high efficiency, great durability and the best commercial value.

Write for New Bulletin No. 10514

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ELECTRIC COMPANY

General Offices:
527-531 West 34th Street, New York.
Chicago Office: Fisher Bldg.

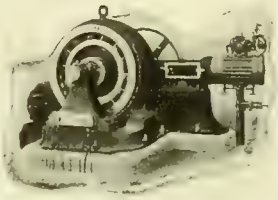
YOU NEED IT!

Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.
Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, 909-100 Washington Street. • CHICAGO.

EMPIRE WIRE COMPANY,
92 William St., N.Y. City.
MAGNET WIRE AND BARE AND TINNED COPPER WIRE.
FACTORIES { ROME, N. Y. / LISBON, N. H.
CHICAGO OFFICE AND STOCK { 60 W. VAN BUREN ST.

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

Warren Alternator



In the WARREN ALTERNATOR everything possible has been done for reliability, durability, ease of management and efficiency; everything to avoid burnouts, repairs and excessive cost of operation. The machine is pleasing in appearance, because of good proportions, is massive, strong, of the highest grade of workmanship, and impresses a thoughtful person with its solidity and special adaptation to the most severe, constant and exacting service, a machine constructed for the one sole purpose of EARNING MONEY WITH, AND NOT TO SPEND MONEY UPON.

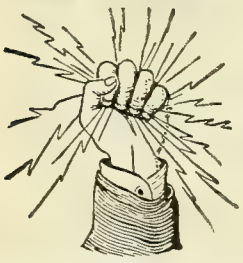
We Guarantee What We Sell
. . . AND . . .
Sell What We Guarantee

WARREN ELECTRIC MFG. CO.
Sandusky, O.

FRANK N. PHILLIPS, President. C. H. WAGENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. R. REMINGTON, Jr., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



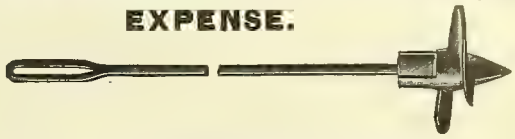
BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

DID YOU EVER COUNT THE COST OF GUYING?

DO SO ON YOUR LINE AND YOU WILL FIND THAT A LOT OF MONEY IS GOING THAT WAY.
USE THE
STOMBAUGH GUY ANCHOR
AND YOU WILL SAVE A GREAT PART OF THIS
EXPENSE.



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SOLICITOR OF U. S. & FOREIGN **PATENTS**
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

Electric Heating Apparatus
SEND FOR 64-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
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Patent Causes. Patent Soliciting.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.
Write for our free Illustrated Book.
"Can I Become an Electrical Engineer?"
We teach Electrical Engineering, Electric Lighting, Electric Railways, Mechanical Engineering, Mechanical Drawing, etc. at your home, by mail. Institute indorsed by Thos. A. Edison.
Electrical Engineer Institute,
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SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

GET ALLEN'S SOLDERING TICKS
MAKE SOLDER FLOW
FOR ALL ELECTRIC WORK.
Do things—Keep still—Get the Habit
of Calling the Man
"ALLEN SOLDERING STICKS OR NOTHING."
A Big Sample Stick for 10c.
Booklet "Soldering Sense" describes.
L. B. ALLEN CO., Inc.,
SOLE MAKERS
1224 Columbia Ave., CHICAGO.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS,
81 W. Van Buren St., Chicago, Ill.

Russian Exports Exclusively

M. GRADSTONE & COMPANY

——MANUFACTURERS' EXPORT AGENTS——

2-4 Stone Street - - NEW YORK

We offer every facility for the proper introduction of Electrical Specialties to the Russian trade

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"ALPHADUCT"
The highest achievement in the art of interior conduit construction.

FOR ELECTRIC WIRES.

ALPHADUCT MFG. CO.
622 West 22d Street, New York.
303 Fisher Building, Chicago.

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 102 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.
Prices and Samples on Application.

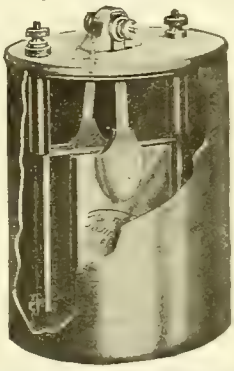
Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

EDISON PRIMARY BATTERIES
Formerly known as Edison-Lalande

EXCELLENCE AND RELIABILITY GUARANTEED BY THIS TRADEMARK SIGNATURE

TRADE Thomas A. Edison MARK

Write for Booklet 7



BEST BATTERIES ON THE MARKET FOR GAS ENGINES, SLOT MACHINES, RAILROAD SIGNALS, CROSSING BELLS, SMALL MOTORS, ETC.

EDISON MANUFACTURING COMPANY,
Factory, Orange, New Jersey, U. S. A.
New York Office, 83 Chambers Street. Chicago Office, 304 Wabash Avenue

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion, additional words 2c each*

POSITION WANTED.

As superintendent of Electric Light or Municipal Water and Light Plant, by young man with technical education and ten years' practical experience from lineman to superintendent. Would accept position as traveling salesman for electrical supply house. References given. Address BOX 301, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By a thoroughly competent electrical engineer, preferably as constructing engineer for large corporation, or company contemplating a large transmission installation; qualified to design and handle high tension, long distance transmission propositions. Especially successful in handling large bodies of men to the best advantage. Reference furnished. Address BOX 293, care Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

Would like position as engineer or manager of light or water works plant, or both combined. Have had wide experience in operating both. Can do my own machinist work and give best of references. Address BOX 302, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Three experienced incandescent lamp salesmen, by an old and well-established company not in the trust. Applicants will please state age, experience and salary wanted. Address BOX 199, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

One 10 x 12 Phoenix center crank automatic engine, has done about 4 years' service, is in good condition and can be had reasonable, as it is being replaced by a larger engine. Address WELLSVILLE ELECTRIC PLANT, Wellsville, Mo.

FOR SALE.

Electric light plant in town of 1,000 population. In fine shape and on sound financial basis. I did not want to take it but was obliged to and now want to sell it. New generator and thoroughly overhauled since taking possession. E. E. SECOR, Buffalo Center, Iowa.

FOR SALE.

Complete new apparatus embodying all the most recent improvements in machinery employed in the manufacture of incandescent electric lamps. Will guarantee lamp manufacturers results as to cost and quality. Address BOX 274, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

An I. C. S. course in telephone engineering. Address F. W. WYNN, General Delivery, Rockford, Ill.

FOR SALE.

6 K. W. Edison 220-volt motor; 5 H. P. Eddy 220-volt motor; 1 H-P Crocker-Wheeler 220-volt motor. WALSH'S SONS & CO., 261 Washington St., Newark, N. J.

FOR SALE.

One of the best telephone systems in Eastern Kansas. Three exchanges, two toll stations and good toll and farmer lines. Connections with all neighboring towns and cities. Over 250 phones in operation. System can be rapidly extended. A fine place for a good telephone man with money. Will sell reasonably if taken at once. Present owners not telephone men and fully occupied with other business. Address J. B. SAGERS, Secretary, Clyde, Kansas

FOR RENT.

Two fine floors for manufacturing purposes, heat, electric light, power and elevator service furnished. Floors contain 11,500 feet each, light four sides. An ideal place for manufacturers of telephones or accessories. Plenty of labor can be had cheap. Address E. J. NOBLETT CO., 121st and Peoria Sts., West Pullman, Chicago, Ill.

Western Electrician WANT ADS Bring Results.

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, February 9, 1904, and publicly opened immediately thereafter, to furnish at the Naval Torpedo Station, Newport, R. I., a quantity of mine cases, battery boxes, automatic anchors, torpedo cases, single conductor cable, dry battery cells, and rubber washers. Blank proposals will be furnished upon application to the navy pay offices, Newport, R. I., and New York, N. Y. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-9-04

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, February 9, 1904, and publicly opened immediately thereafter, to furnish at the Navy Yards, Portsmouth, N. H., and Boston, Mass., a quantity of wire and cable, conduit and fittings, electrical supplies, bolts, nuts, washers, rivets, miscellaneous hardware and hand tools, drills, hydraulic jacks, files, ratchets, deck winch, traveling cranes, furnaces, ash, white and yellow pine, spruce, brass rod, sheet copper, bar and sheet steel, galvanized sheet steel, solder, sheet lead, bar iron, magnesia blocks and pipe covering, asbestos millboard, hair felting, flax packing, whale oil, engine oil, lard oil, sperm oil, Japan drier, asphaltum varnish, polishing paste, granular sodium carbonate, tallow, gum camphor, brass and copper pipe, lead pipe, iron pipe, valves, brass and iron pipe fittings, lavatories, blank books, pencils, pads, typewriter paper, shipping tags, miscellaneous stationery, toilet paper, laundry and toilet soap, sponges, hair and steel wire brushes, marine cement, oakum, flax twine, plain and khaki cotton twine, lampwick, lacing leather, rigging and bellows leather, buckets, hand and leg irons, squilgees, and emery cloth. Blank proposals will be furnished upon application to the Navy Pay Offices, Portsmouth, N. H., and Boston, Mass. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-14-04

Notice is hereby given that specifications have been adopted by the City of Fond du Lac, by its Mayor and Common Council, for the granting of a franchise to construct, maintain and operate a plant or plants within or without the City of Fond du Lac, for the purpose of furnishing, and to furnish to the City of Fond du Lac and its citizens and others in said State electricity for light, heat, and power and to that end to set poles and string wires and construct and maintain the necessary appurtenances to said business in said City of Fond du Lac, which said specifications are now on file in the office of the City Clerk of said City of Fond du Lac, to which reference is hereby made.

Now, therefore notice is hereby given that bids will be received for the sale of such franchise at the office of F. A. Bartlett, City Clerk of the City of Fond du Lac, up to five o'clock P. M. on the 7th day of March, 1904, which such bids shall propose, on behalf of the applicant, to pay annually into the treasury of said City in consideration of receiving such franchise, a percentage of the gross receipts from the business carried on under said franchise. Such bid must be accompanied by a certified check in the sum of Three Hundred ($300) Dollars, as a guarantee of the acceptance of the franchise if granted and the giving of the bond provided for in said specifications.

By order of the Common Council:
Dated, February 2, 1904.
F. A. BARTLETT,
City Clerk, Fond du Lac, Wis.

GREGORY ELECTRIC CO. 54-62 S. CLINTON ST. CHICAGO

All dynamos, motors, meters and transformers listed by this Company are at their warehouses ready for immediate delivery.

FOR SALE

at a bargain if taken immediately:

1-400 K. W. Westinghouse Alternator.
1-200 " Stanley Alternator.
2-150 " General Electric Alternators.
3-120 " " " "
2-150 " Westinghouse 500 V. Railway Generators.

Largest stock of second-hand electrical apparatus in this country. Send for our monthly Bargain sheet with complete list and net prices. Everything fully guaranteed.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish,
Sterling Black Air Drying Varnish,
Sterling Black Core Plate Varnish.

THE STERLING VARNISH CO., Pittsburg, Pa., U. S. A. **THE STERLING VARNISH CO.,** Brougham St., Blackfriars Road, Salford, Manchester, England.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH 3 OUNCE BOX 10 CENTS SAMPLES SENT FREE GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295. E. WASHINGTON ST. INDIANAPOLIS, IND.

FOR SALE

220 V. DIRECT CURRENT.

80 H. P. Westinghouse 400 R. P. M.
20 H. P. Eddy, 1450 R. P. M.
7½ H. P. General Electric 900 R. P. M.
5 H. P General Electric, 1820 R. P. M.
5 H. P. Paragon, 900 R. P. M.
3½ H. P. Paragon, 1000 R. P. M.
2 H. P. General Electric, 1025 R. P. M.
2 H. P. Simpson, 2100 R. P. M.
1½ H. P. General Electric, 1800 R. P. M.
1 H. P. Lundell, 1200 R. P. M.
25 H. P. Crocker Wheeler, 750 R. P. M.
15 H. P. Detroit, 1000 R. P. M.
10 H. P. General Electric, 1350 R. P. M.
10 H. P. Simpson, 2000 R. P. M.
7½ H. P. Crocker-Wheeler, 1575 R. P. M.
7½ H. P. Card, 775 R. P. M.
6 H. P. C. & C., 1030 R. P. M.
5 H. P. Westinghouse, 1050 R. P. M.
5 H. P. C. & C. 1600 R. P. M.
3 H. P. Jenny, 1600 R. P. M.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, CHICAGO.

Like Finding Money.

Save your scrap copper, brass and platinum, also incandescent lamp bases, etc., and send them to us. We pay the highest market prices for this material. What have you?
We manufacture copper hard babbitt, the best on earth for electrical work, wire solder, pig lead, ingot copper, spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING & REFINING COMPANY, CHICAGO.

FLORIDA?

Yes, I'm going.
Well, there's *something new* for you to consider. The
SOUTHERN RAILWAY
in connection with the
Queen & Crescent Route
will TAKE YOU DOWN ONE WAY and BRING YOU BACK ANOTHER, for a slight advance in the regular winter tourist rate.
Low round-trip rates now in effect to all tourist points in Florida and the South. Good connections, through sleepers, fine equipment, best of everything.
On JANUARY 11, 1904, the "Chicago & Florida Special" and the **"Florida Limited"** with through Pullman sleepers, dining, club and observation cars will again go into service Chicago to St Augustine, via Cincinnati, Chattanooga, Atlanta and Jacksonville For through sleeping car reservations, literature and full particulars, write
J. S. McCULLOUGH, N. W. P. A.
Phone Har. 1813. 225 Dearborn St., Chicago, Ill
G. B. ALLEN, A. G. P. A., St. Louis, Mo.

FOR SALE.

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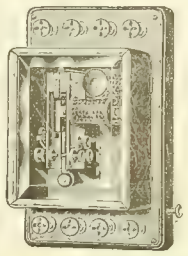

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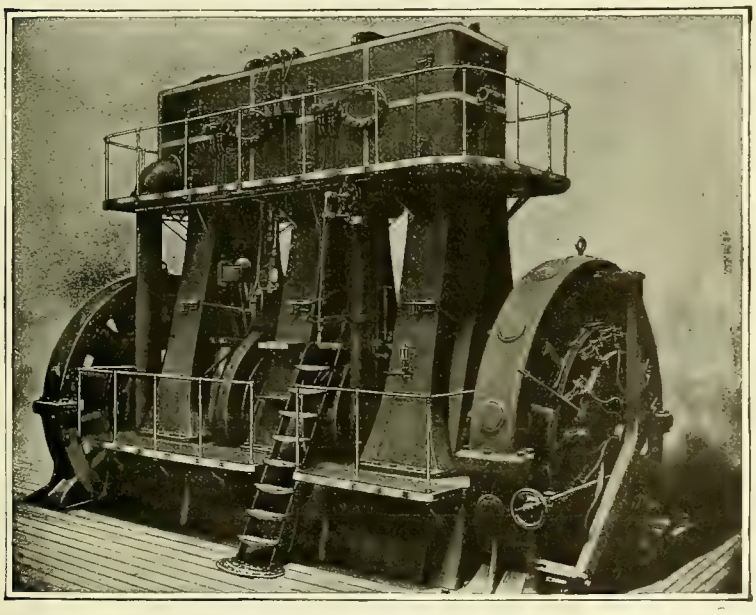

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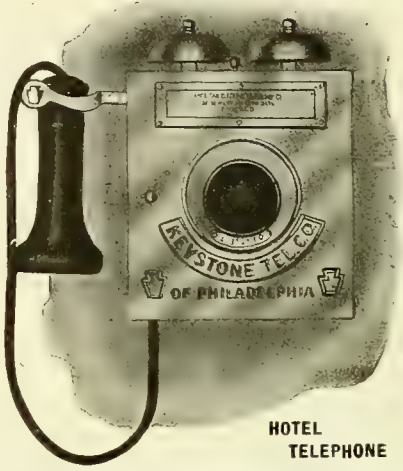

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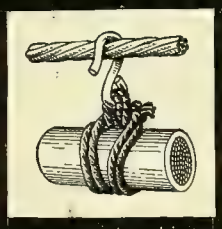

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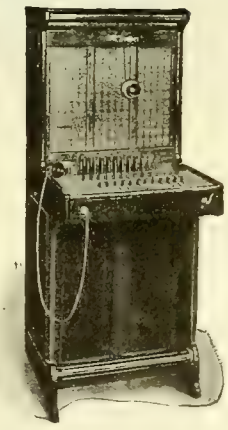

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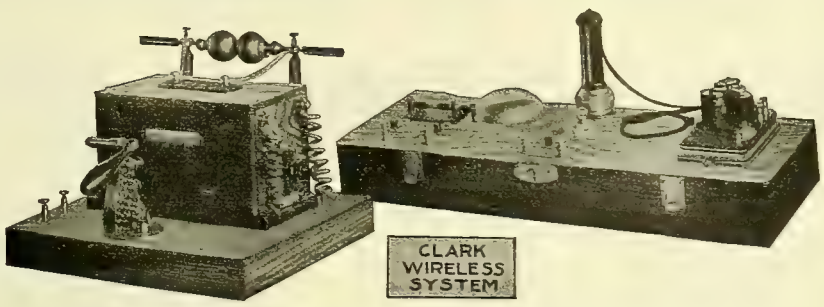

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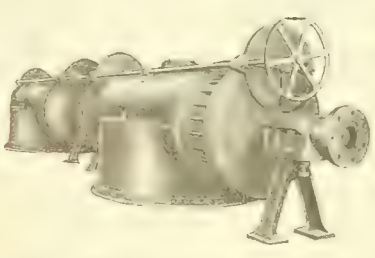
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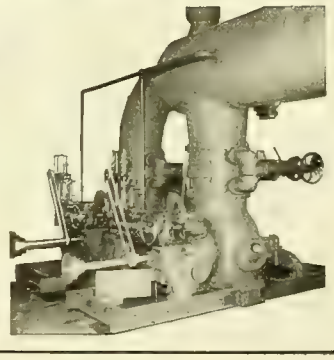

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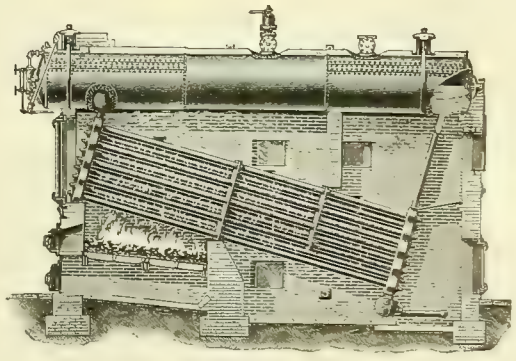

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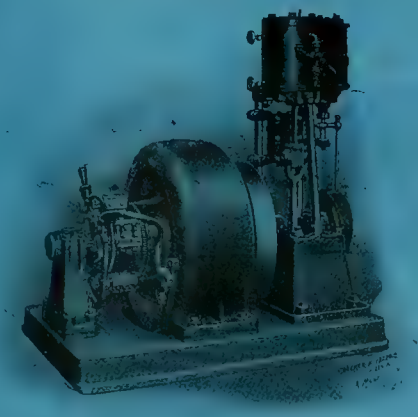

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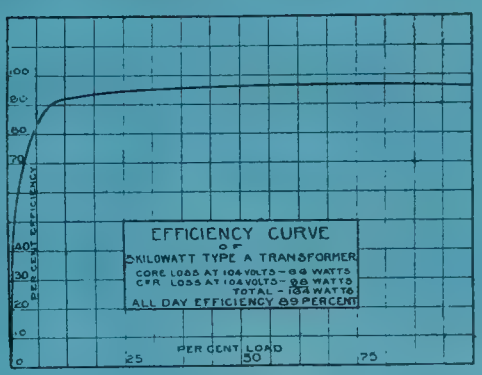

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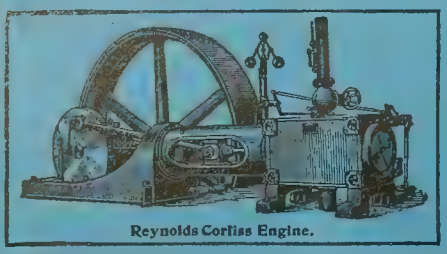
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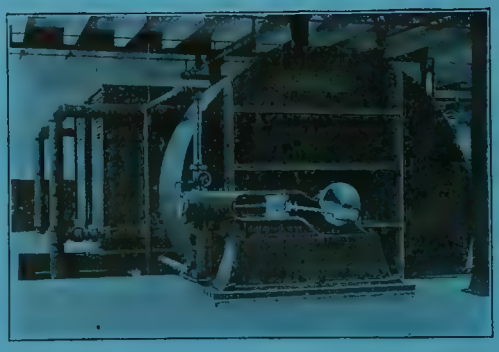

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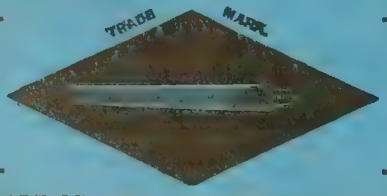

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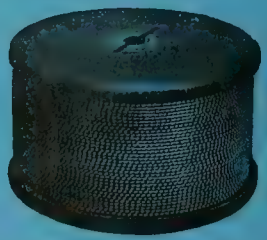

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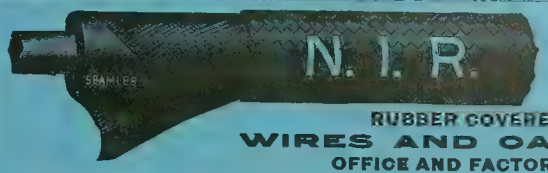

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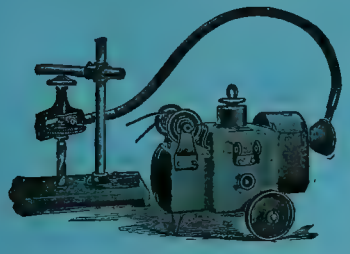
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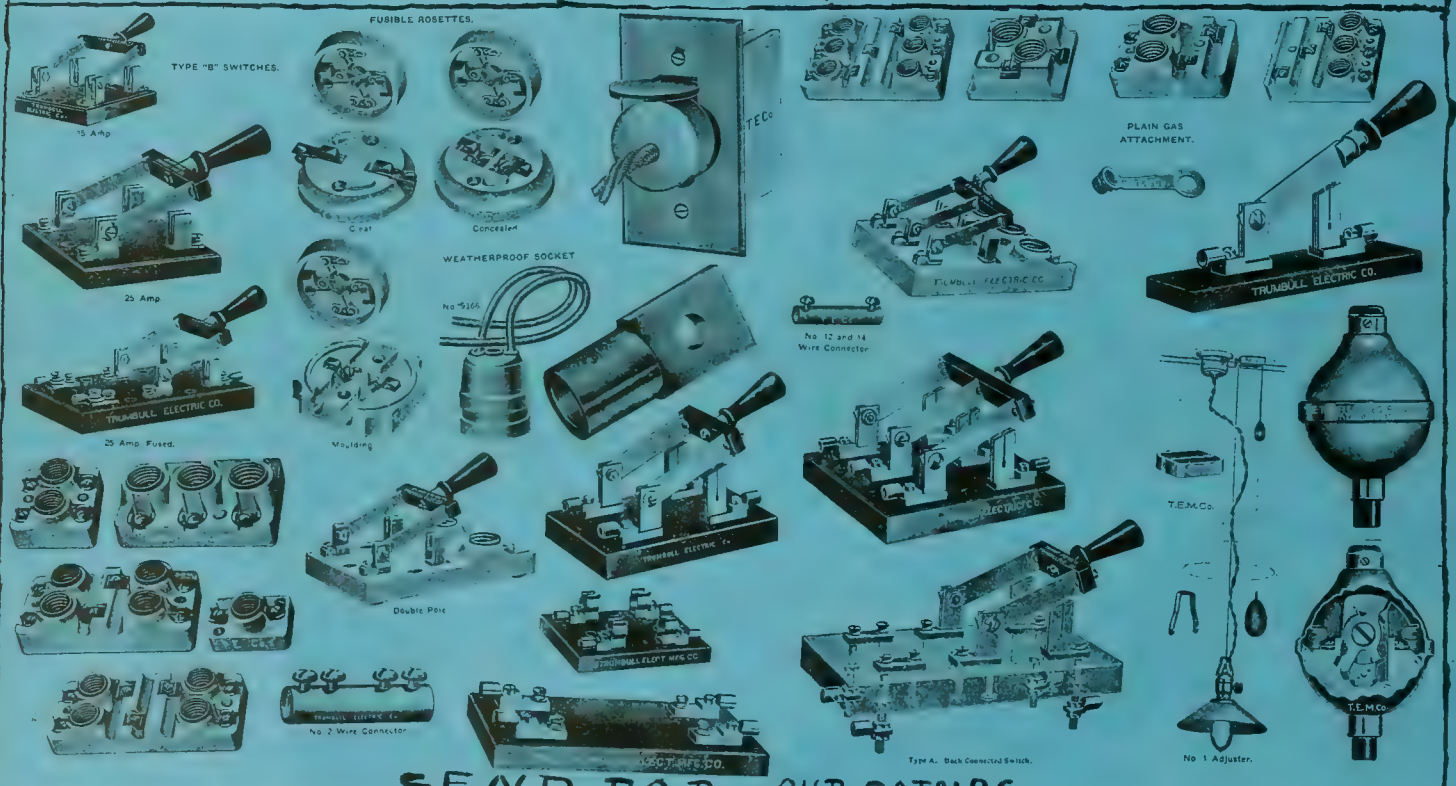

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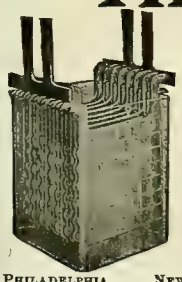

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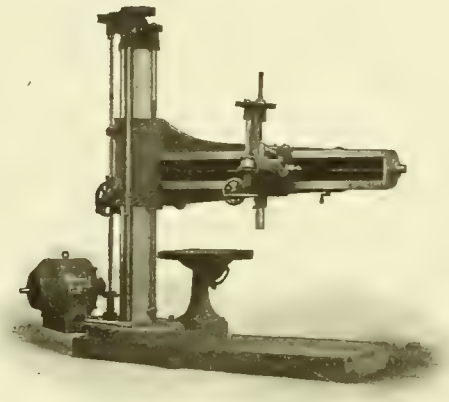

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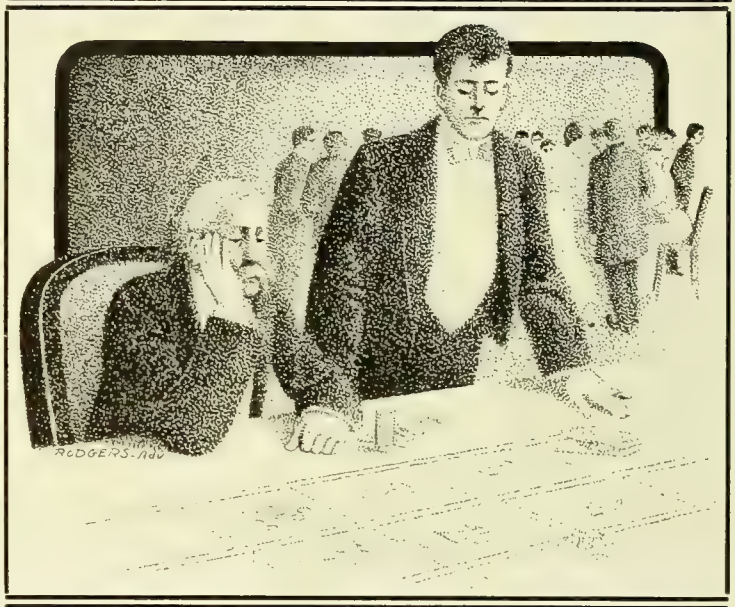

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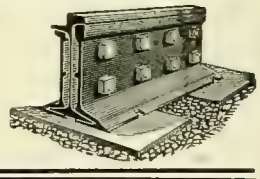

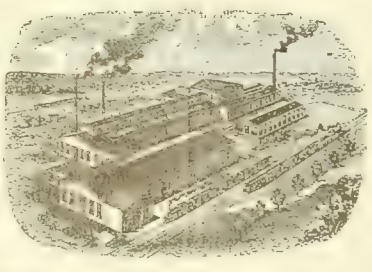

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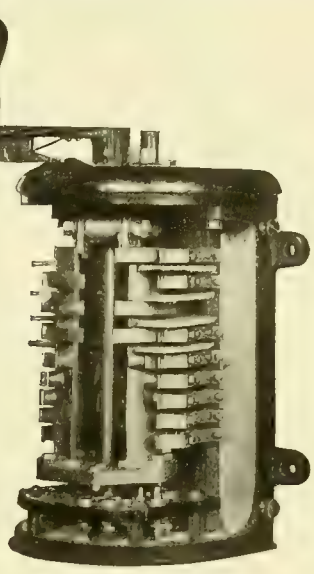

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Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
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Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

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Weston Electrical Inst. Co.

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American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

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Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Ewing-Merkle Electric Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

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Crouse-Hinds Co.
Gen. Incand. Arc Light Co.
Walker Electric Co.

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Automatic Electric Co.
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Fahnestock Transmitter Co.
International Tel. Mfg. Co.
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Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
National Elec. Signalling Co.
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Western Electric Co.
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Central Electric Company.
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Leffel & Co., Jas.

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Phillips, Eugene F.
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CARBONS

BEST LIGHT

STEADIEST LIGHT

ELECTRA

•TRADE MARK•

LONGEST LIFE

LEAST DUST

REMAIN THE STANDARD OF THE WORLD FOR ALL ARC LIGHTING SYSTEMS, BECAUSE they cannot be equaled in QUALITY or EFFICIENCY, producing the highest standard of candlepower in proportion to the current consumed.

HUGO REISINGER, Sole Importer, - - 11 Broadway, NEW YORK.

STONE CONDUIT

For Underground Wires. The Only Conduit that Improves with Age.
AMERICAN STONE CONDUIT CO., Suite 29. 94 La Salle St., Chicago, Ill.

Made Right

Sold Right

Factories at Brazil, Ind., and in Ohio, Pennsylvania and New Jersey.

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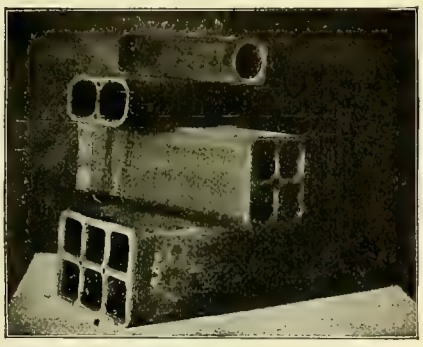
Pittsburg Sewer Pipe & Conduit Company



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VITRIFIED CLAY CONDUITS

IN 1, 2, 3, 4 AND 6 DUCT.

Superior Conduits for underground wires a specialty.

General Office and Factory:
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Branch Office and Sale Yard: 2417 East 18th Street, KANSAS CITY, MO.

Bituminized Fiber Conduit.

THE ELECTRICAL ENGINEER WHO HAS A SUBWAY TO CONSTRUCT

and

Wants the best possible protection to his cables
A conduit of endless durability
A continuous, sealed, insulating duct from manhole to manhole; impervious to gas and moisture and Electrolysis-proof
A duct that is and remains perfectly aligned, into which and out of which he can draw cables with ease and rapidity without the possibility of a scratch
Wants to save his company sixty per cent of freight and handling costs and twenty to thirty-five per cent of construction cost

Will write for our book and price.
All diameters from one inch to ten inches, seven-foot lengths.
Bends of all angles.

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TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current — Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

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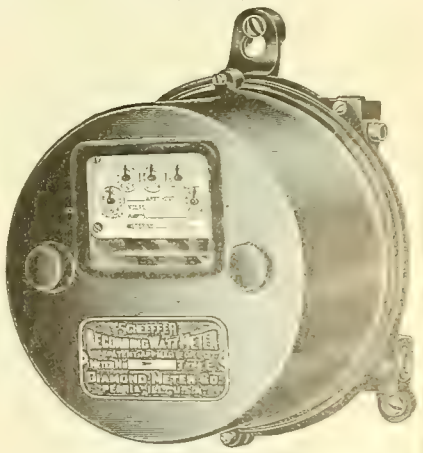
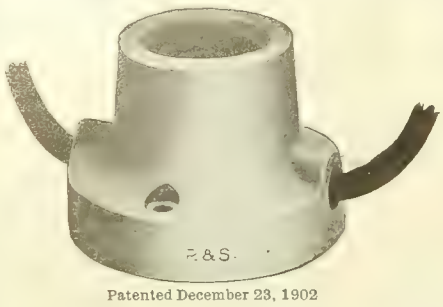


DIRECT CURRENT.



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RECEPTACLES FOR ALL PURPOSES

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SOLVAY, N. Y.

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ELECTRIC HEATING and COOKING APPARATUS
Send for Catalogue and Price List
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Is entirely encased in iron and is weather-proof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

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Russian Exports Exclusively

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—MANUFACTURERS' EXPORT AGENTS—

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Electric Heating Apparatus
SEND FOR 64-PAGE CATALOGUE.
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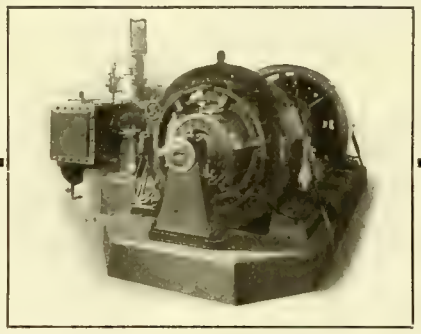
CHICAGO, Monadnock Block.

Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

PLACE YOUR
"Want" and "For Sale" advertisements in the
WESTERN ELECTRICIAN,
Immediate Returns.



147

As Good as The Best— "And Then Some."

Ball Compound Engine

Northern Dynamos

Northern Direct Current Apparatus possesses all the characteristics of economical, convenient operation common to excellent electric dynamos and motors and

Many exclusive meritorious features that make it worth your while to get acquainted by reading Bulletin No. 2,530.

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MADISON, WIS., - - - - U. S. A.

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The highest achievement in the art of interior conduit construction.

FOR ELECTRIC WIRES.

ALPHADUCT MFG. CO.
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You Are Always Safe
IN ADVOCATING THE USE OF OUR
SINGLE-PHASE, SELF-STARTING
MOTORS and CEILING FANS

THEY ARE BUILT OF THE BEST MATERIAL, WITH A LIBERAL MARGIN OF OVERLOAD CAPACITY, AND WE WILL GUARANTEE THE RESULTS FROM THEIR OPERATION.

CENTURY ELECTRIC CO.
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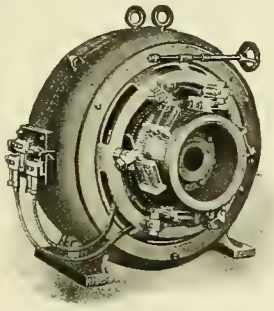
DIRECT CURRENT

GENERATORS

For Light and Power



SUPERIOR

in every respect, our generators have a high efficiency, great durability and the best commercial value.

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ELECTRIC COMPANY

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EXTRACT FROM REPORT OF

Test of 15,000-Volt, 30-Amp.

SACHS "NOARK" FUSES

AT ONE OF THE

Largest High Potential Transmission Plants

"TWO 750-KILOWATT TRANSFORMERS: COLD FUSE PLACED DIRECT ACROSS TRANSFORMER TERMINALS.

"FIRST—Blew in a fraction of a second, without noise or apparent strain, tube not more than perceptibly heated.

"SECOND—Blew as No 1, except that there was indication (in sound of generator) that the current made again for an instant after the first interruption, and a very slight discharge through vent holes in end of tube.

"THIRD—One generator was removed, leaving only one. Fuse blew quietly and with no sign of strain in about one second.

"You will note from the above that the performance was quite satisfactory, and we will be pleased to have you advise us how soon we may expect shipment of the completed fuses and fuse blocks for our complete installation."

If you are looking for a safe and accurate Protective Device for similar service, let us do the same for you.

SACHS "NOARK" FUSES

5,000 - - 20,000 Volts

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H.W. JOHNS-MANVILLE CO
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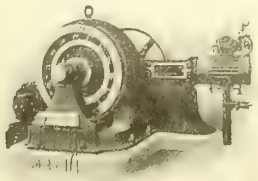
PHILADELPHIA CLEVELAND PITTSBURG NEW ORLEANS LONDON

Warren Alternator



The WARREN ALTERNATOR needs no garrulous knight to champion its virtues. Simple statements of merit and NOTHING BUT FACTS, devoid of technical verbiage, are all that are necessary in selling Warren Alternators.

We Guarantee What We Sell

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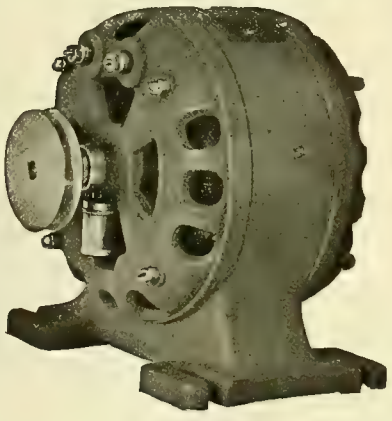
Sell What We Guarantee

WARREN ELECTRIC MFG. CO.

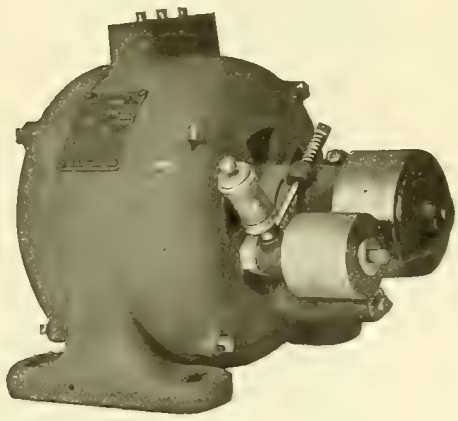
Sandusky, O.

The General Electric Company's



1-10 H. P. A. C. Power Motor.

New Small Alternating Current Motor For Machine Tools.



¼ H. P. A. C. Motor With Belt Tightener.

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OUR CUSTOMERS SAY SO

It is not only the price of an arc lamp—that's not the end Repairs, delays, inferior results, increased expense in maintaining and in operation—these all add to the cost.
The A-B is simple and correct in its mechanism—is a perfected and practical arc lamp.

IT CUTS OUT THE TROUBLE AND SAVES MONEY

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92 AND 94 W. VAN BUREN ST., CHICAGO.

Hot Air and Flv Chasers

All of the LATEST STYLES for both Alternating and Direct Current.

There is Money in the Fan Business

Write for our new 1904 WESCO BULLETINS on DESK, CEILING AND WALL FANS

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EVERYTHING ELECTRICAL

NORTON Ammeters and Voltmeters

High-Grade Instruments at Moderate Cost.
Write for Circular and Price List.
The Norton Electrical Instrument Co., Main Office and Factory MANCHESTER, CONN.
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You Who are Troubled with Sparking and Cutting of Commutators to Use

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.
Absolutely will Not Gum The Brushes . . .
It will put that high gloss on the commutator you have so long sought after.

K. McLENNAN & CO.,
Sole Manufacturers,
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We import directly from India and handle the output of the best mines. A large stock constantly on hand enables us to make prompt shipments. **ALL OTHER QUALITIES.** Prices low.

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VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
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WE PUT THE MICA POOL OUT OF BUSINESS!
CHICAGO MICA CO.
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"STAR" INCANDESCENT LAMPS

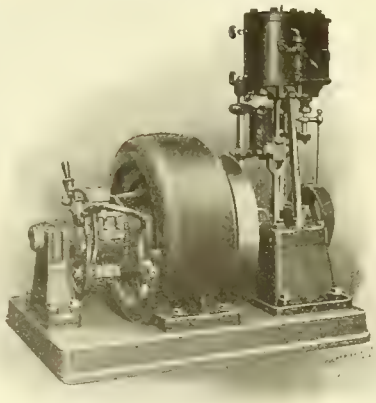
LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

Small Electric Generating Sets

Low Steam Consumption.
High Efficiency.
Built for Continuous Hard Service.



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Manufacturers and Electrical Engineers

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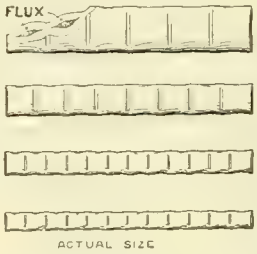
KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux. Requires no Acid.
SAVES—LABOR—TIME—MONEY.



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Send for Free Samples.
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Crowe Metal Mfg. Co. CHICAGO.

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BEST QUALITY — LOWEST PRICE.

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

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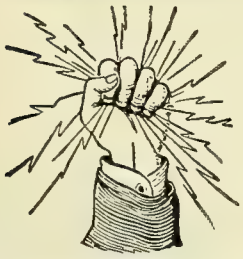
AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
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3½, 5 and 6 in. RODLESS

Invincibly Strong
Needful Wrench
Endless Variety
Xtremely Cheap
Perfect Safety
Exceedingly Simple
National Reputation
Serviceable Formula
Invariably Reliable
Very Durable
Entire Satisfaction

3½, 5 and 6 in. RODLESS

Will Soon Be Sent Out--They Will Talk About
STOMBAUGH GUY ANCHORS
Do You Want To Be On Our List?
W. N. MATTHEWS & BRO.
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Patent Causes. Patent Soliciting.

Crown Cord Adjuster
BEST AND SIMPLEST

⅝ ACTUAL SIZE
PATENTED
No Slip, No Abrasion, No Removing socket. Easily attached
Sample Free
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HANSON & TUNELIUS MACHINE CO.
—Designers and Builders of—
Insulating, Cabling
and Special
MACHINERY FOR ELECTRICAL PURPOSES.
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Rousseau's Ideal Electric Bell

Made on a new principle to ring with 1 to 600 volts without burning out the contact. Send for descriptive catalogue.
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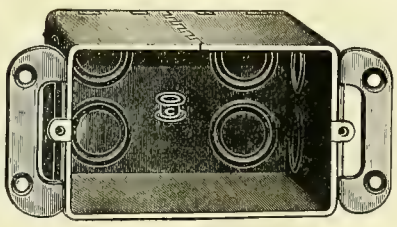
GET ALLEN'S SOLDERING PICKS
MAKE SOLDER FLOW
FOR ALL ELECTRIC WORK
What's on top belongs there—Get the Habit
of telling the man
"ALLEN SOLDERING STICKS OR NOTHING"
A Big Sample Stick for 10c.
Booklet "Soldering Sense" describes.
L. B. ALLEN CO., Inc.,
SOLE MAKERS
1334 Columbia Ave., CHICAGO.

"Union" Outlet Switch Boxes

PATENTS PENDING



STYLE B.

"Union" Switch Box. This style fits Rectangular Push Button Switches and Receptacles having connections 3¼" c. to c. Dimensions under switch plate, 4⅛" x 2"; outside dimensions at bottom, 3 1/16" x 2"; inside depth, 2⅝".

"Union" boxes will take all well-known Push-Button Switches, including "Perkins," "G. I.," "C. & S.," "H. & H.," "Diamond H.," etc.; also most of the Flush Receptacles in common use. Manufactured by

CHICAGO FUSE WIRE & MFG. CO.
358 Dearborn St., Chicago. 853 Broadway, New York. 187 Pratt St., Buffalo.

Eclipse Pocket Ammeter
For General Battery Testing, 0 to 15 Amperes.
"Ready for use," with flexible cord attached and contact spur in case, which is drawn back into case, when carried in pocket. Used in any position, and works in either direction of current. Size of watch, and very light weight. Pivots hardened and polished. Ask your jobber. Eldredge Electric Mfg. Co., Springfield Mass.

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Used extensively for lighting oil paintings. Light can be regulated and thrown just where you want it. Send for illustrated booklet and quotation to

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New England Representatives: McKENNEY & WATERBURY CO., 181 Franklin St., Boston.
Pennsylvania Representatives: H. P. WHITE CO., Ltd., Wayne Junction, Philadelphia, or to
McLeod, Ward & Co., 27 Thames St., New York
Beware of Spurious Imitations.
Mfrs of Kinsman Specialties.

Crimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

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NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

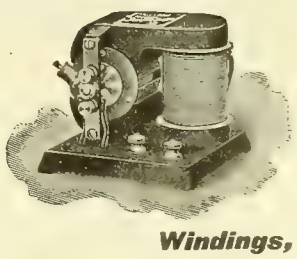
"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Slow-Burning Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.

Office and Factory: PAWTUCKET, R. I.

Perfection Dry Battery Power Motor



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Windings, 2, 4 and 6 volts
List price, $9.00

J. JONES & SON
Manufacturers of Electrical Apparatus
64 CORTLANDT ST. NEW YORK CITY

WANTED, FOR SALE and similar **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion, additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion, additional words 2c each.*

POSITION WANTED.

By a thoroughly competent electrical engineer, preferably as constructing engineer for large corporation, or company contemplating a large transmission installation; qualified to design and handle high tension, long distance transmission propositions. Especially successful in handling large bodies of men to the best advantage. Reference furnished. Address BOX 293, care Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

As superintendent of Electric Light or Municipal Water and Light Plant, by young man with technical education and ten years' practical experience from lineman to superintendent. Would accept position as traveling salesman for electrical supply house. References given. Address BOX 301, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent or manager of electric light and power plant by a man thoroughly posted theoretically and practically in steam, electricity, machinery and wiring. Seven years' practical experience managing and constructing. Am married, strictly temperate and can furnish splendid references. Address C. M. Poor, Jr., Glendale, Ohio.

WANTED.

Three experienced incandescent lamp salesmen, by an old and well-established company not in the trust. Applicants will please state age, experience and salary wanted. Address BOX 199, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

Electric light plant in town of 1,000 population. In fine shape and on sound financial basis. I did not want to take it but was obliged to and now want to sell it. New generator and thoroughly overhauled since taking possession. E. E. SECOR, Buffalo Center, Iowa.

FOR SALE.

One of the best telephone systems in Eastern Kansas. Three exchanges, two toll stations and good toll and farmer lines. Connections with all neighboring towns and cities. Over 250 phones in operation. System can be rapidly extended. A fine place for a good telephone man with money. Will sell reasonably if taken at once. Present owners not telephone men and fully occupied with other business. Address I. B. SAGERS, Secretary, Clyde, Kansas.

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Largest stock of second-hand electrical apparatus in this country. Send for our monthly Bargain sheet with complete list and net prices. Everything fully guaranteed.

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, February 23, 1904, and publicly opened immediately thereafter, to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of lighting wire, electrical supplies, hand scrub brushes, corn brooms, Portland cement, cotton twine, curled hair, mattress ticking, linen, furniture, belting, white ash, pine, redwood, thimbles, files, hardware, machine tools, galvanized sheet steel, magnesia, rubber sheet packing, hose, alcohol, turpentine, brass pipe, wrought-iron pipe, pipe fittings, rubber coupling washers, baseballs, athletic goods, stationery, and cotton waste. Blank proposals will be furnished upon application to the navy pay offices, San Francisco, Cal., and Seattle, Wash. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-18-04

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, March 1, 1904, and publicly opened immediately thereafter to furnish at the navy yards, Norfolk, Va., Charleston, S. C. and Port Royal, S. C., a quantity of electric blowers, electric fans, electric traveling crane, split pulleys, hardware, railroad track tools and materials, lamps, lanterns, lantern globes, drills, machinists' tools, shovels, leather belting, roofing felt, hammock hooks, lumber, fire brick, nickel steel, galvanized sheet steel, copper, zinc, hose, flax packing, kerosene, sperm oil, gasoline, petrolatum, rosin, turpentine, tar, shellac, bath brick, pumice stone, brass pipe, pipe fittings, stationery, marine cement, oakum, lenses, cotton waste, wheelbarrows, target switch stands, push cars, and a foundry cupola. Blank proposals will be furnished upon application to the navy pay offices, Norfolk, Va., Charleston, S. C., and Port Royal, S. C. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-29-04

Notice is hereby given that specifications have been adopted by the City of Fond du Lac, by its Mayor and Common Council, for the granting of a franchise to construct, maintain and operate a plant or plants within or without the City of Fond du Lac, for the purpose of furnishing, and to furnish to the City of Fond du Lac and its citizens and others in said State electricity for light, heat, and power and to that end to set poles and string wires and construct and maintain the necessary appurtenances to said business in said City of Fond du Lac, which said specifications are now on file in the office of the City Clerk of said City of Fond du Lac, to which reference is hereby made.

Now, therefore notice is hereby given that bids will be received for the sale of such franchise at the office of F. A. Bartlett, City Clerk of the City of Fond du Lac, up to five o'clock P. M. on the 7th day of March, 1904, which such bids shall propose, on behalf of the applicant, to pay annually into the treasury of said City in consideration of receiving such franchise, a percentage of the gross receipts from the business carried on under said franchise. Such bid must be accompanied by a certified check in the sum of Three Hundred ($300) Dollars, as a guarantee of the acceptance of the franchise if granted and the giving of the bond provided for in said specifications.

By order of the Common Council:
Dated, February 2, 1904.
F. A. BARTLETT,
City Clerk, Fond du Lac, Wis.

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15 H. P. Detroit, 1000 R. P. M.
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10 H. P. Simpson, 2000 R. P. M.
7½ H. P. Crocker Wheeler, 1575 R. P. M.
7½ H. P. Card, 775 R. P. M.
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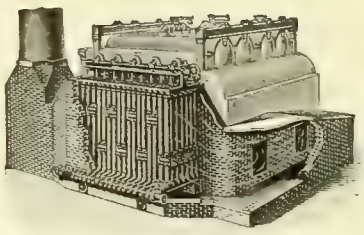

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American Electrical Engineering Association.

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ILLUSTRATIONS.

Patent of A. G. Bell, No. 174,465. Patent of Emile Berliner, No. 233,969. Patent of Emile Berliner, No. 463,569. Patents of Emile Berliner in Parallel Columns. Patent of C. A. Cheever, No. 208,463. Patent of H. H. Eldred, No. 303,714. Patent of Thos. A. Watson, No. 256,258. Patent of L. B. Firman, No. 283,334 Patent of M. G. Kellogg, No. 247,199. Patent of C. E. Scribner, No. 330,058. Patent of C. E. Scribner, No. 300,144. Trunking Principle. Patent of Shaw & Childs, No. 319,856. Mann System. Patent of L. B. Firman, No. 252,576. Western Union Pin Switch. Express System. Patent of Sabin & Hampton, No. 513,534. Subscriber's Automatic Signal. Raverot-Hess System. Patent of M. J. Carney, No. 258,886. Apostoloff System.

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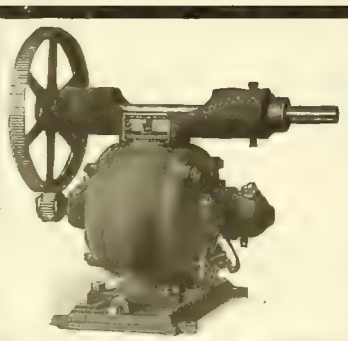

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RESOURCES		
Time Loans	$21,278,572.63	
Demand loans	7,233,798.31	$28,512,379.94
Overdrafts		970.22
U. S. bonds		1,000,000.00
Other bonds		979,050.00
Cash	8,809,219.51	
Clearing house checks	1,133,875.29	
Due from banks	9,169,336.73	
Due from treasurer U. S.	256,000.00	$19,368,431.53
		$49,860,822.69

LIABILITIES	
Capital	$ 3,000,000.00
Surplus	2,000,000.00
Undivided Profits	1,150,109.11
Circulation	499,950.00
Dividends unpaid	801.00
Deposits	43,209,962.58
	$49,860,822.69

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One 12x34 C. H. Brown & Co., right-hand wheel 10 ft. diameter, 30 in. face.

One 10, 1 18x20 Payne tandem compound right-hand wheel 9 ft. 6 in. x 25 in., with Knowles condenser.

Three 18½x18 Armington & Sims center crank, governor wheel and driving pulley each 86 in. diameter, 16 in. face.

Two 18, 1 30x16 Westinghouse compound, driving wheel 8 ft. diameter, 25 in. face.

One 12 and 20x16 Erie Ball tandem compound, center-crank, driving wheel 72 in. diameter, 21½ in. face; governor wheel 82 in. x 17 in.

One 14x13 Armington & Sims center crank, governor wheel and driving pulley each 42 in. diameter, 12½ in. face

One 10½, 1 16½x12 Armington & Sims cross-compound, governor wheel and driving pulley each 75 in. diameter, 10 in. face.

One 13x12 Armington & Sims center crank, governor wheel and driving pulley each 62 in. diameter, 12 in. face.

One 12x12 Watertown center crank, driving wheel 40 in. diameter, 12½ in. face; governor wheel 60 in. x 12½ in.

One 11x12 New York safety center crank, governor wheel and driving pulley each 50 in. diameter, 12½ in. face.

One 10x12 Armington & Sims center crank, driving pulley 74 in. diameter, 11 in. face, governor wheel 62 in. x 10½ in.

One 8x10 B. F. Sturtevant center crank, driving wheel 78 in. diameter, 14 in. face.

One 7x8 Payne center crank, driving wheel 44 in. diameter, 7 in. face; governor wheel 42 in. x 7 in.

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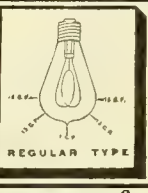

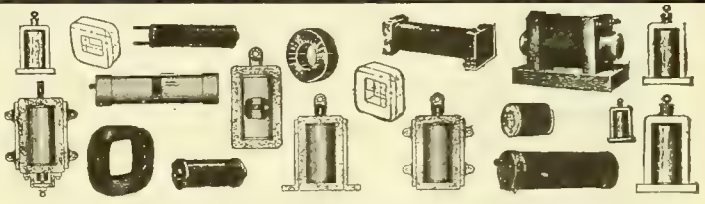

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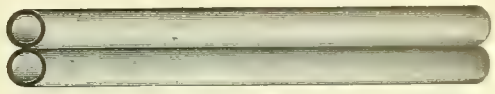

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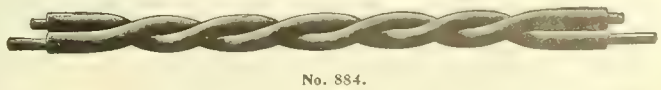

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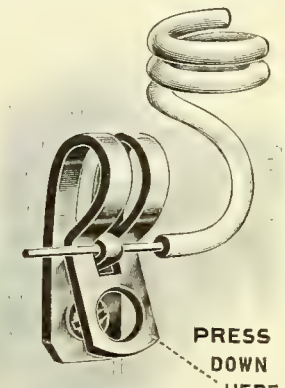

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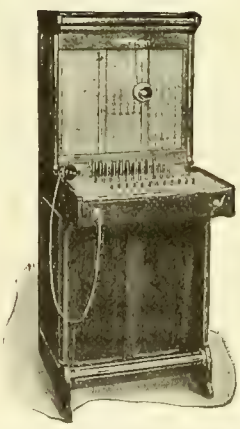

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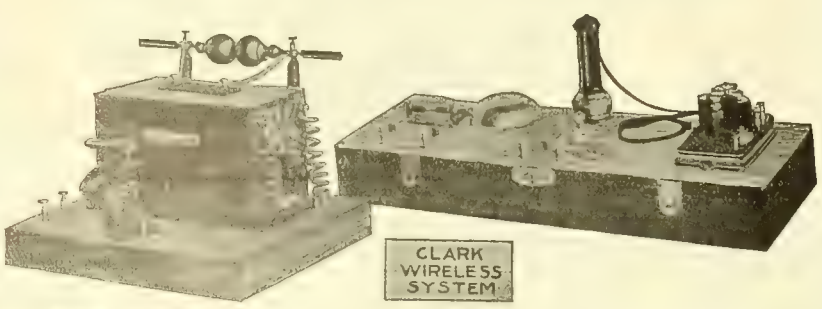

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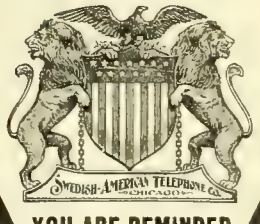

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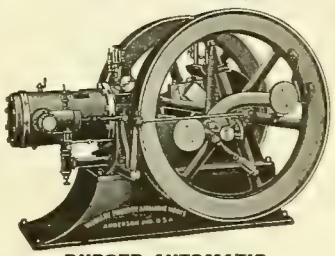

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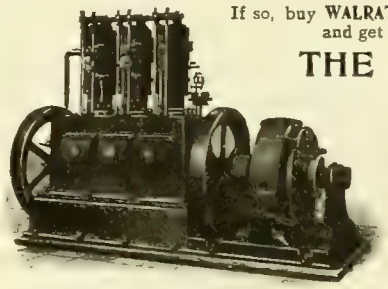

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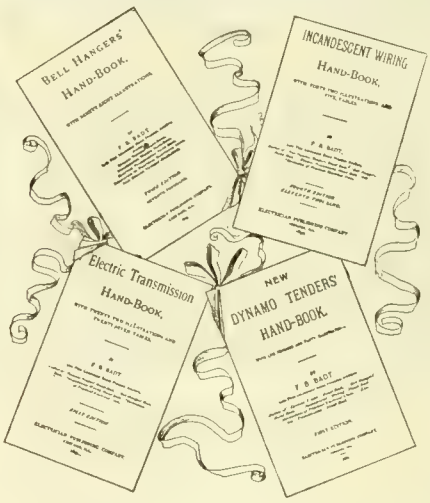

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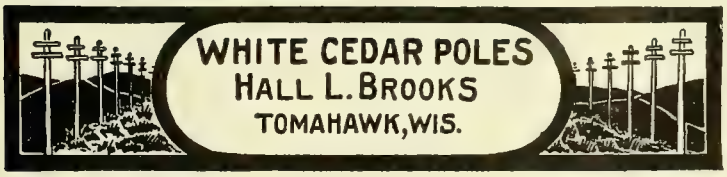

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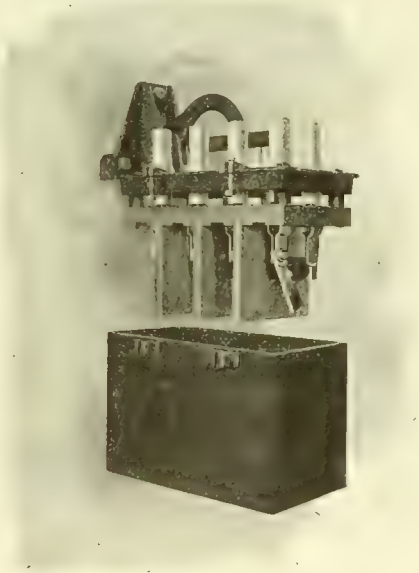

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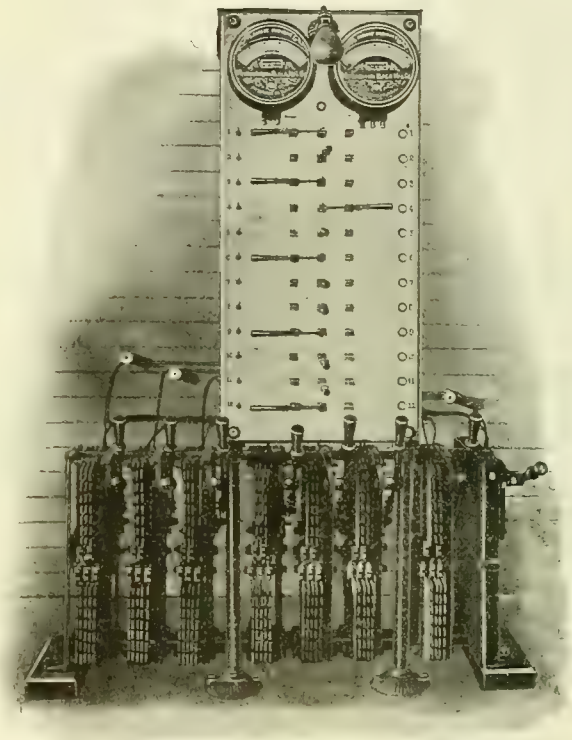

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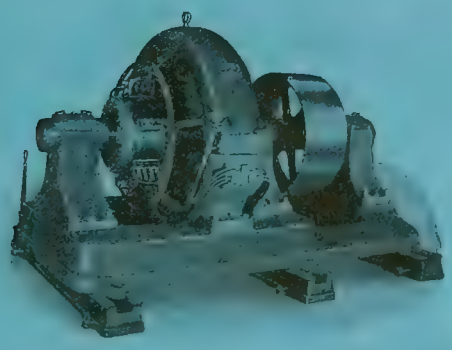

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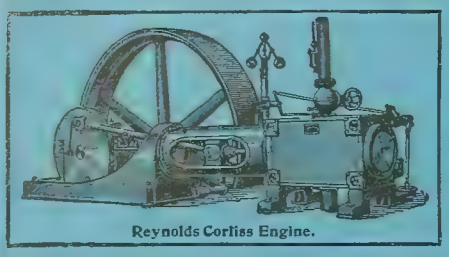
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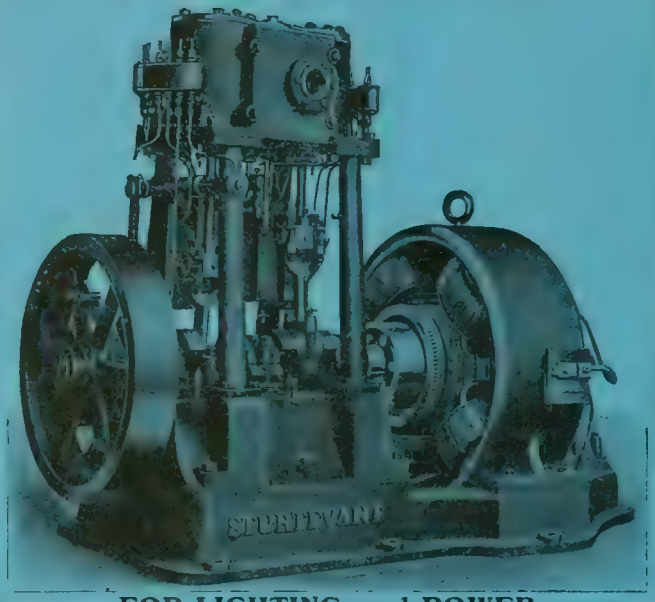

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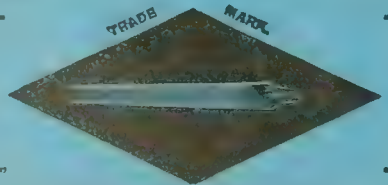

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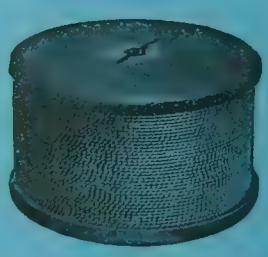

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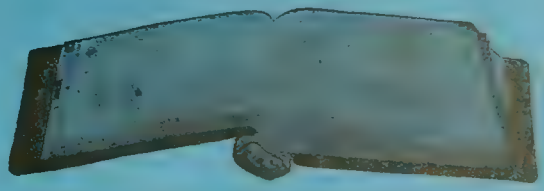
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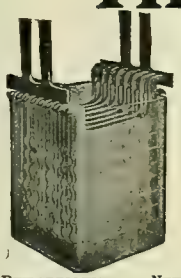

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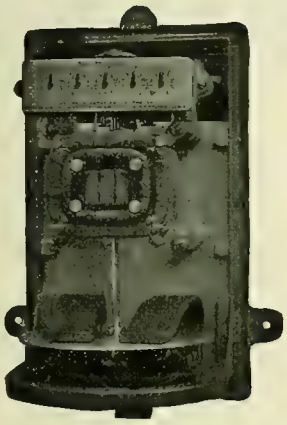

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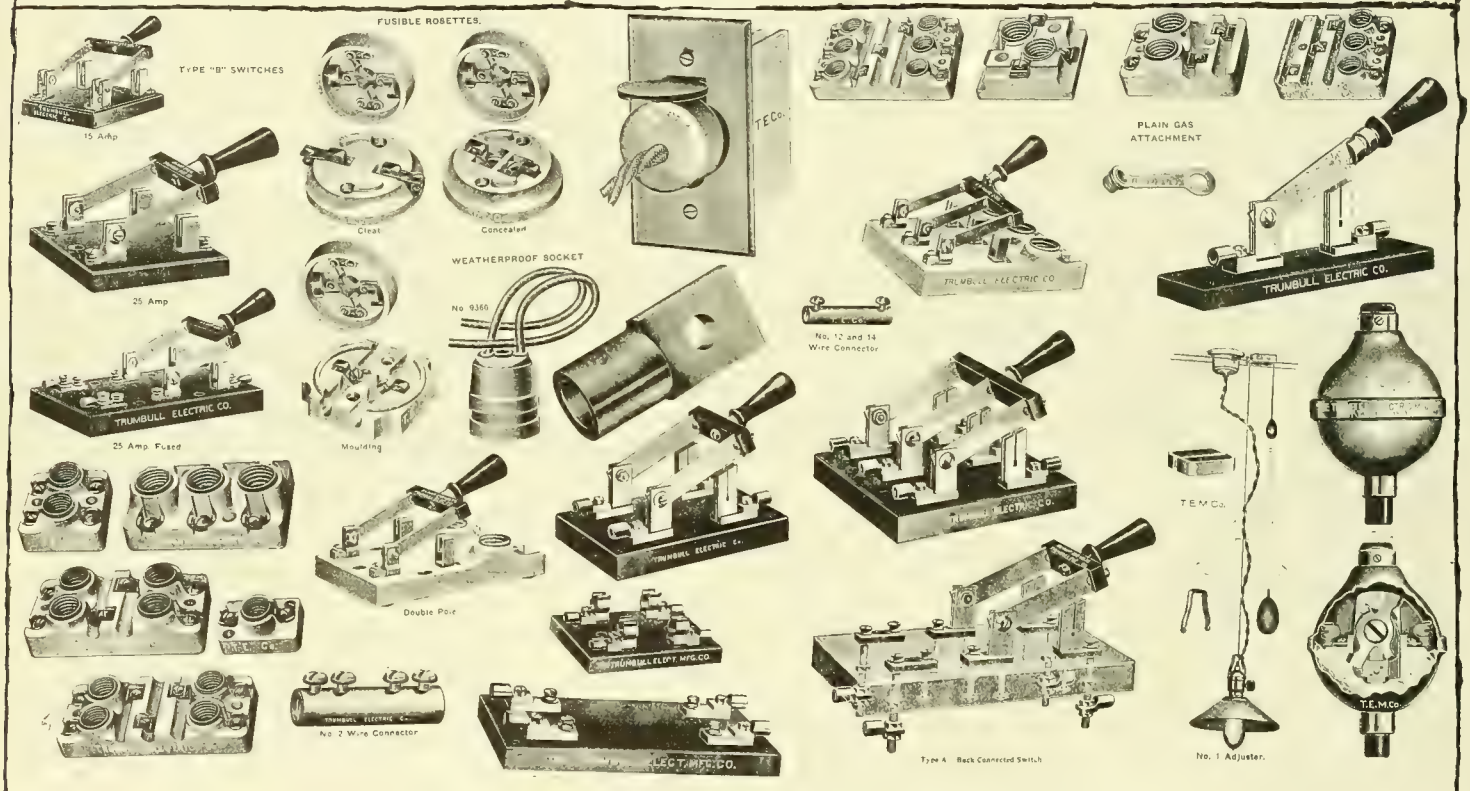

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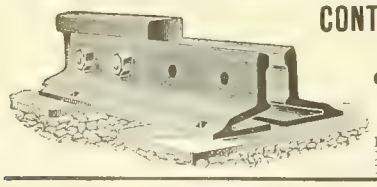

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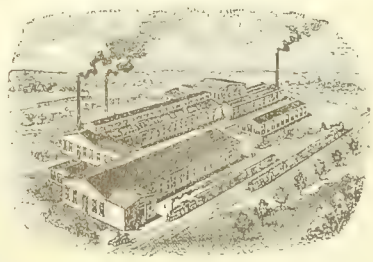

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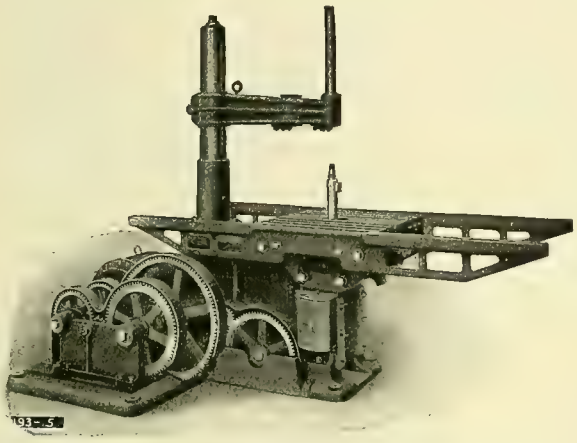

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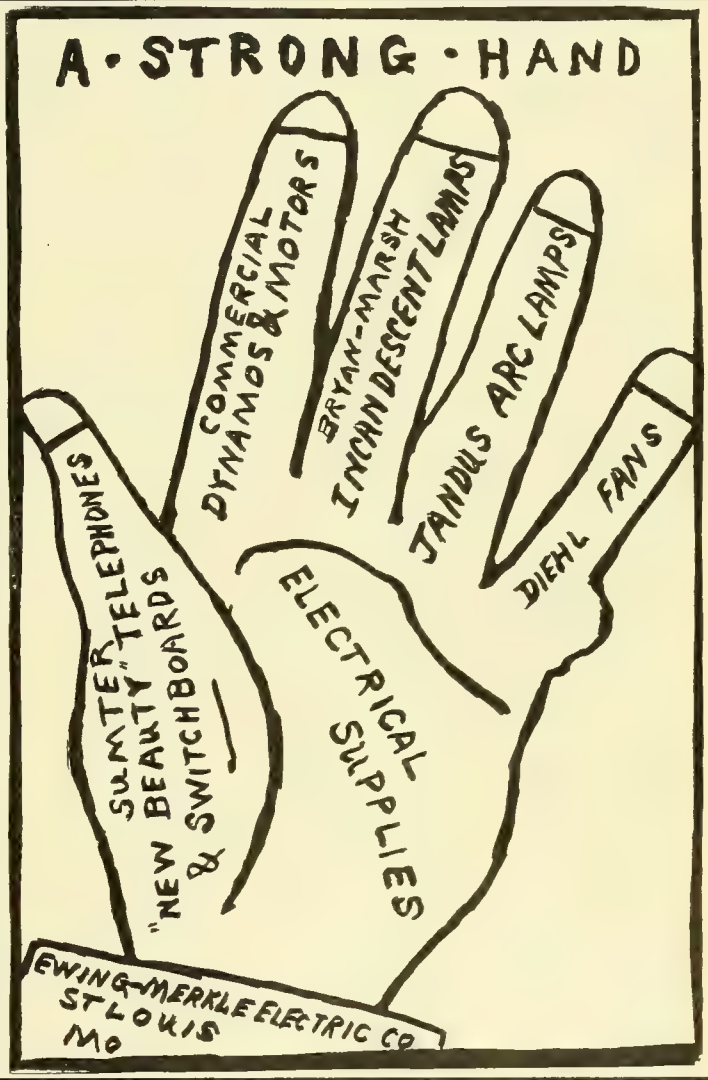

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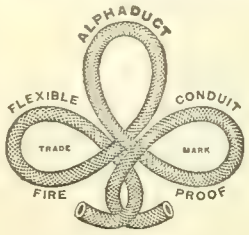

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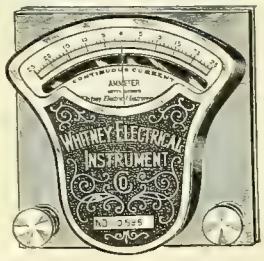

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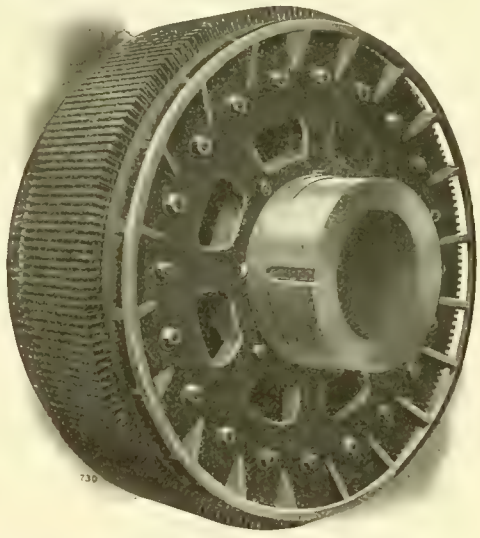

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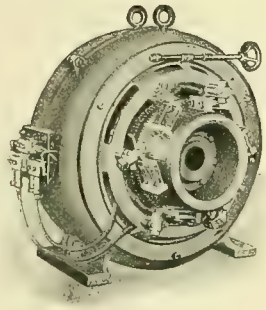

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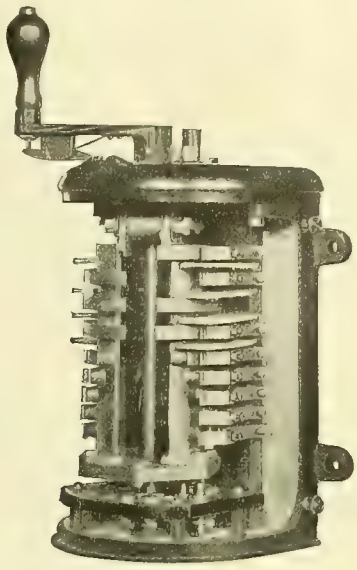

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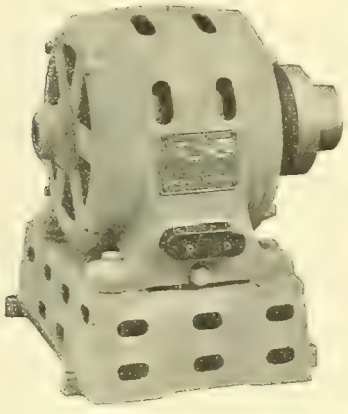

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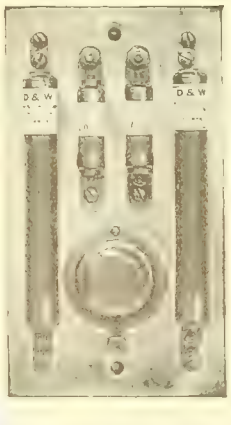

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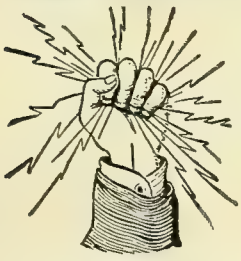

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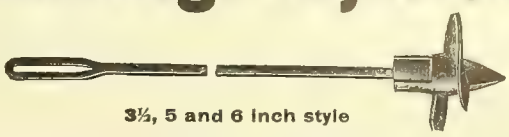

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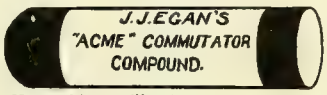

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PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, March 1, 1904, and publicly opened immediately thereafter to furnish at the navy yards, Norfolk, Va., Charleston, S. C., and Port Royal, S. C., a quantity of electric blowers, electric fans, electric traveling crane, split pulleys, hardware, railroad track tools and materials, lamps, lanterns, lantern globes, drills, machinists' tools, shovels, leather belting, roofing felt, hammock hooks, lumber, fire brick, nickel steel, galvanized sheet steel, copper, zinc, hose, flax packing, kerosene, sperm oil, gasoline, petrolatum, rosin, turpentine, tar, shellac, bath brick, pumice stone, brass pipe, pipe fittings, stationery, marine cement, oakum, lenses, cotton waste, wheelbarrows, target switch stands, push cars, and a foundry cupola. Blank proposals will be furnished upon application to the navy pay offices, Norfolk, Va., Charleston, S. C., and Port Royal, S. C. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-29-04

Notice is hereby given that specifications have been adopted by the City of Fond du Lac, by its Mayor and Common Council, for the granting of a franchise to construct, maintain and operate a plant or plants within or without the City of Fond du Lac, for the purpose of furnishing, and to furnish to the City of Fond du Lac and its citizens and others in said State electricity for light, heat, and power and to that end to set poles and string wires and construct and maintain the necessary appurtenances to said business in said City of Fond du Lac, which said specifications are now on file in the office of the City Clerk of said City of Fond du Lac, to which reference is hereby made.

Now, therefore notice is hereby given that bids will be received for the sale of such franchise at the office of F. A. Bartlett, City Clerk of the City of Fond du Lac, up to five o'clock P. M. on the 7th day of March, 1904, which such bids shall propose, on behalf of the applicant, to pay annually into the treasury of said City in consideration of receiving such franchise, a percentage of the gross receipts from the business carried on under said franchise. Such bid must be accompanied by a certified check in the sum of Three Hundred ($300) Dollars, as a guarantee of the acceptance of the franchise if granted and the giving of the bond provided for in said specifications.

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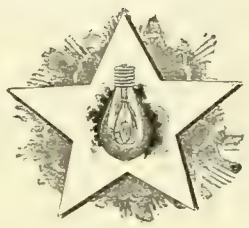

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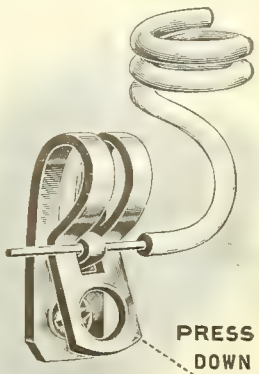

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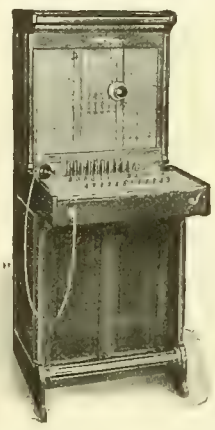

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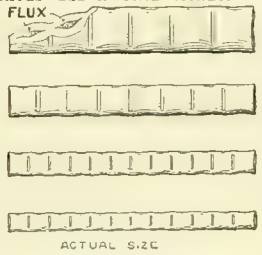

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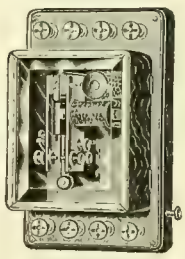

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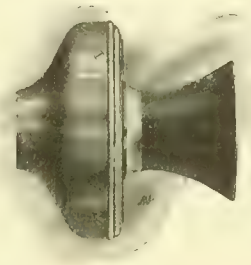

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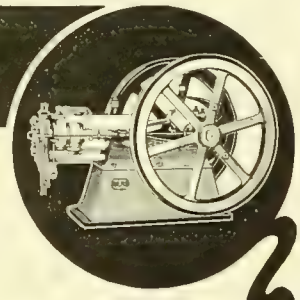
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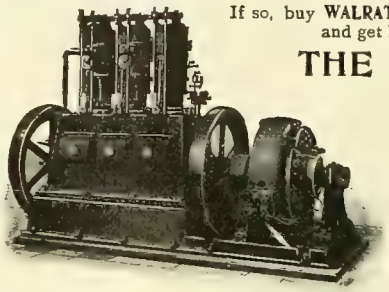
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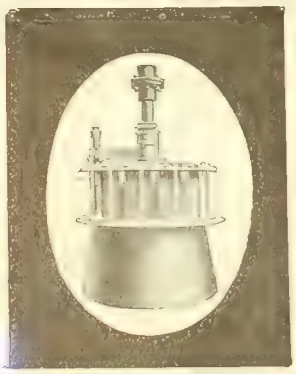
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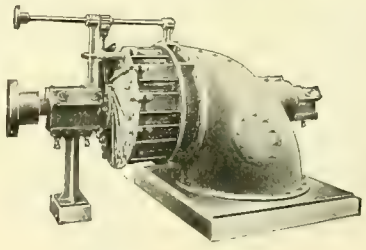
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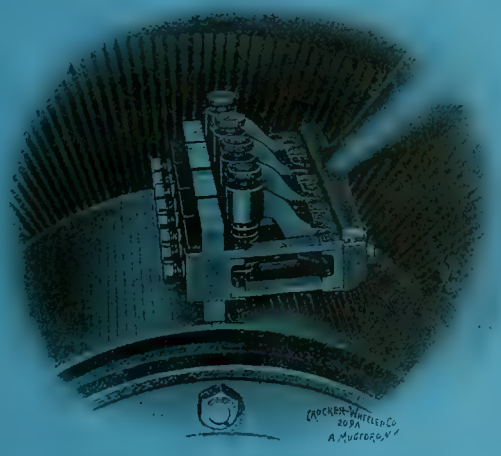

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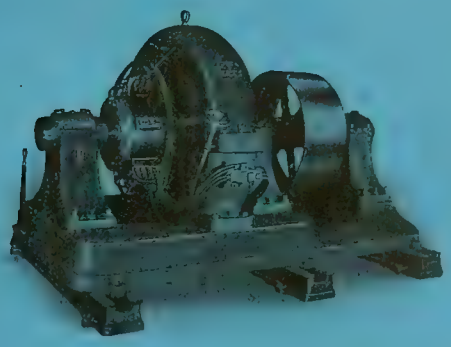

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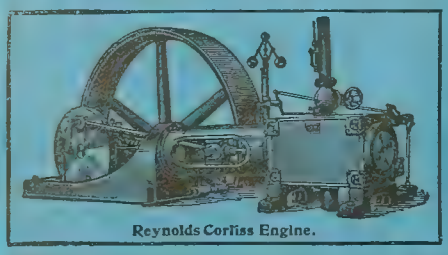
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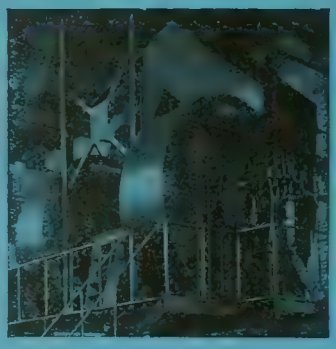

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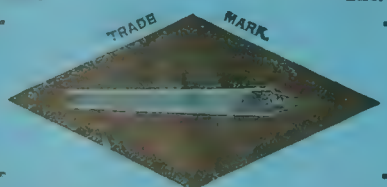

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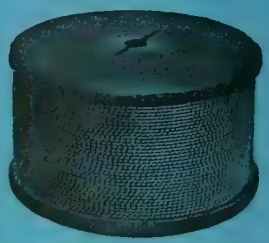

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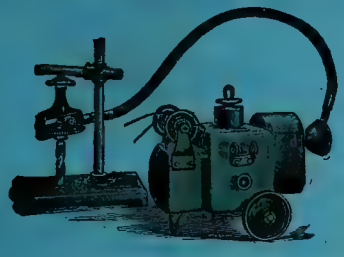
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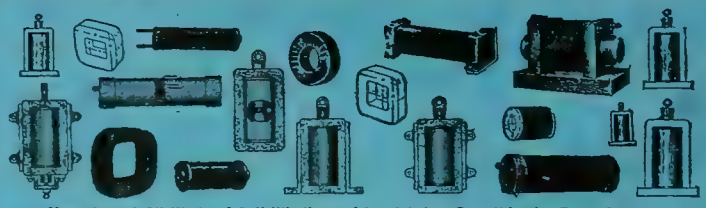

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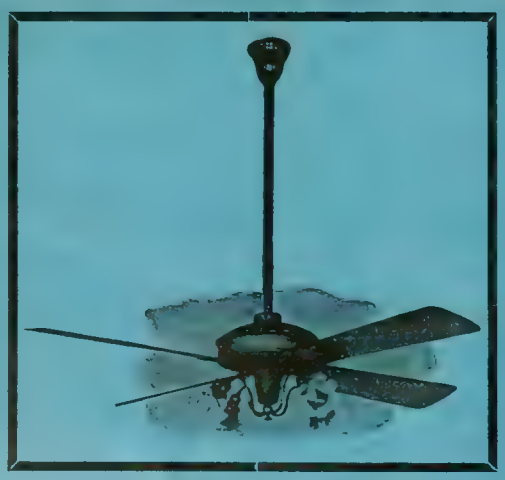

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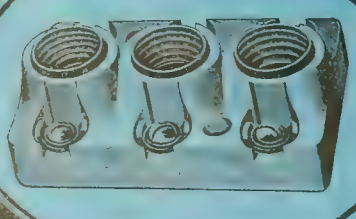

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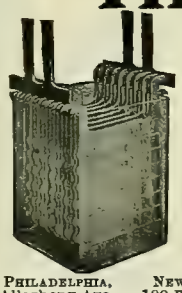

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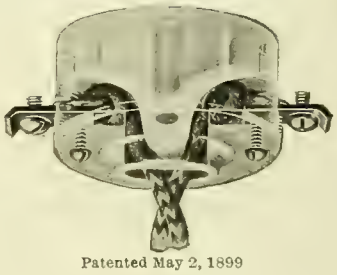

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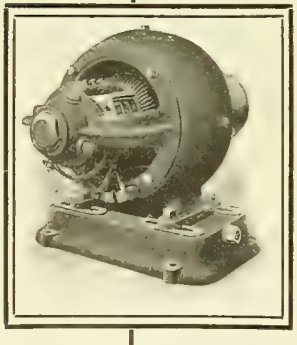

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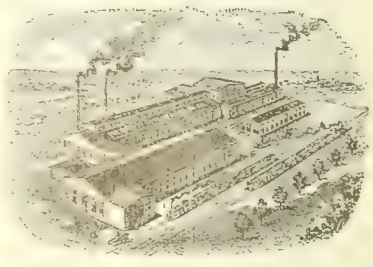

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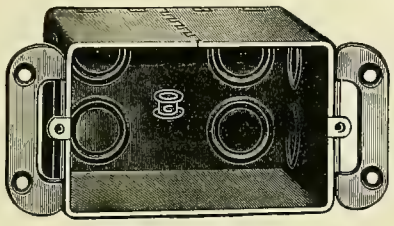

STYLE B.

"Union" Switch Box. This style fits Rectangular Push Button Switches and Receptacles having connections 3¼" c. to c. Dimensions under switch plate, 4⅛" x 2"; outside dimensions at bottom, 3⅛" x 2"; inside depth, 2⅜".

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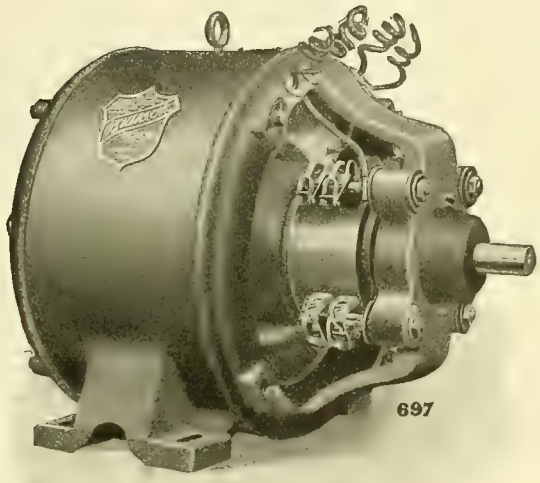

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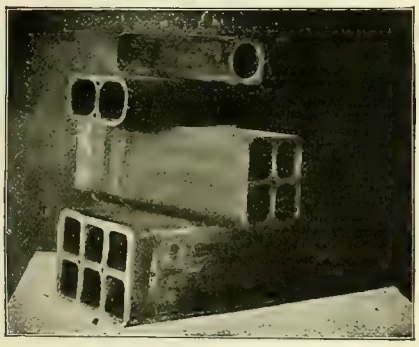

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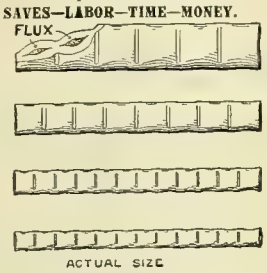

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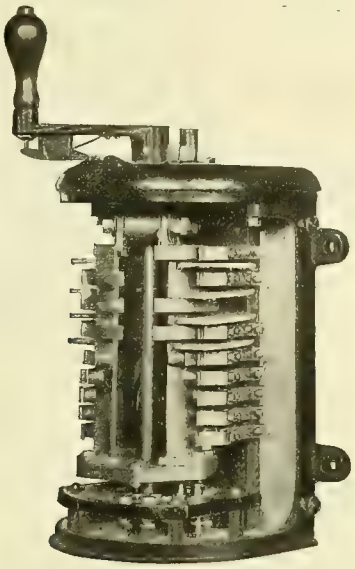

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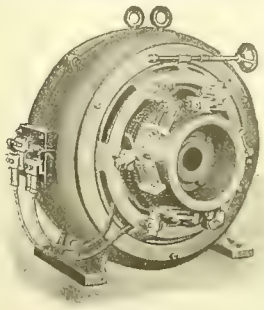

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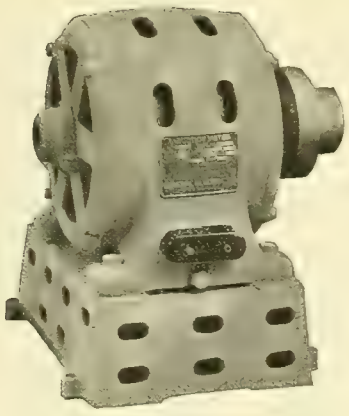

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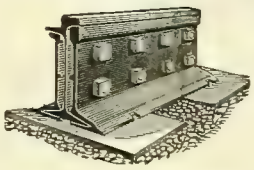

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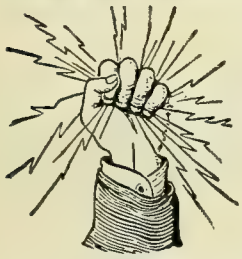

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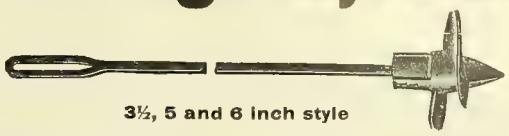

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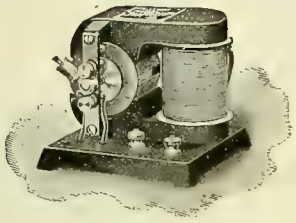

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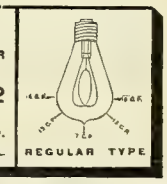

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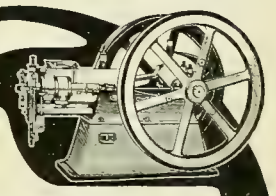

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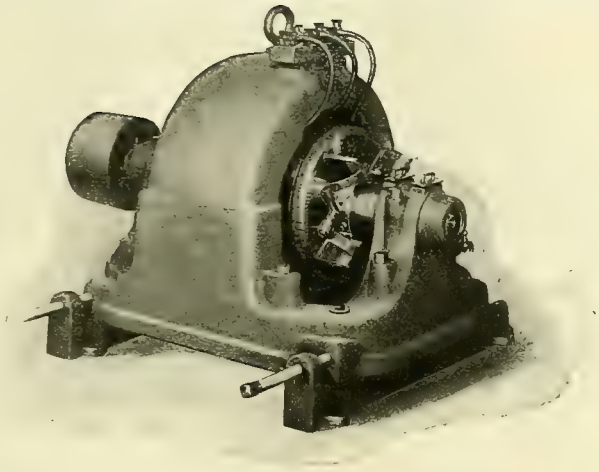

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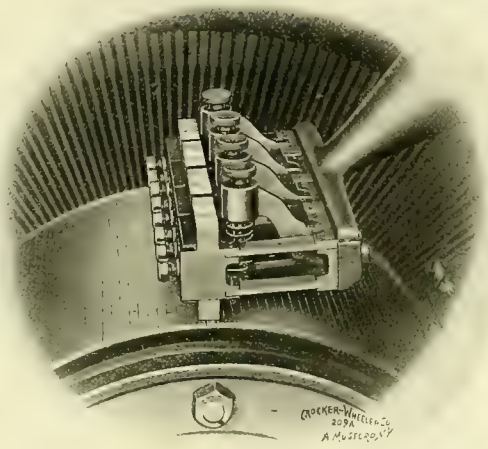

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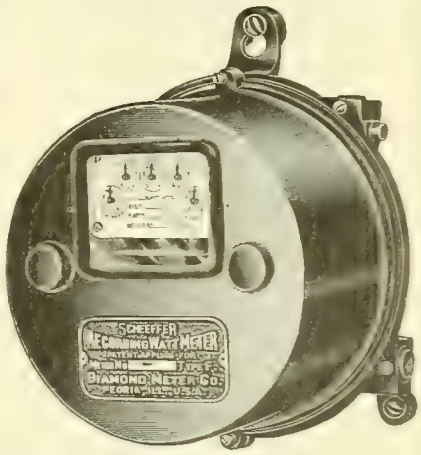

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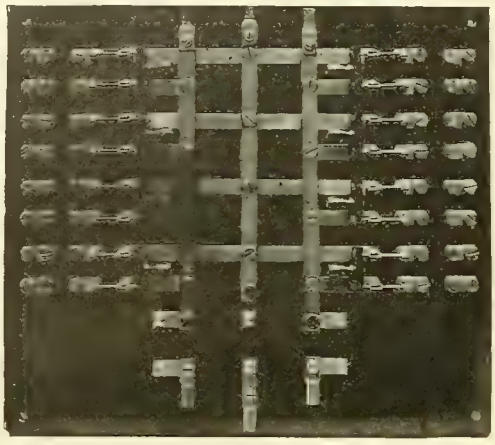

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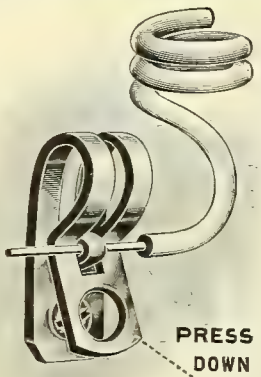

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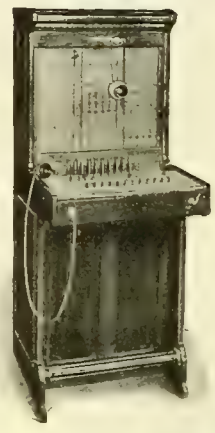

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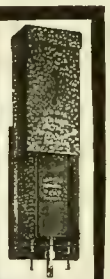

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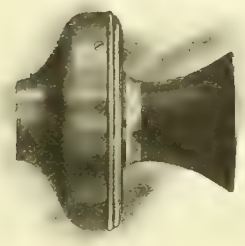

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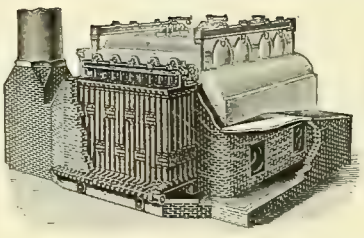

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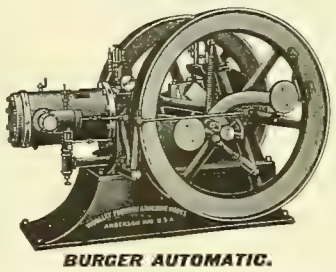

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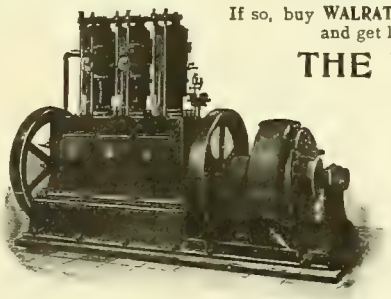

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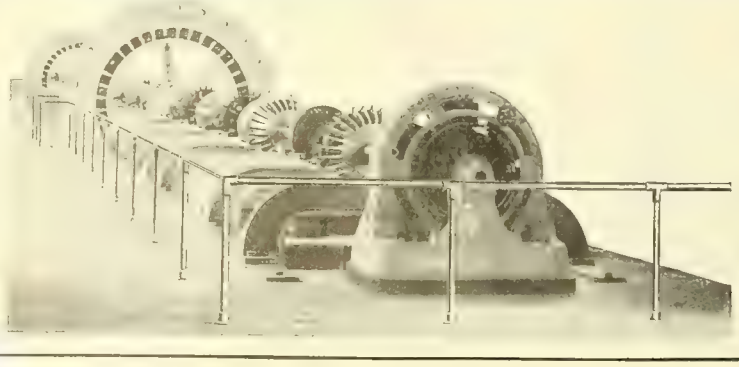

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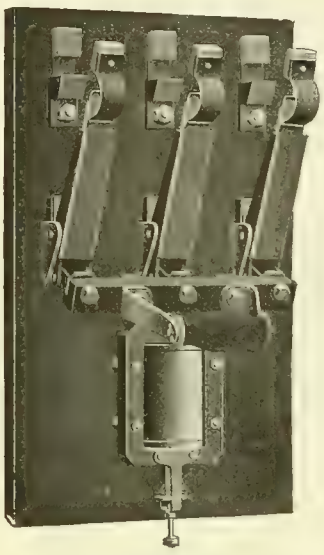

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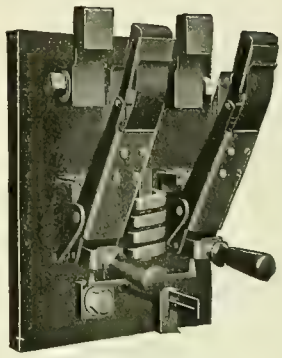

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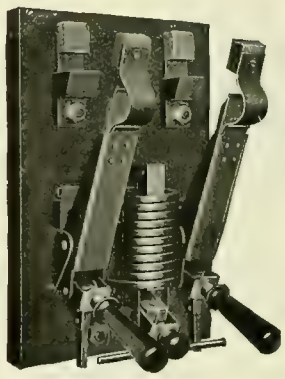

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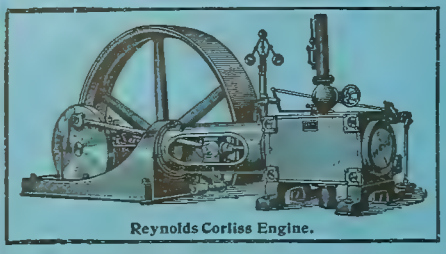
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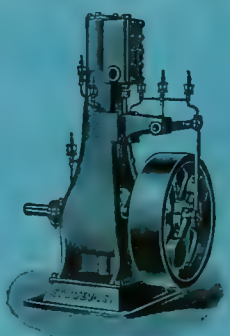

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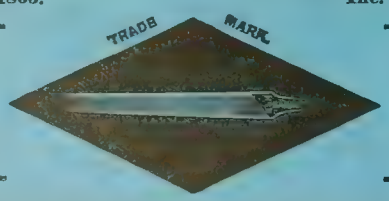

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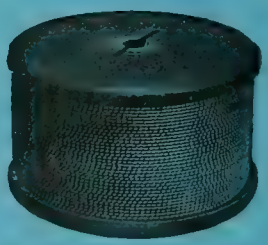

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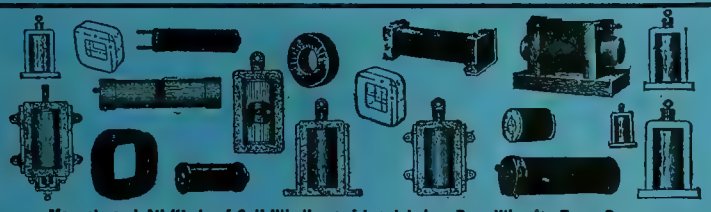

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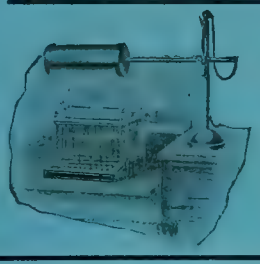

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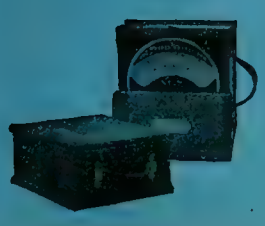

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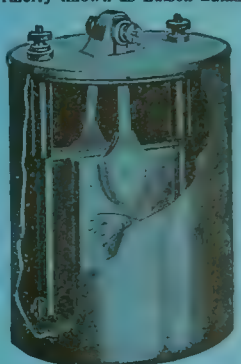

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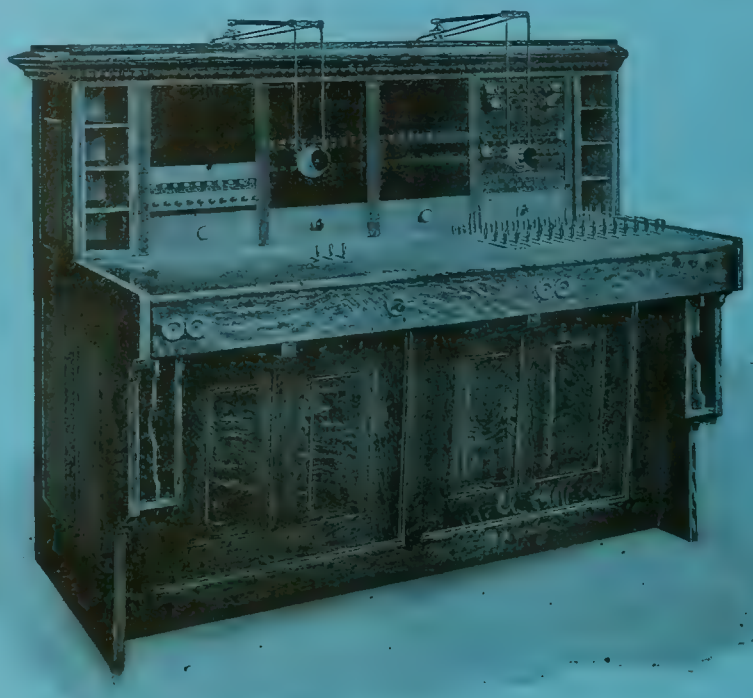

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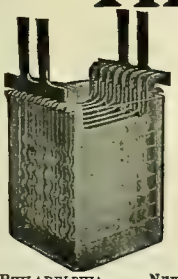

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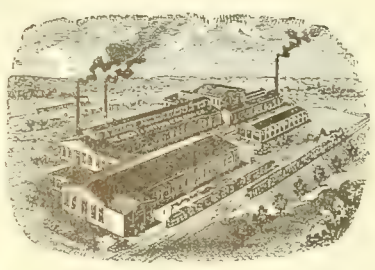

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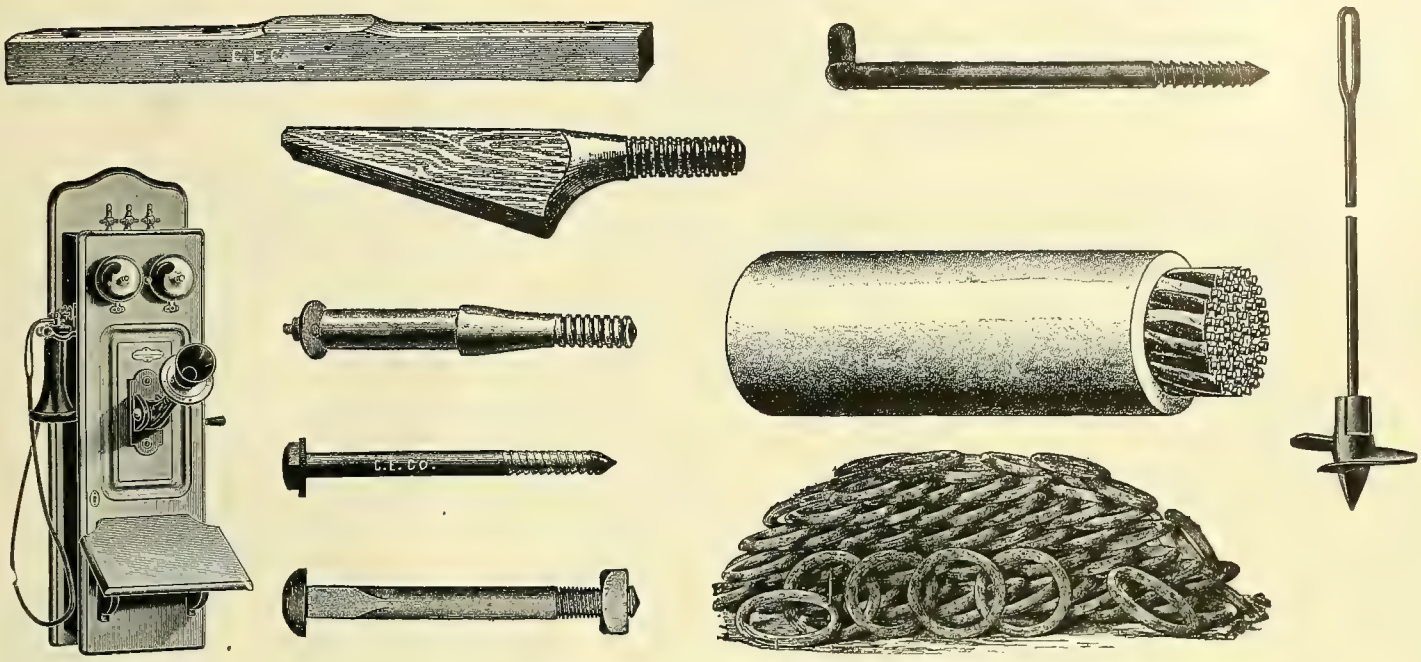

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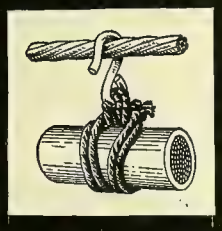

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Fowler, John H.
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Hopkins & Co., A. P.
Kellogg Switch. & Sup. Co.
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Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Lumber Co.
Maus & Co., H. H.
Medora Milling Co.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Perrizo & Sons.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Standard Pole & Tie Co.
Standard Tie Company.
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Torrey Cedar Co.
Valentine-Clark Co., The.
Western Lumber & Pole Co.
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Worcester Co., C. H

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Hoffman, Geo. W

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Continuous Rail Joint Company of America.

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Crouse-Hinds Co.
Gen. Incand. Arc Light Co.
Walker Electric Co.

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Couch Co., S. H.
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STEADIEST LIGHT — LEAST DUST

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REMAIN THE STANDARD OF THE WORLD FOR ALL ARC LIGHTING SYSTEMS, BECAUSE they cannot be equaled in QUALITY or EFFICIENCY, producing the highest standard of candlepower in proportion to the current consumed.

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For Underground Wires. The Only Conduit that Improves with Age.
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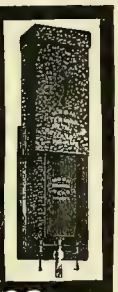

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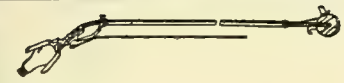

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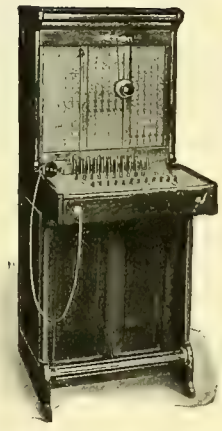

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Sample parts and quotations on request.

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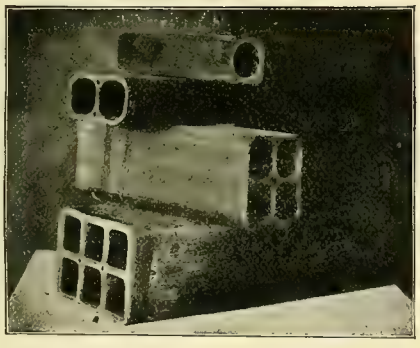

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IN 1, 2, 3, 4 AND 6 DUCT.

Superior Conduits for underground wires a specialty.

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for the repair and calibration of all classes and makes of electrical measuring instruments, including voltmeters, ammeters, wattmeters, ohmmeters, testing sets, galvanometers, etc. Our special facilities insure the highest grade of work, prompt deliveries and low prices.

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And Many Others

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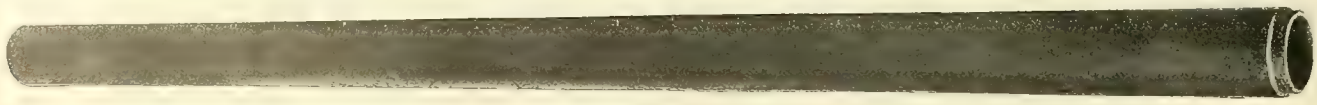

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A SMOOTH LAMINATED INSULATOR OF UNCHANGING DURABILITY

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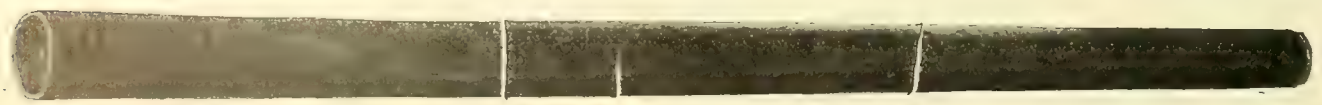

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General Electric Single Phase 60 Cycle Induction Motors

1 to 15 horsepower

These motors combine high power factors and efficiency.
Full load starting torque.
Small starting current.

Write for information. **Promptly delivered in all sizes.**

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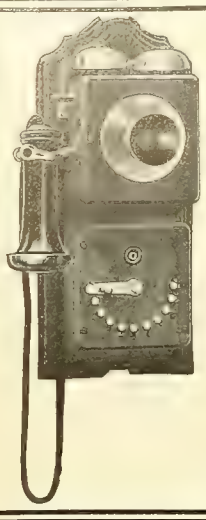

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Has iron back for cable and splices.
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Bulletins and Diagrams Free.

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BEST AND SIMPLEST

⅔ ACTUAL SIZE

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No Slip, No Abrasion, No Removing socket, Easily attached
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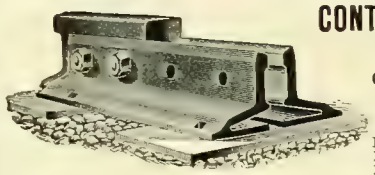

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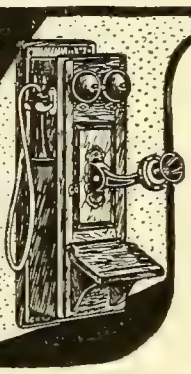

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"MARVEL OF MECHANICAL SIMPLICITY"
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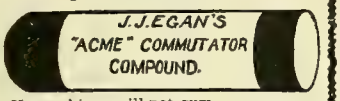

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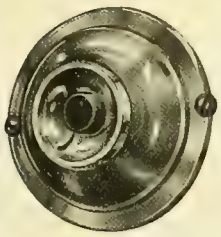

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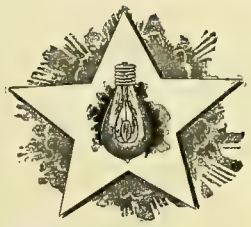

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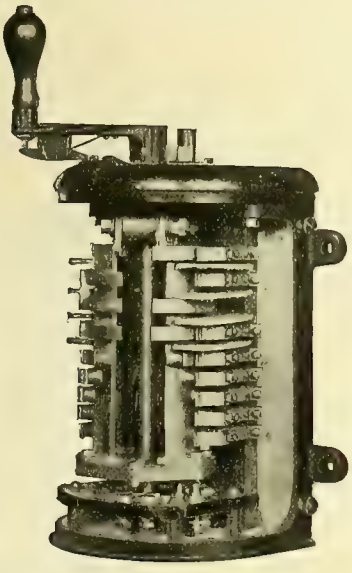

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Design perfect.	Construction the best.
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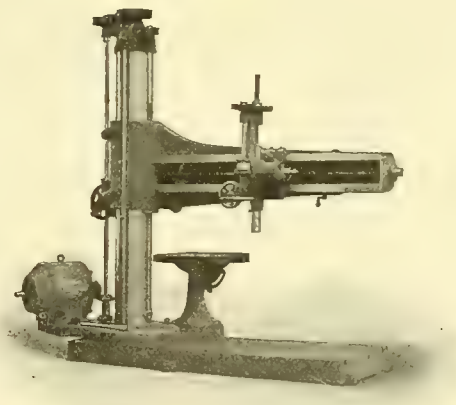

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The Bullock Multiple Voltage System provides the only successful means of controlling the speed of motors driving machinery which requires variable speeds

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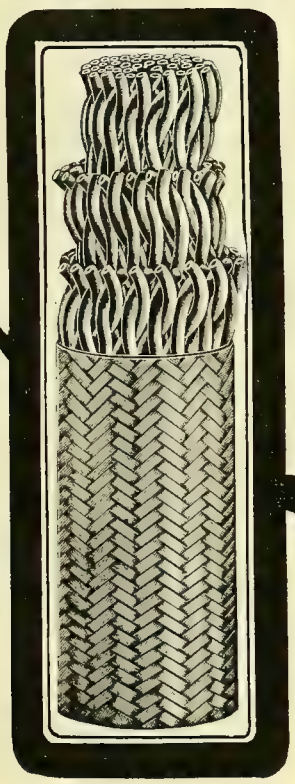

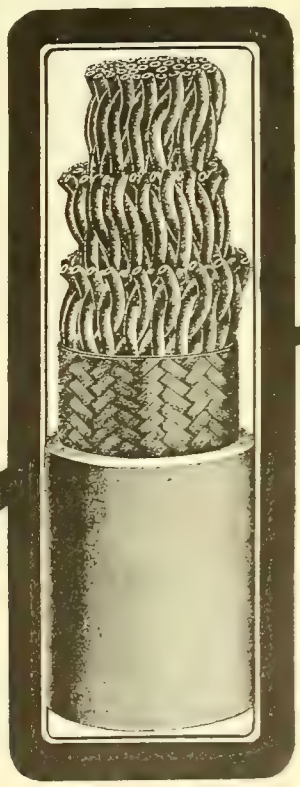

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They require no shadeholder.

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EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

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HIGH INSULATOR FOR ARMATURES, ETC.
NON-ABSORPTIVE, FLEXIBLE and STRONG.
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For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
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DYNAMOS AND MOTORS
Compact, Simple, Trustworthy, Economical in Operation
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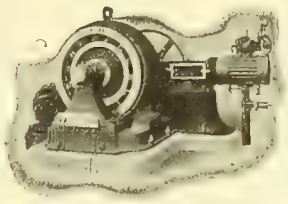
WHAT? NAME PLATES
BEST QUALITY — LOWEST PRICE.

Warren Alternator



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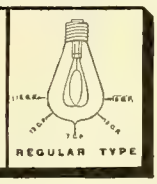

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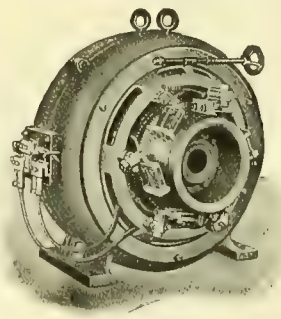

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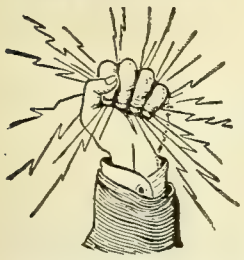

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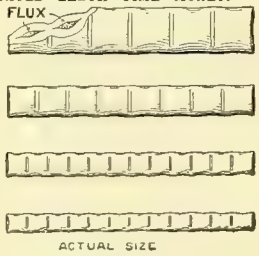

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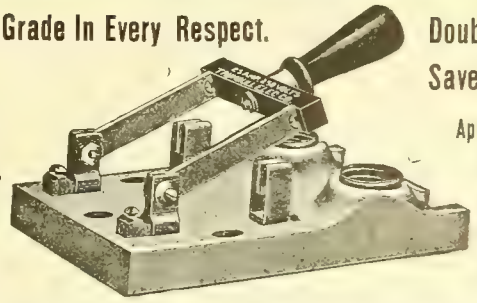

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POSITION WANTED.

By experienced bookkeeper, 28 years of age; at present employed as bookkeeper and cashier for electric-light and power plant; experienced in reading meters. Address BOX 437, Georgetown, S. C.

POSITION WANTED

As superintendent of electric-light or municipal water and light plant, by young man with technical education and ten years' practical experience from lineman to superintendent. Would accept position as traveling salesman for electrical supply house. References given. Address BOX 301, care Western Electrician, 510 Marquette Bldg., Chicago.

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Engineer, electrician and machinist, all around man; competent of holding any position in the above lines; have tools and test instruments; also have Chicago and western licenses and recommendations; 20 years' experience; have family; 37 years old; temperate. L. J. HOW, Master Mechanic H. & R. Mines, Folsom, Cal.

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As superintendent or head electrician in some electric or power plant in city from 2,000 to 5,000. Southern Pacific states preferred. Thirty-one years old, married; have had 12 years' experience with direct and single 2 and 3 phase systems. Can read meters and repair arc lamps. Employed at present as superintendent of the Goodland Electric Light Plant. References. Address GLEN O. THARP, Goodland, Ind.

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Summitville Ind. Nov 23 1903

Western Electrician
Chicago Ill.

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I am Yours Resp.
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Clerk.

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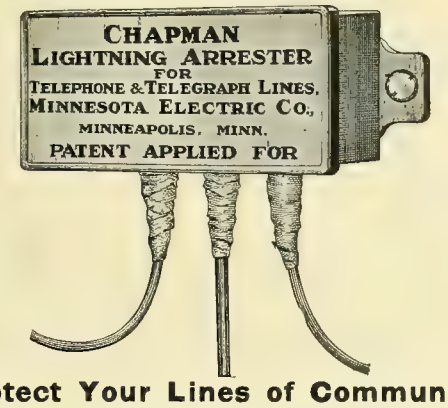

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One 12x12 Watertown center crank, driving wheel 40 in. diameter, 12½ in. face; governor wheel 60 in. x 12½ in.

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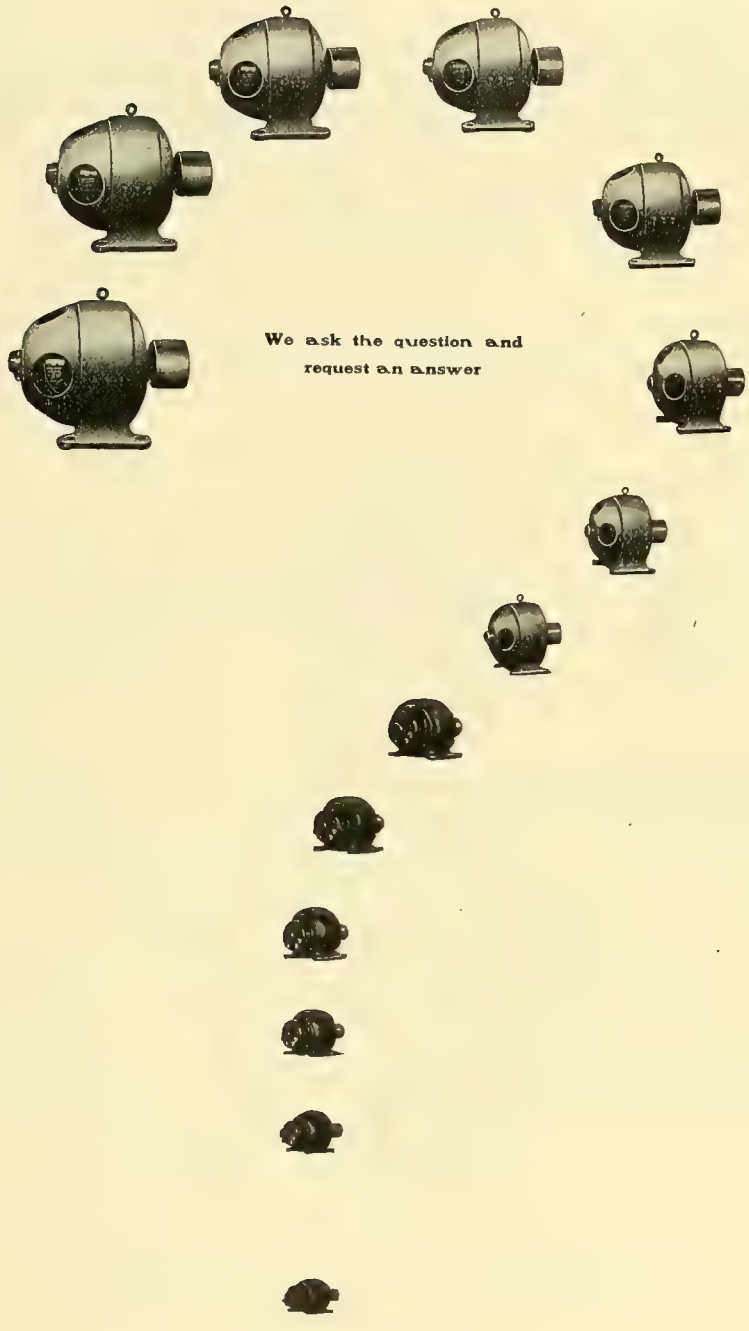

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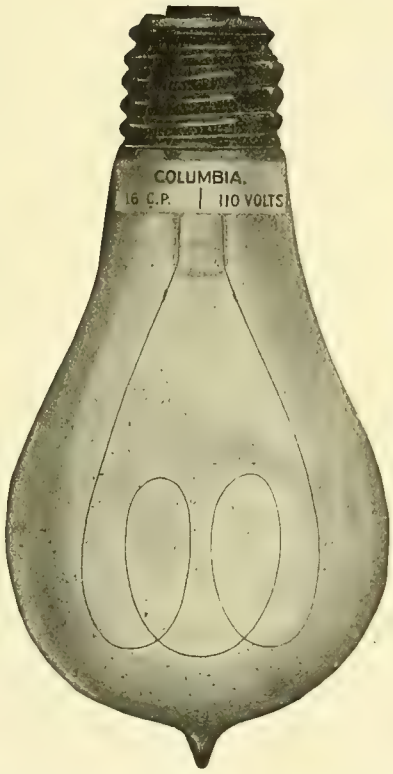

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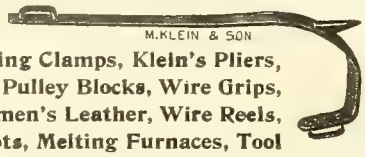

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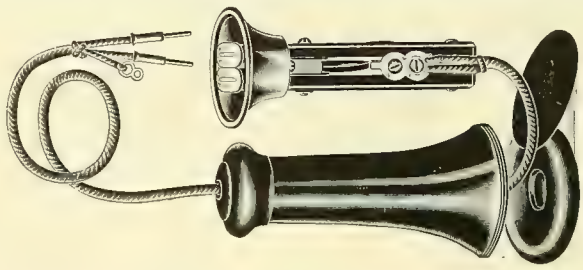

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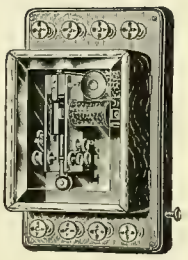

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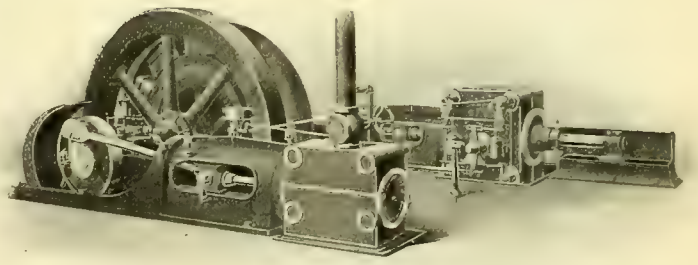

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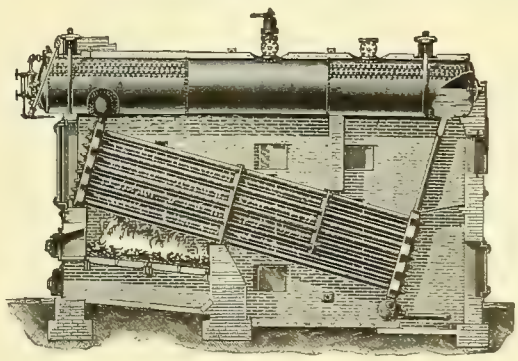

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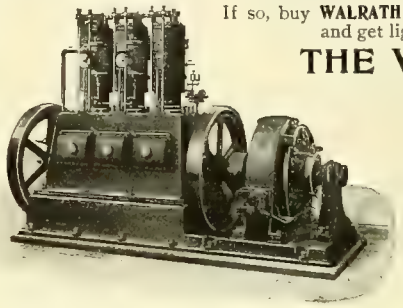
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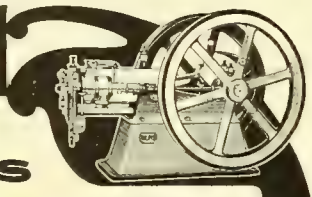
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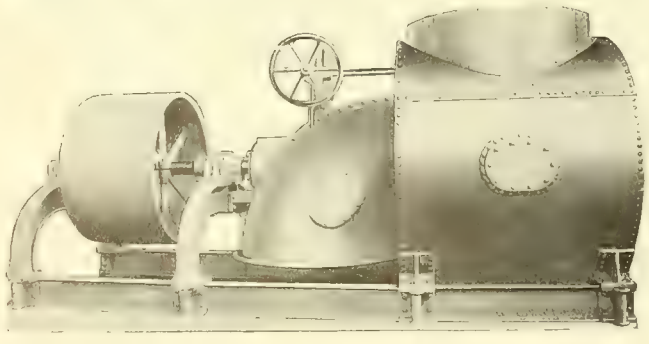
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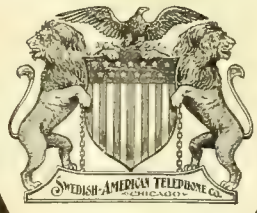

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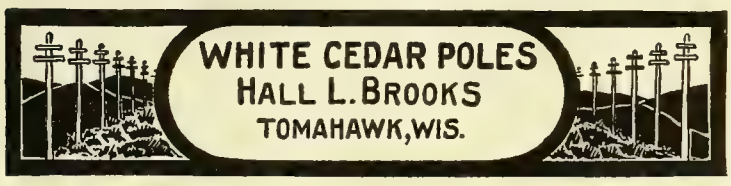

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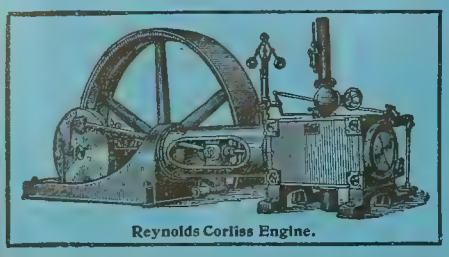
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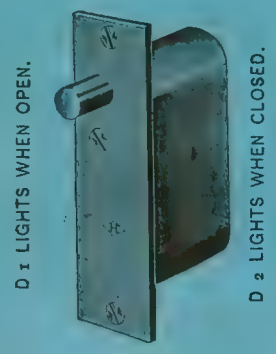

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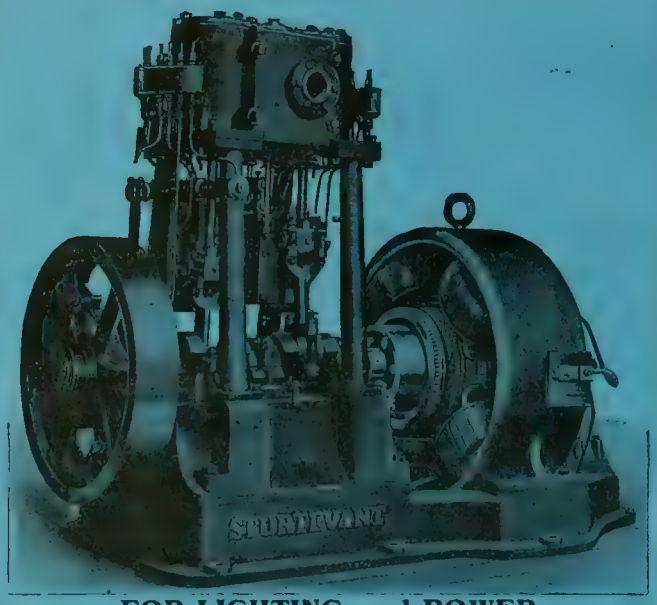

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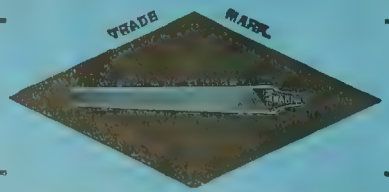

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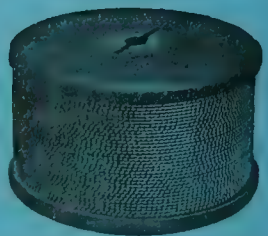

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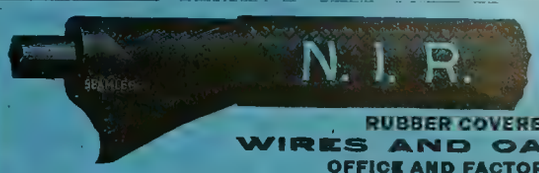

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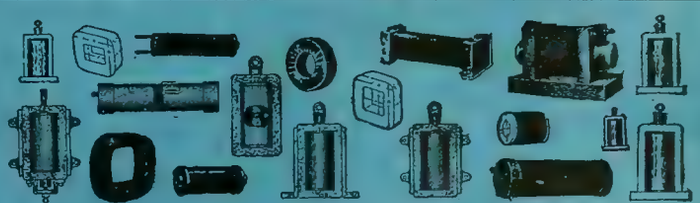
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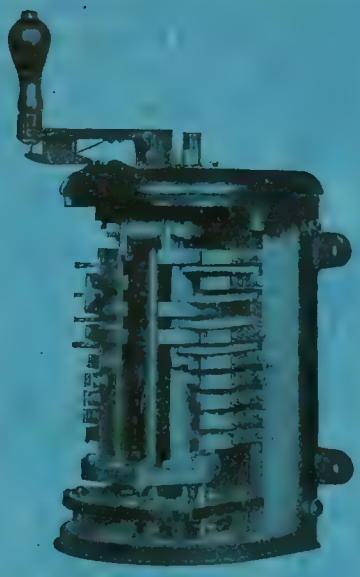

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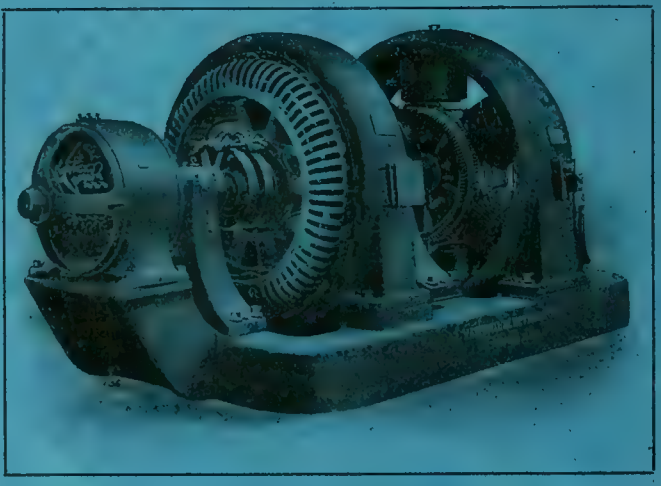

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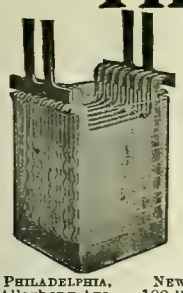

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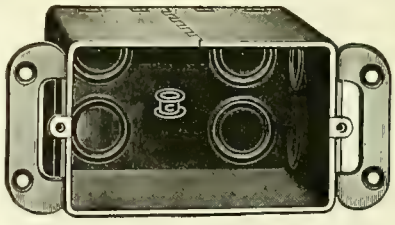

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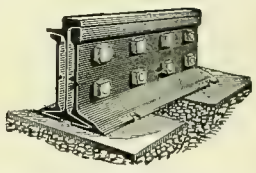

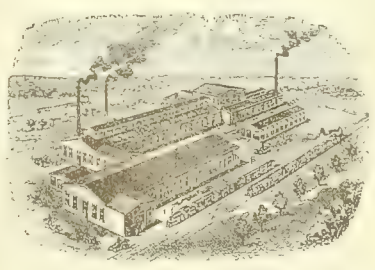

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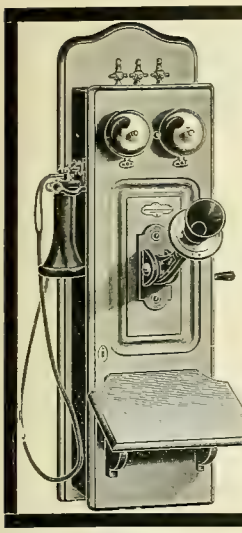

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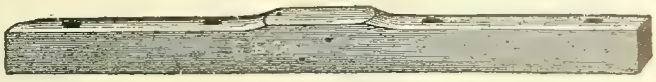

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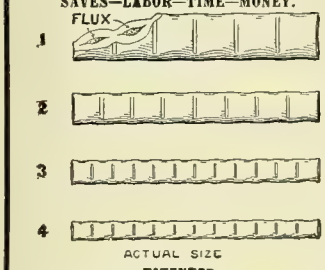

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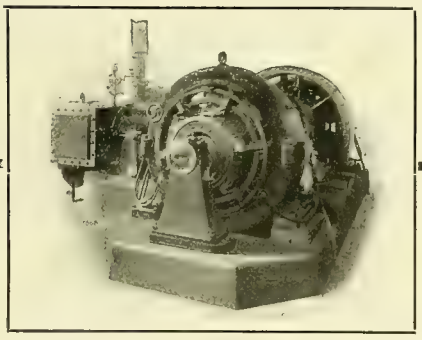

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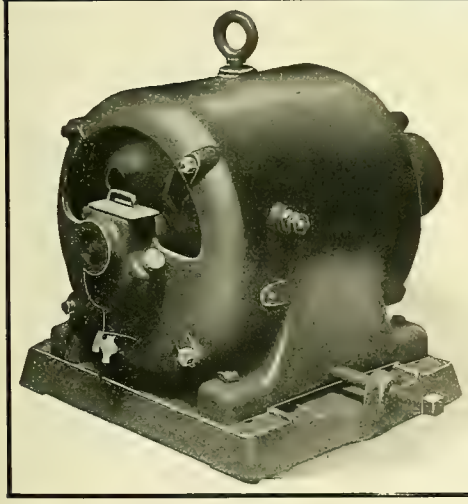

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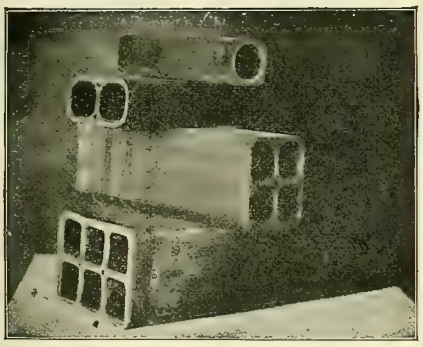

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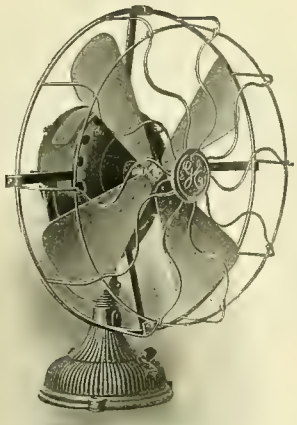

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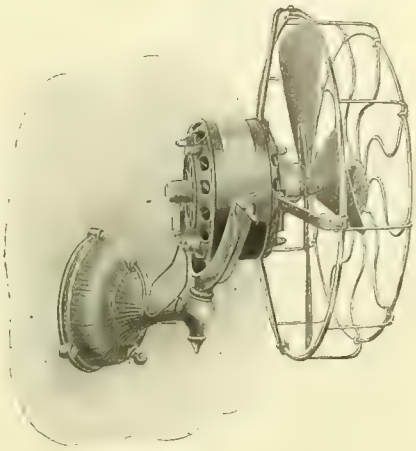

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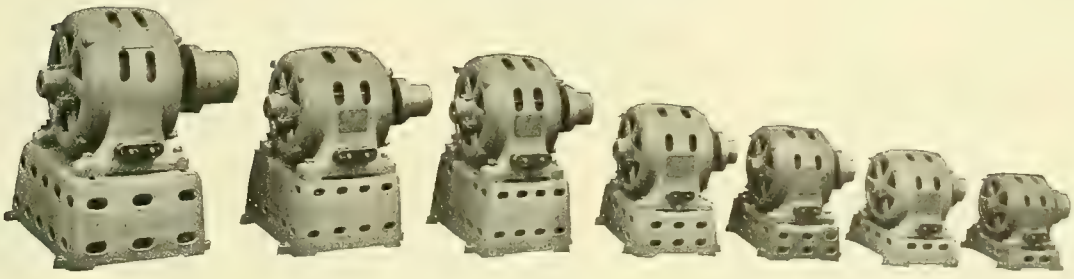

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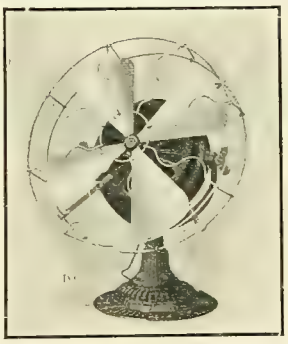

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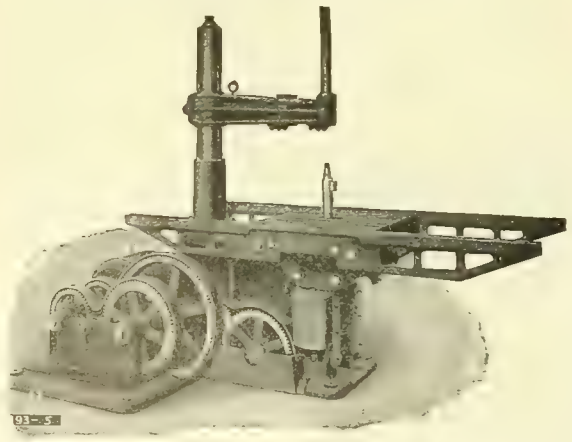

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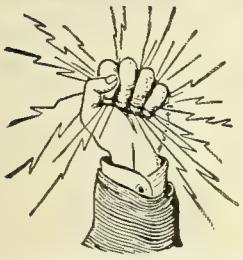

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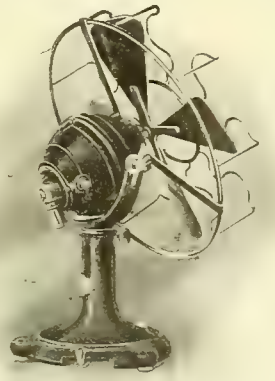

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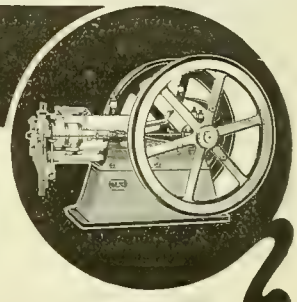

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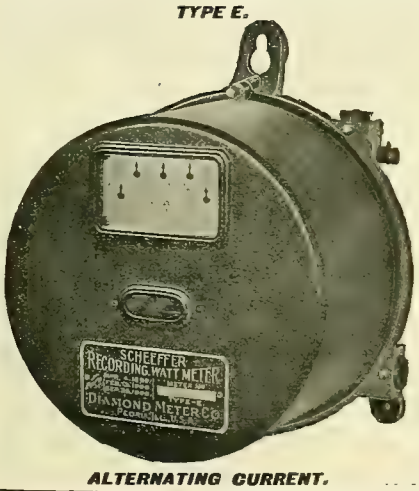

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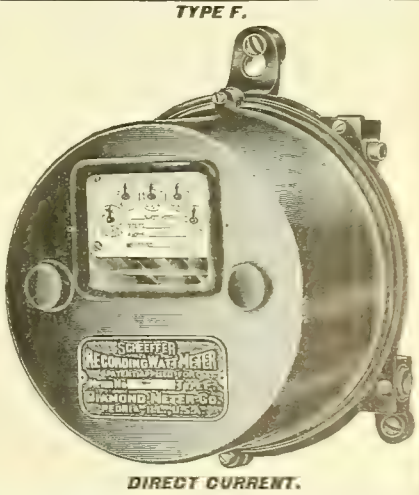

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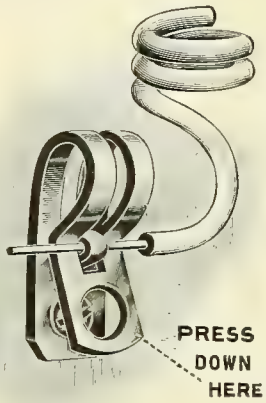

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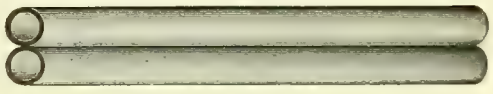

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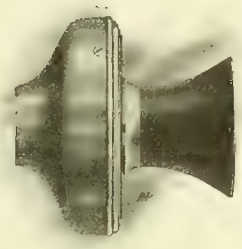

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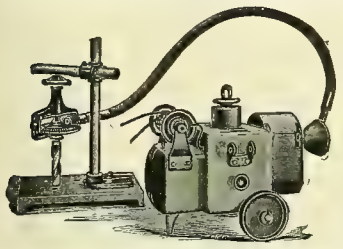

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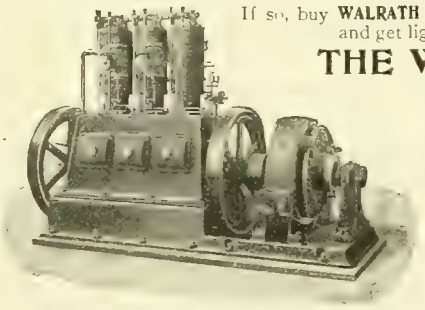
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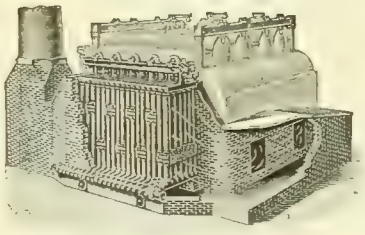
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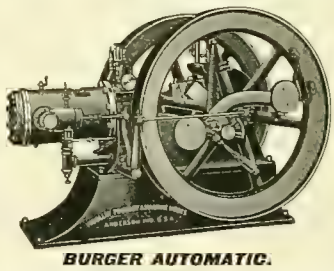
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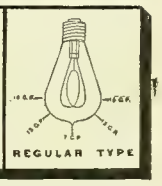
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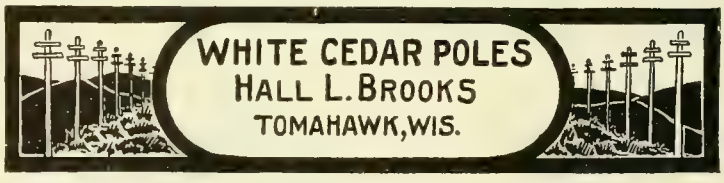

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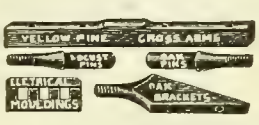

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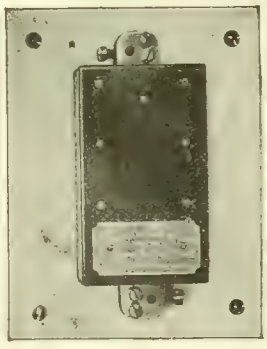

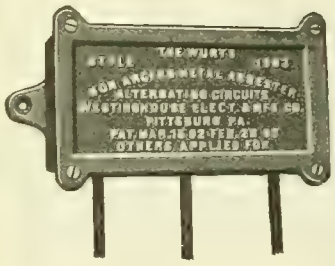

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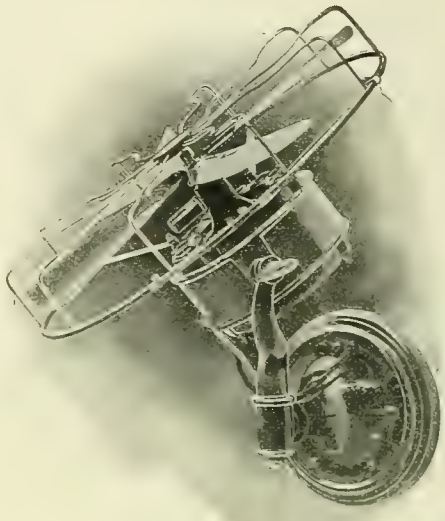

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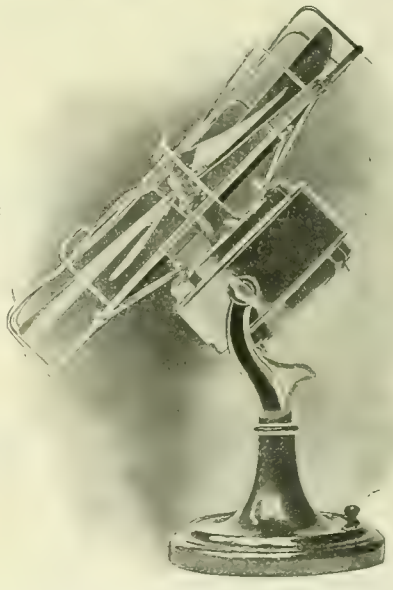

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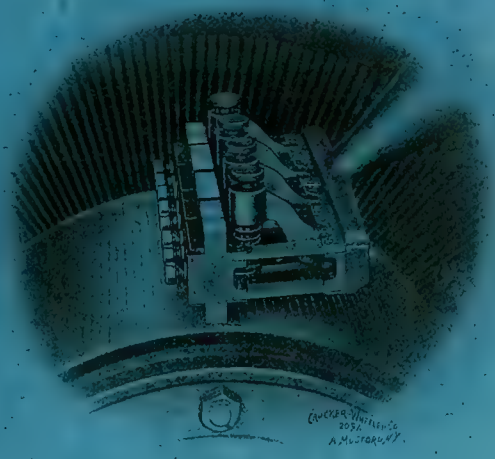

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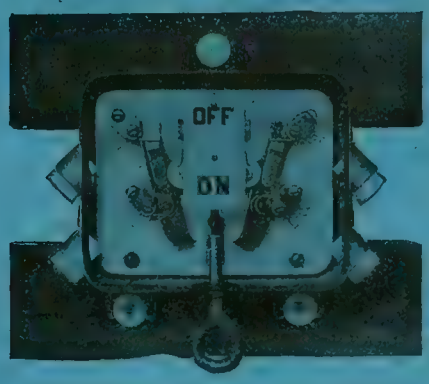

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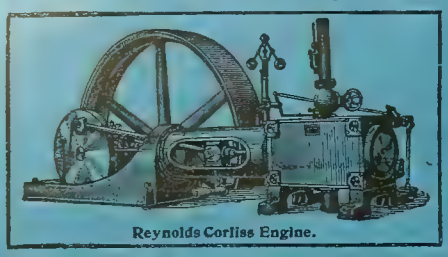
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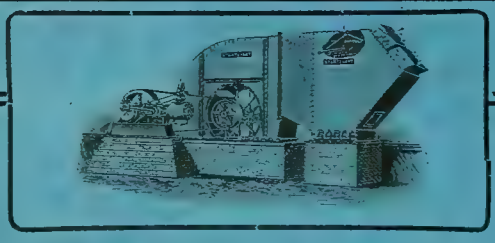

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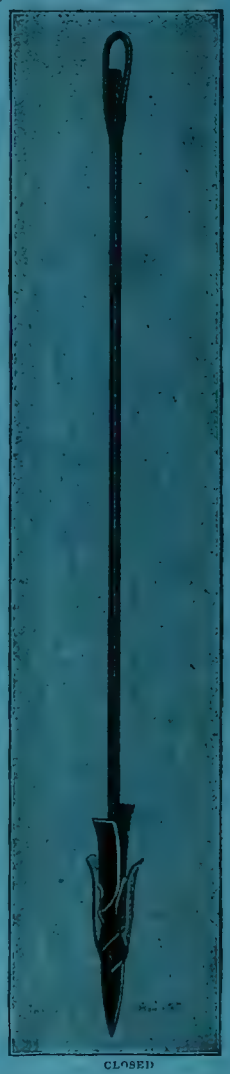
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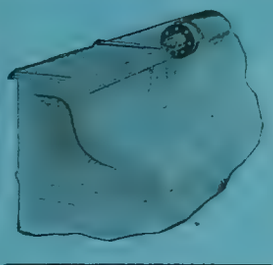

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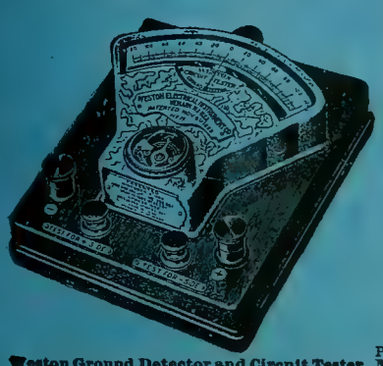

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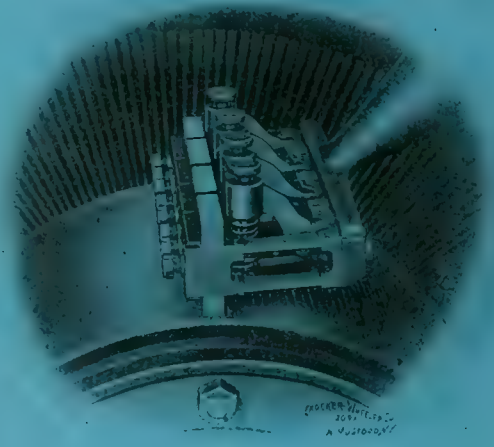

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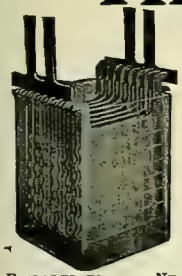

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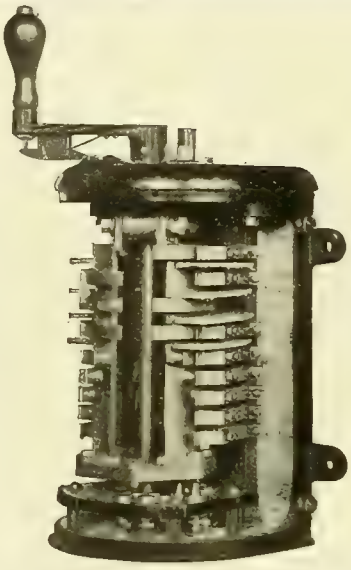

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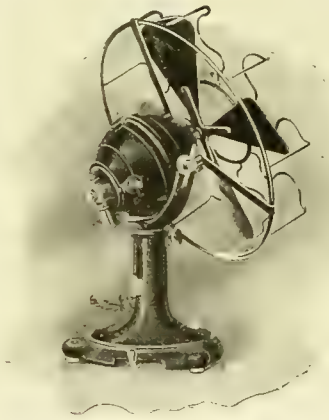

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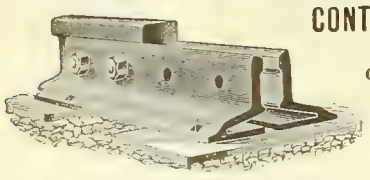

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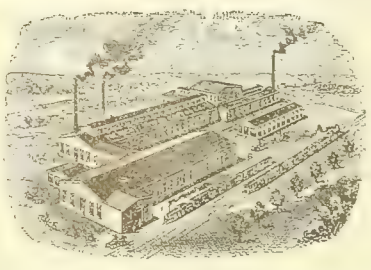

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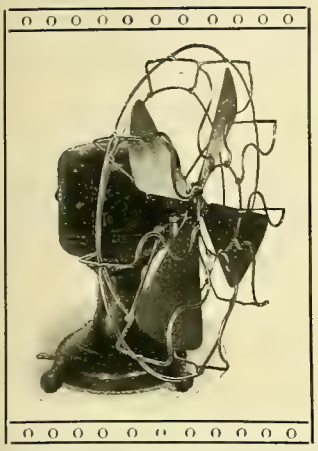

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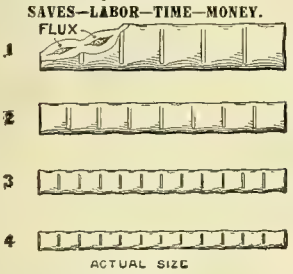

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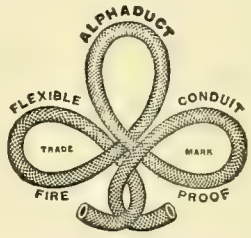

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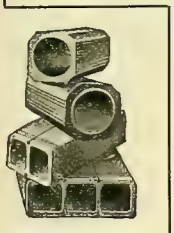

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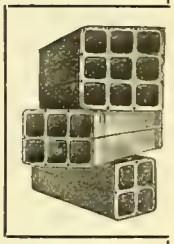

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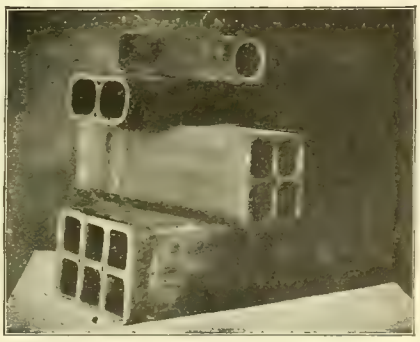

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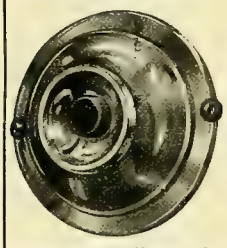
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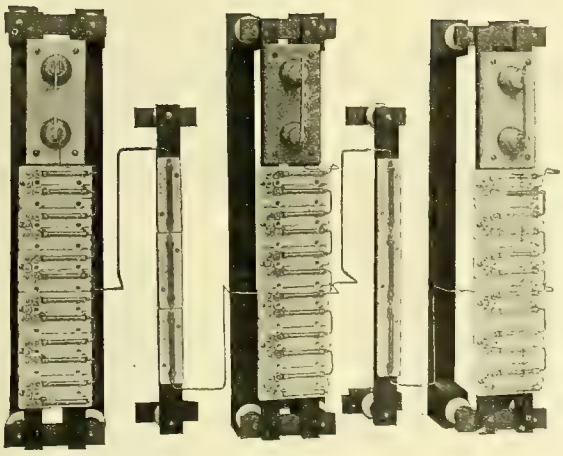
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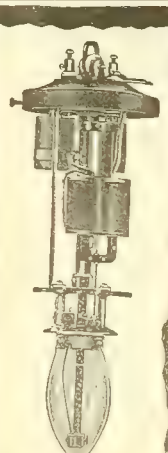

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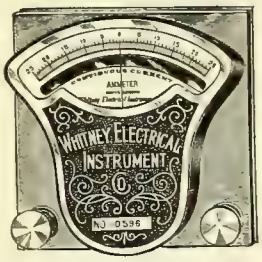

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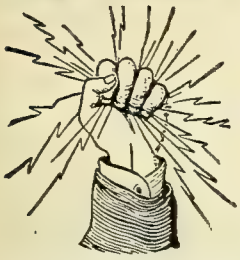

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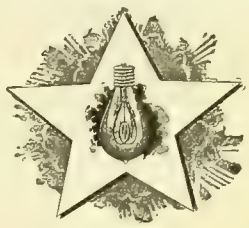

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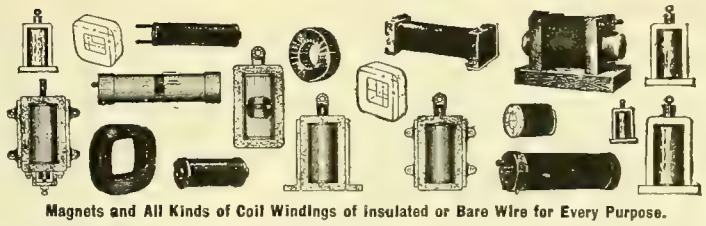

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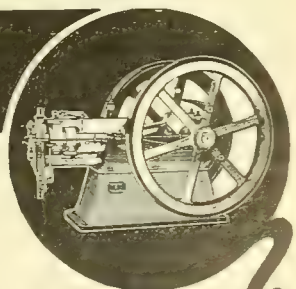

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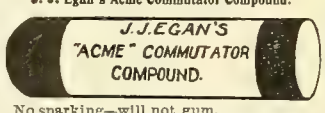

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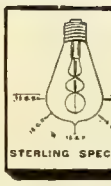

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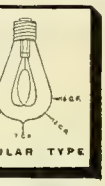

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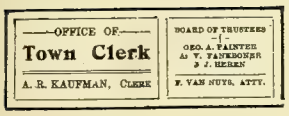

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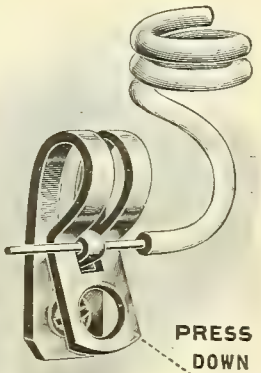

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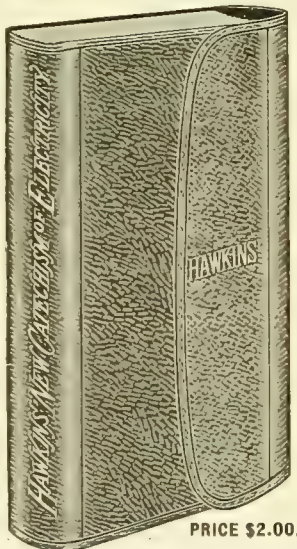

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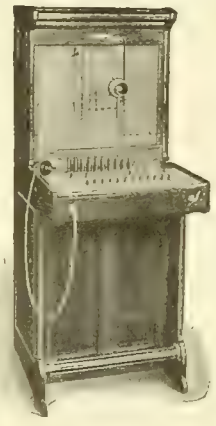

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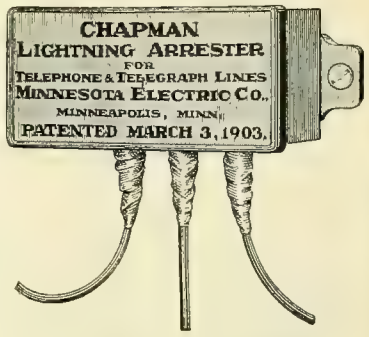

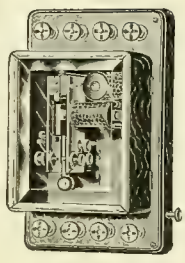

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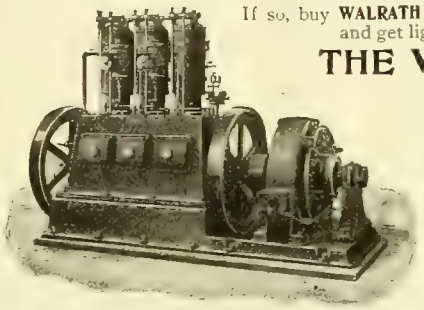
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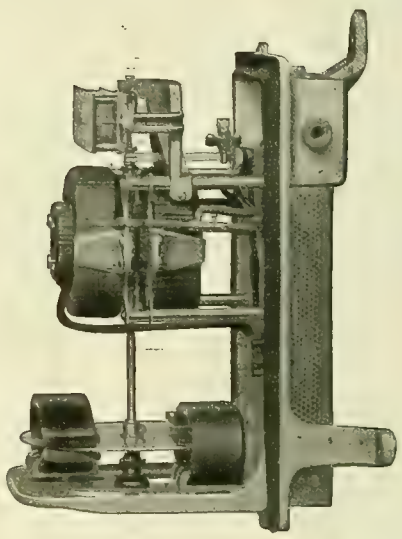

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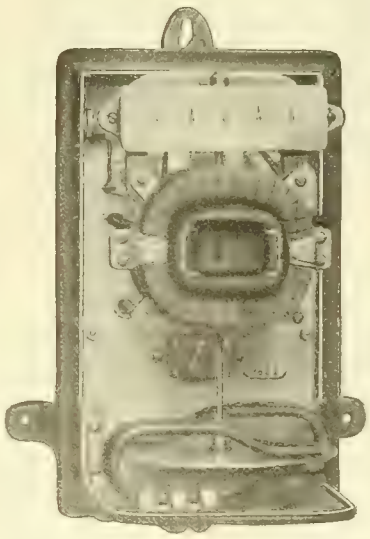

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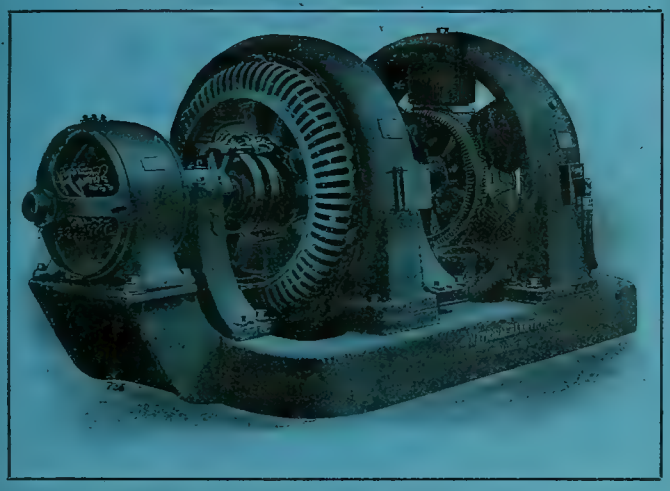

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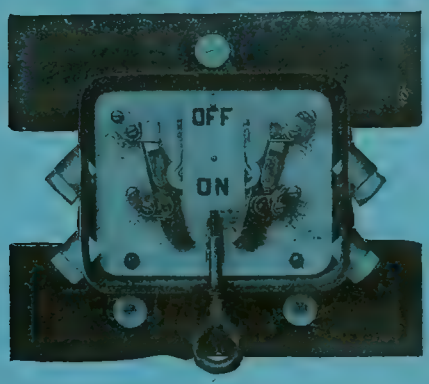

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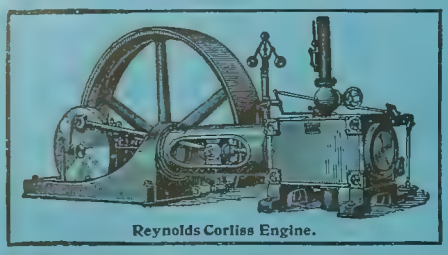
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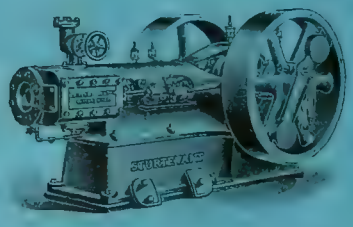

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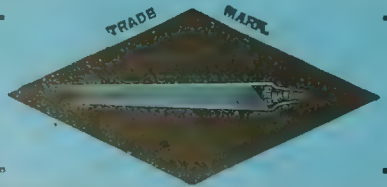

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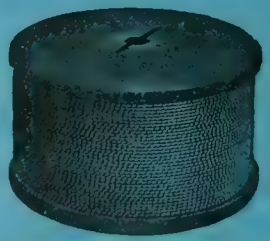

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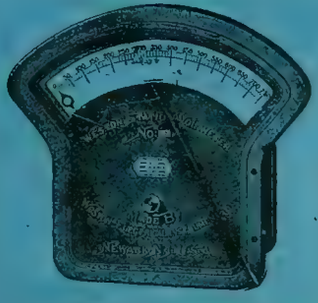

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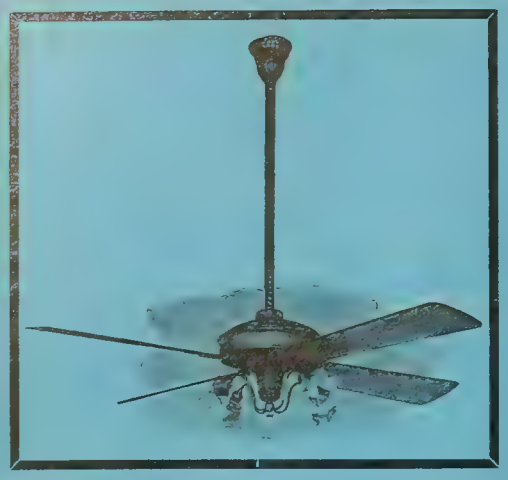

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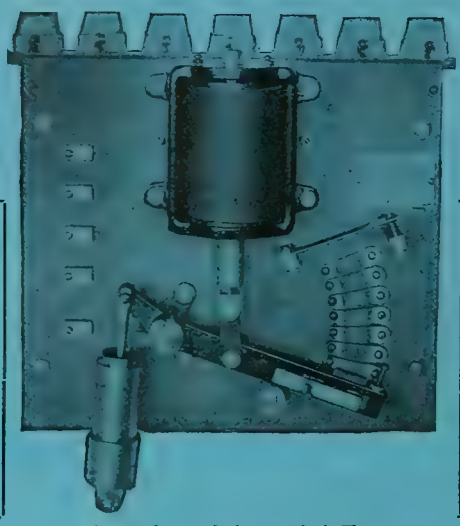

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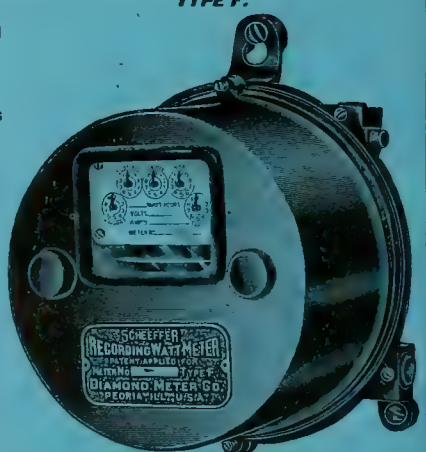

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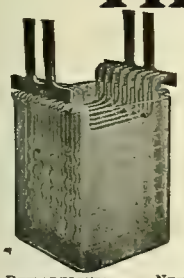

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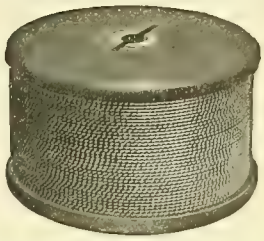

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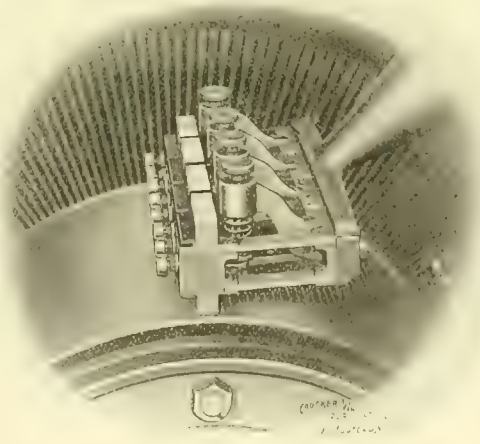

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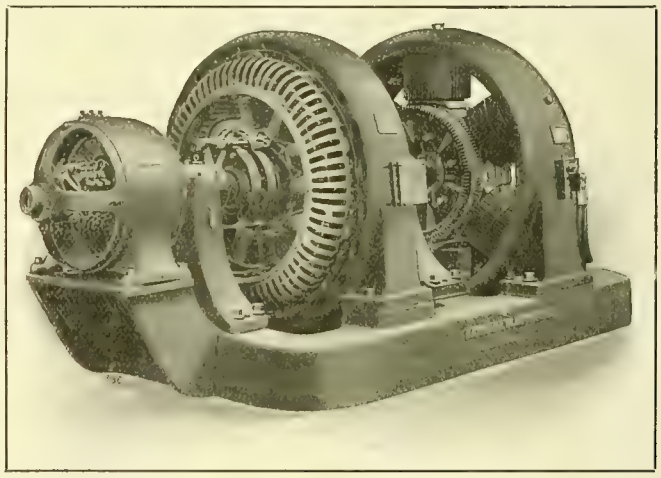

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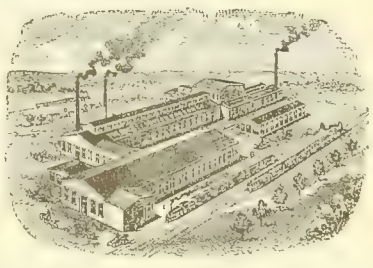

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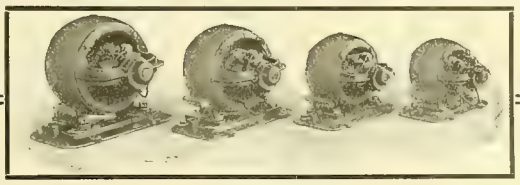

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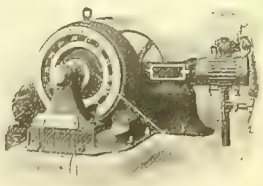

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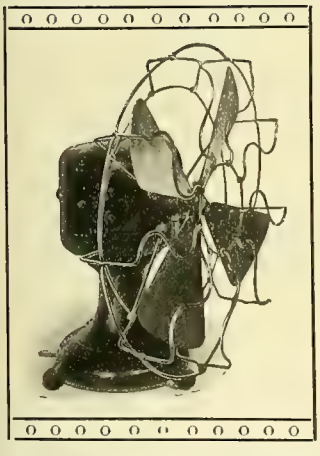

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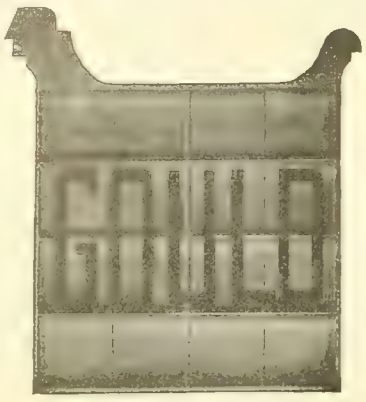

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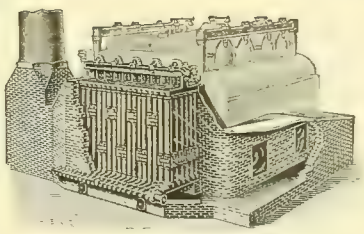

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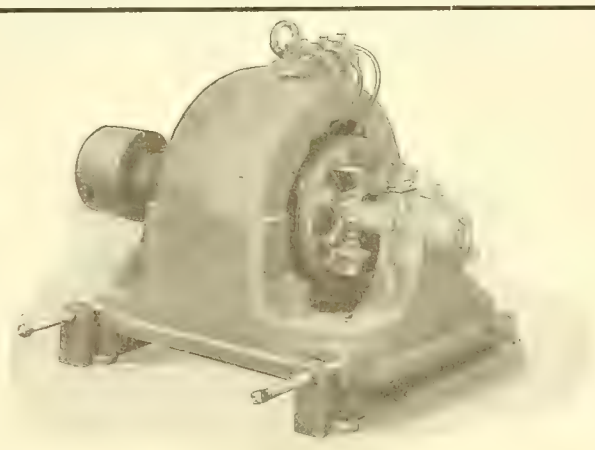

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This Lange patent covers the mode of fastening the cap, shell and insulation together, which is recognized as the standard.

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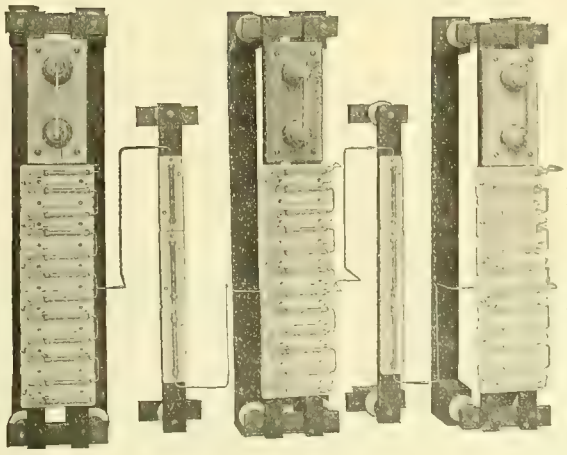

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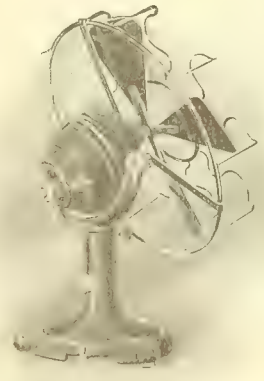

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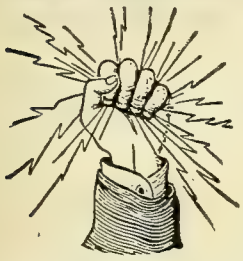

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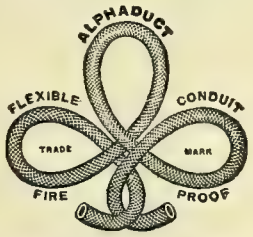

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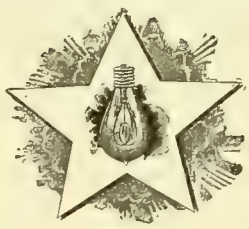

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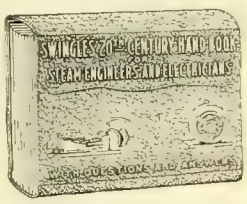

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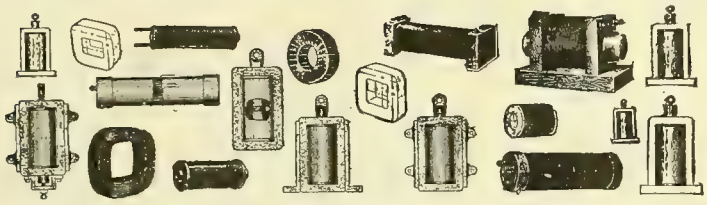

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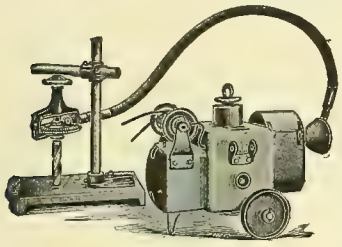

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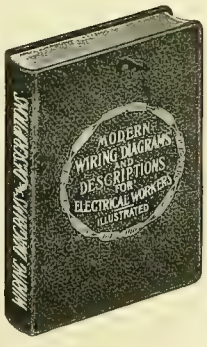

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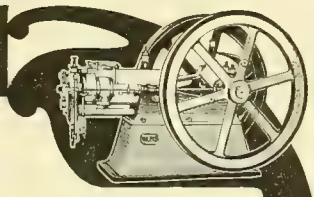

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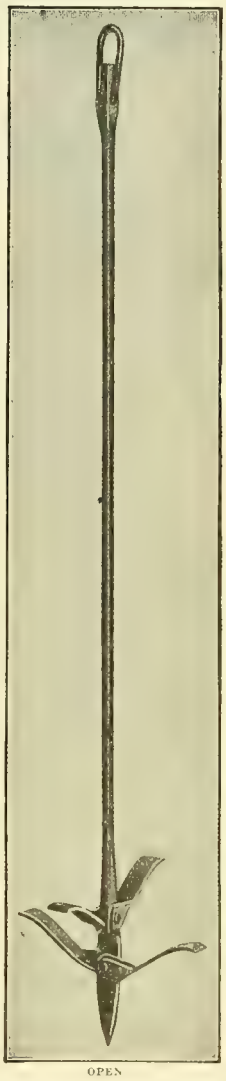

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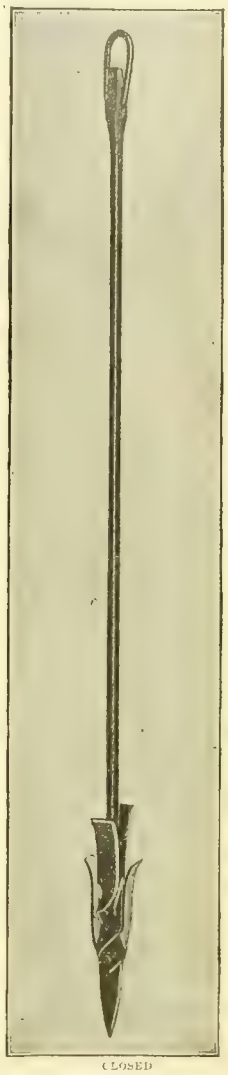

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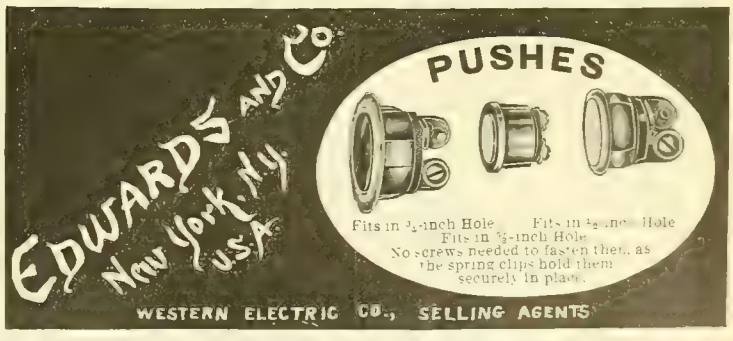

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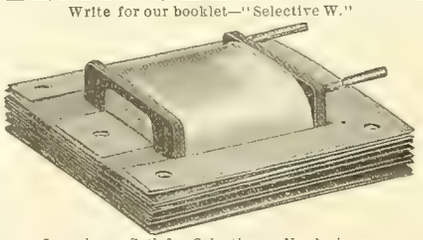

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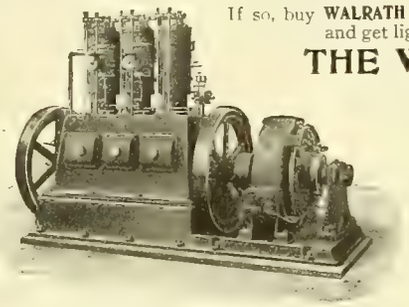
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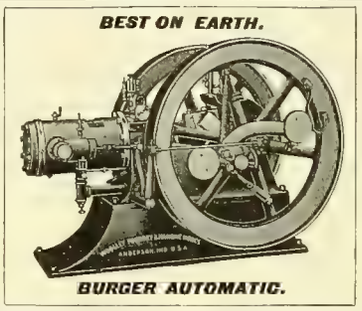
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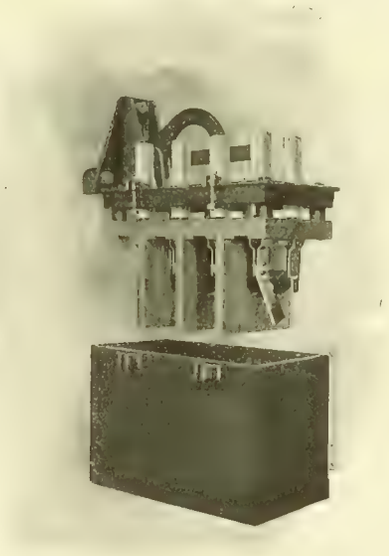

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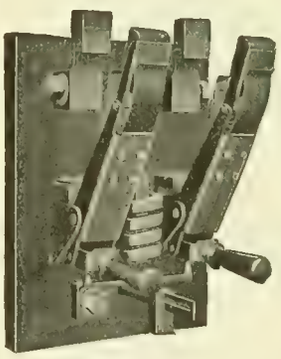

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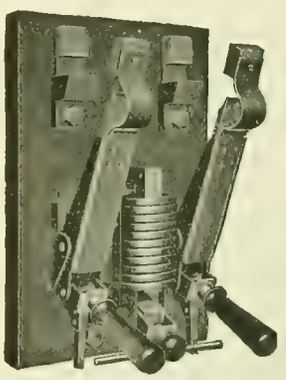

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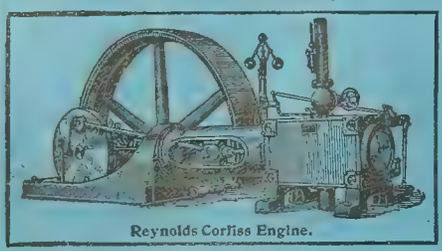
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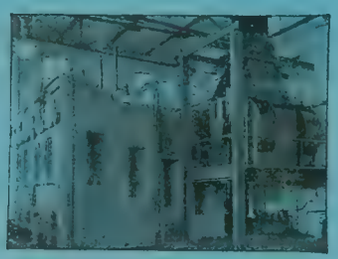

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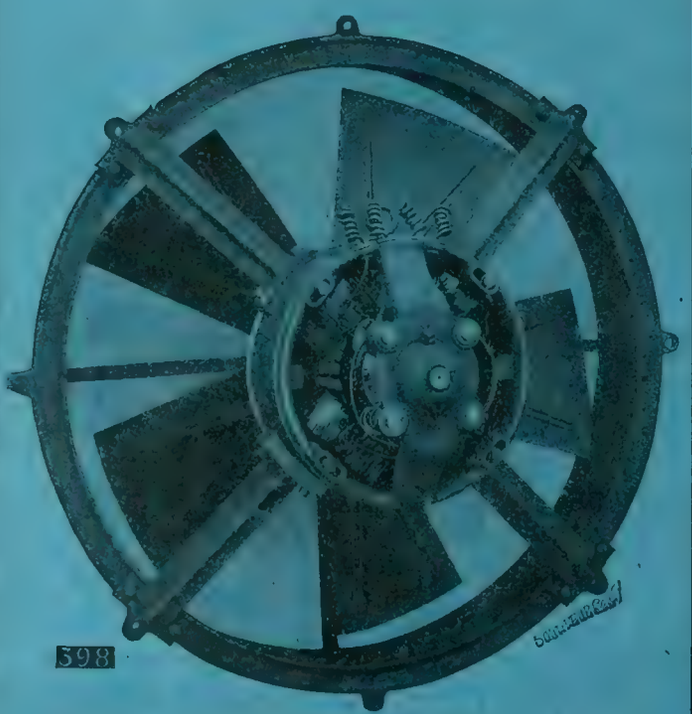
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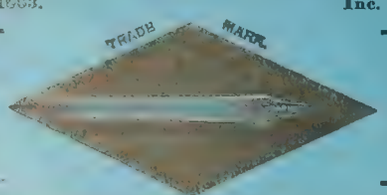

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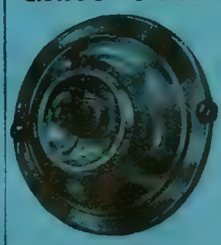

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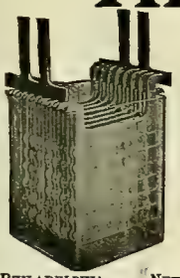

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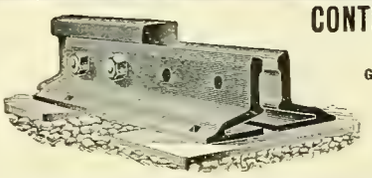

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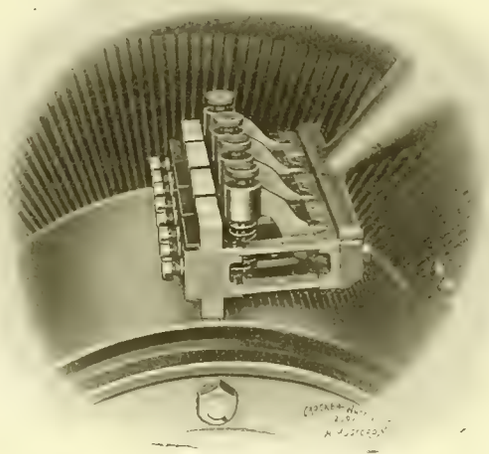

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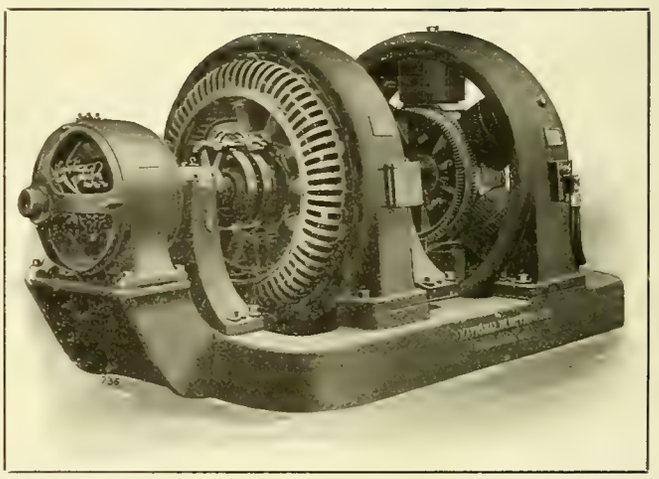

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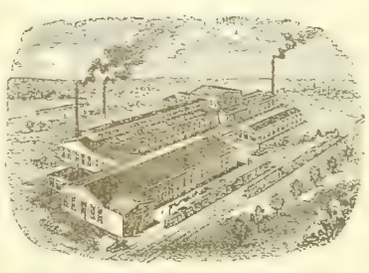

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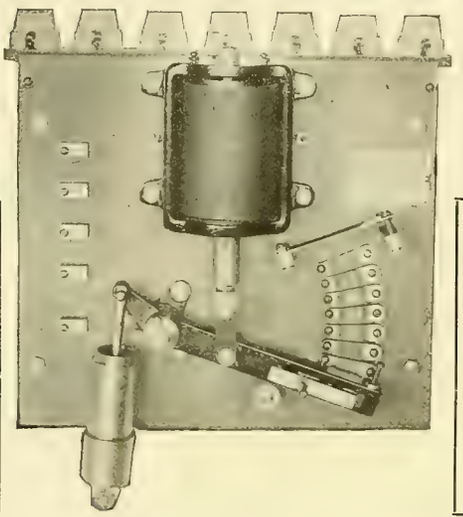

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Phillips, Eugene F.
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Safety Ins. Wire & Cable Co
Simplex Electrical Co.
Standard Underground C. Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

BITUMINIZED FIBER CONDUIT.

FOR ELECTRICAL UNDERGROUND CONSTRUCTION.

ELECTROLYSIS PROOF—WATERPROOF.

(COPY.) General Electric Company,
San Francisco Office, Crossley Bldg.,
March 19, 1904.

Mr. George H. Barker, Vice-President,
American Conduit Co.,
170 Broadway, New York, N. Y.

Dear Sir:—

We have used the Bituminized Fiber Conduit for ducts in many high potential stations and consider it an ideal conduit for high potential work.

The conduit can be made absolutely waterproof and is easy to handle, and possesses in itself an extremely high insulation.

We have recommended it to all our customers for this class of work.

Yours very truly,
(signed) J. A. Lighthipe,
Engr. San Francisco Office.

A smooth laminated insulator of unchanging durability.

Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.

There has never been a gas explosion in our conduits, nor the slightest evidence of electrolysis.

Abrasion of the cables is an impossibility.

It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction cost.

Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.

All sizes from one inch to ten inches interior diameter. Bends of all angles.

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For Underground Wires. The Only Conduit that Improves with Age.
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Announcement

THE WHITNEY ELECTRICAL INSTRUMENT CO. announces that it has opened in its new factory at Penacook, N. H., a separate

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for the repair and calibration of all classes and makes of electrical measuring instruments, including voltmeters, ammeters, wattmeters, ohmmeters, testing sets, galvanometers, etc. Our special facilities insure the highest grade of work, prompt deliveries and low prices.

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General Sales Office, . . Whitney Electrical Instrument Company.

Standard Vitrified Conduit Co.

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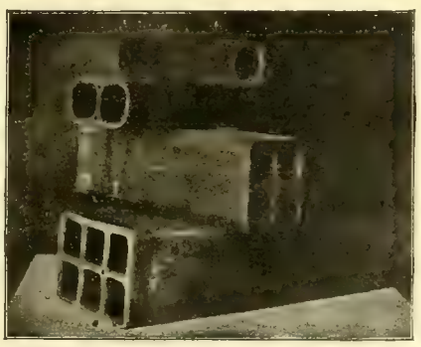

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IN 1, 2, 3, 4 AND 6 DUCT.

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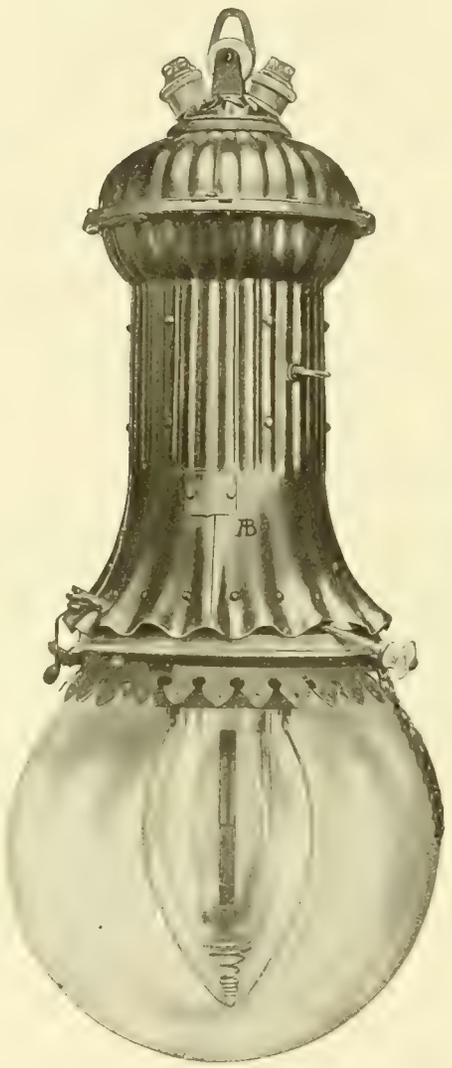
FOR ALL CIRCUITS



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THE ADAMS - BAGNALL ELECTRIC CO.

New York Office: 136 Liberty St. CLEVELAND, OHIO Chicago Office: 309 Dearborn St.

The attention of Manufacturers of, Dealers in and Users of Incandescent Lamps is called to the following patents covering the types of incandescent lamps in most general use, and processes for their manufacture.

U. S. Patent No. 537,693, April 16, 1895
U. S. Patent No. 726,293, April 28, 1903
U. S. Patent No. 444,530, Jan. 13, 1891
U. S. Patent No. 532,760, Jan. 22, 1895

The rights of the owners of and licensees under these patents will be vigorously enforced.

GENERAL ELECTRIC COMPANY
EDISON ELECTRIC LIGHT COMPANY
SCHENECTADY, N. Y.

YOST SOCKETS INFRINGE PERKINS PATENT

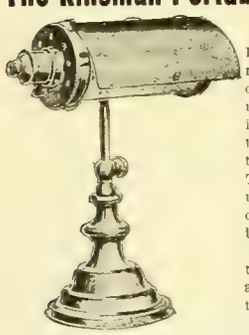
THE United States Circuit Court for the Eastern District of Pennsylvania has handed down an opinion sustaining the Perkins Socket Patent No. 626,927, against the Yost Socket in the suit of the Perkins Electric Switch Mfg. Co. against J. F. Buchanan & Co. The Court has directed the issuance of an injunction against the defendants, selling the Yost sockets, and the case is to be referred to a master to ascertain profits and damages to be awarded to the complainant. :: :: :: ::

A copy of this decision will be mailed upon receipt of a request to

THE PERKINS ELECTRIC SWITCH MFG. COMPANY

NEW YORK CITY BRIDGEPORT CONN. CHICAGO, ILL.

The Kinsman Portable No. 1



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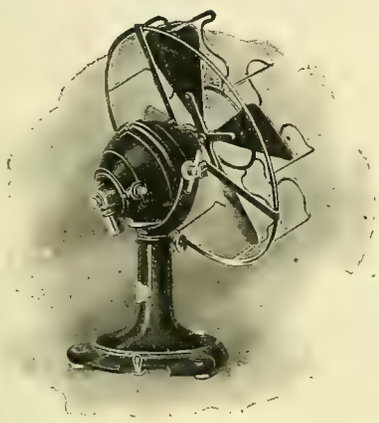

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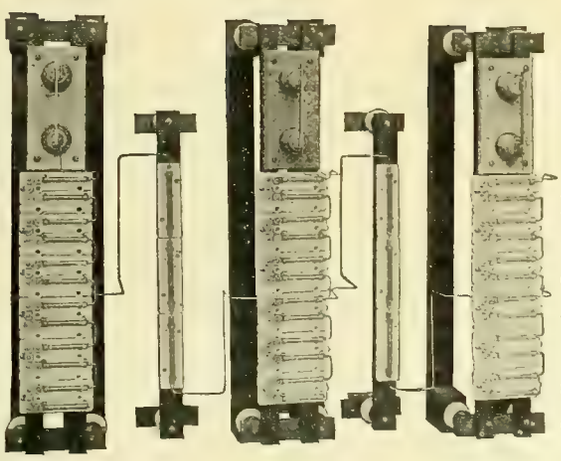

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Alternating circuits are more frequently subjected to abnormally high voltage strains than is generally recognized.

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All types supplied—
Accurately rated—
Carefully selected.

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Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

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for machine tools and micellaneous machinery. Northern Apparatus in successful daily use in a wide range of progressive American industries. 118

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Get the Habit (s)
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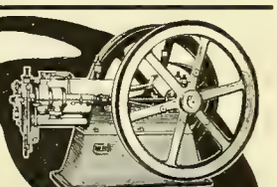
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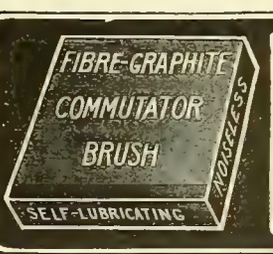

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Three experienced incandescent lamp salesmen, by an old and well-established company not in the trust. Applicants will please state age, experience and salary wanted. Address BOX 199, care Western Electrician, 510 Marquette Bldg., Chicago.

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An opportunity to secure a first-class complete Electric Light Plant very cheap

$3,500.00 for the Complete Plant

One 16-inch and 26-inch by 36-inch cross compound condensing Corliss engine with two band wheels 22-inch face by 12 feet and 16 feet diameters. Henry W. Bulkley syphon condenser with circulating pump, hot well, etc. Complete with all valves and fittings. In good condition.

One "WOOD" 60 cycle 150 K.W. Alternator, 2,200 volts 450 r. p. m. Complete with exciter and switchboard instruments. Armature newly rewound. In first-class condition. The above has been recently replaced by larger units.

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3-120 " " " "
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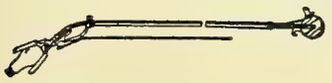

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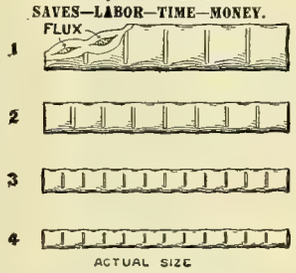

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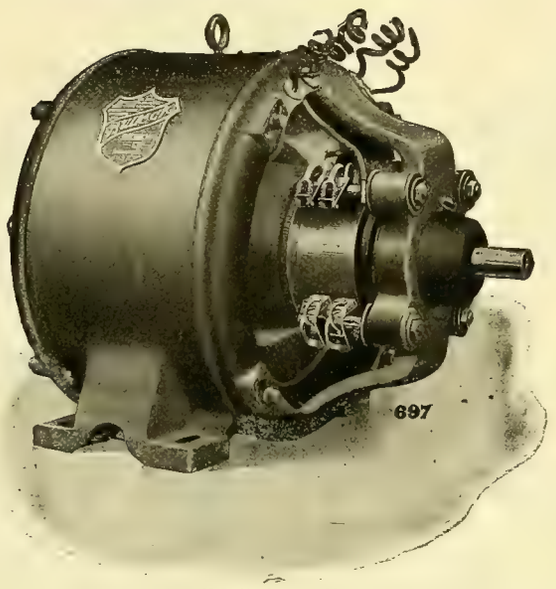

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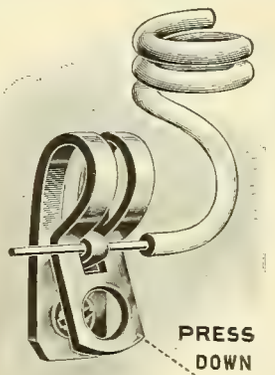

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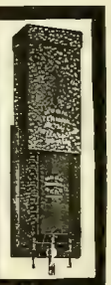

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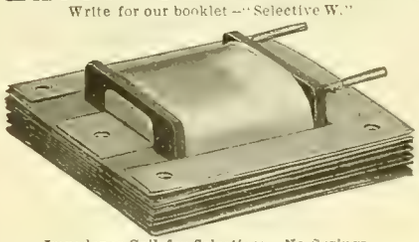

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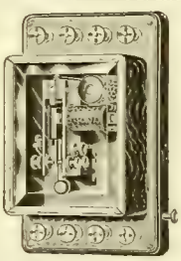

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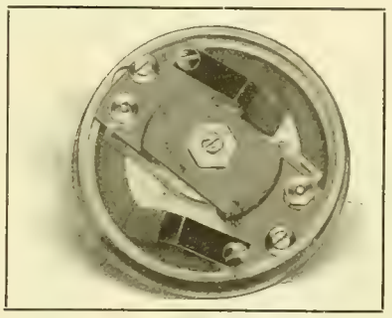

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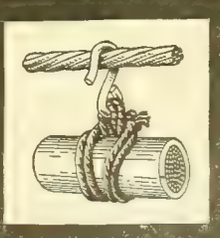

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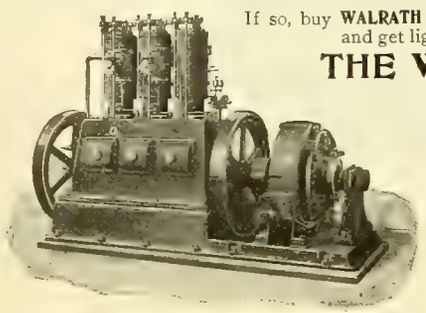
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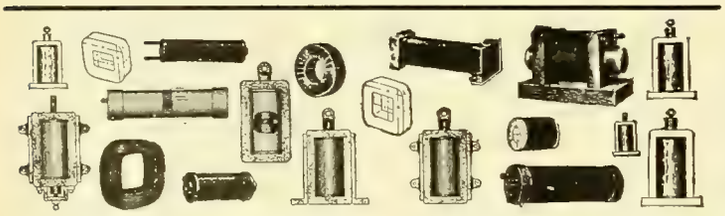
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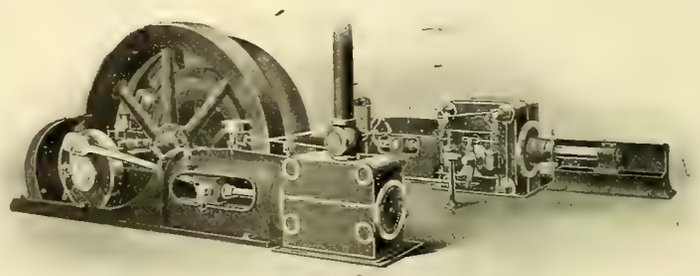
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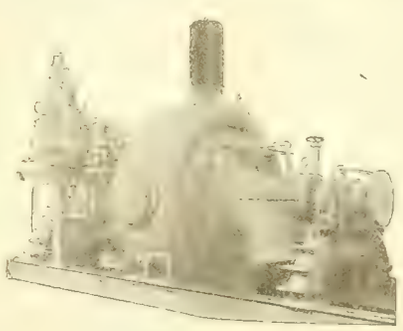

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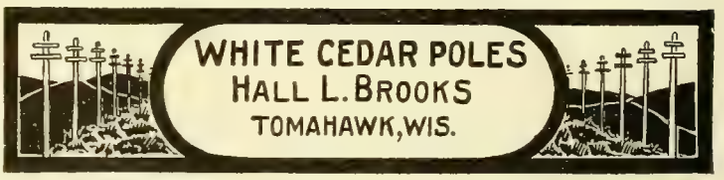

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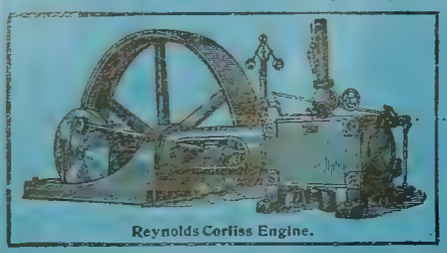
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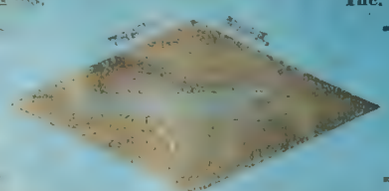

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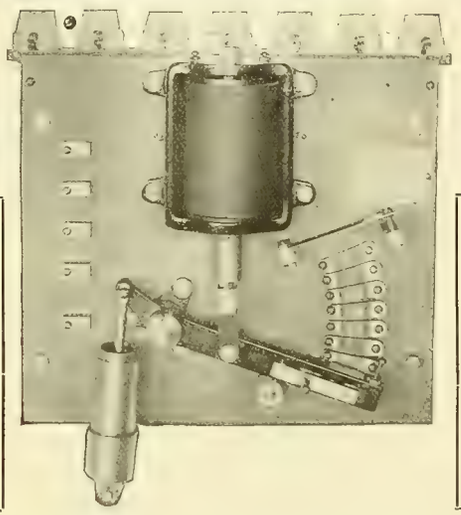

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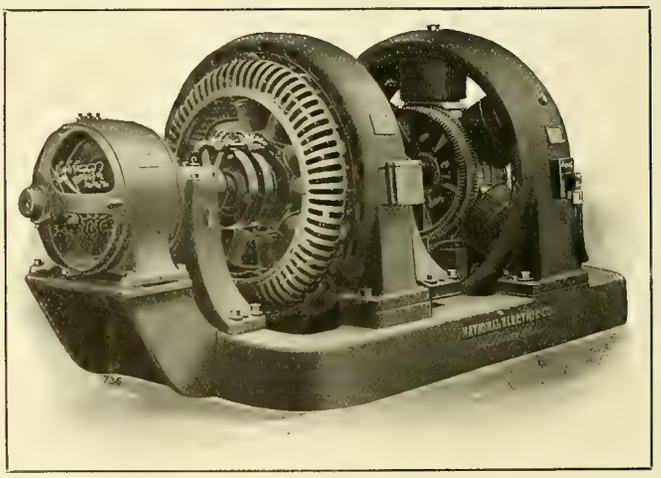

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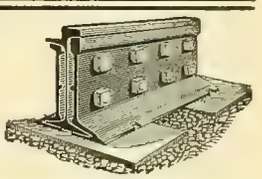

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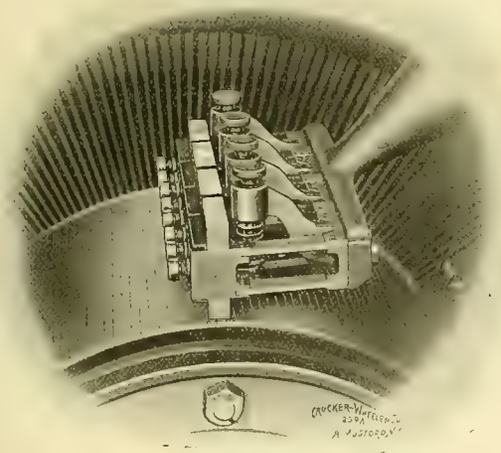

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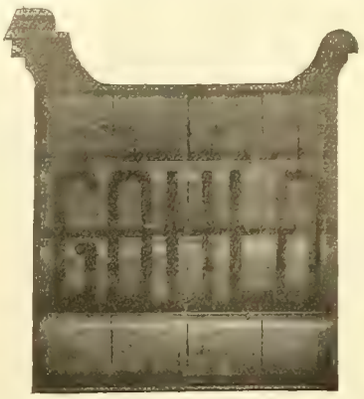

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Wesco Supply Co.
Western Electric Company.
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BITUMINIZED FIBER CONDUIT.

FOR ELECTRICAL UNDERGROUND CONSTRUCTION.

ELECTROLYSIS PROOF—WATERPROOF.

(Copy.) General Electric Company,
San Francisco Office, Crossley Bldg.,
March 19, 1904.

Mr. George H. Barker, Vice-President,
American Conduit Co.,
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Dear Sir:—

We have used the Bituminized Fiber Conduit for ducts in many high potential stations and consider it an ideal conduit for high potential work.

The conduit can be made absolutely waterproof and is easy to handle, and possesses in itself an extremely high insulation.

We have recommended it to all our customers for this class of work.

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Engr. San Francisco Office.

A smooth laminated insulator of unchanging durability.

Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.

There has never been a gas explosion in our conduits, nor the slightest evidence of electrolysis.

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It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction cost.

Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.

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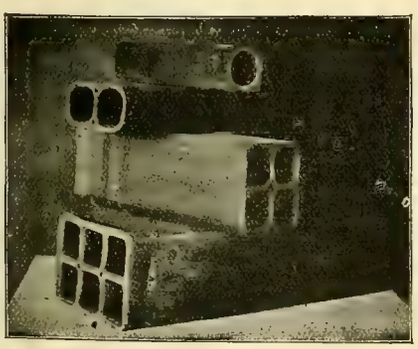

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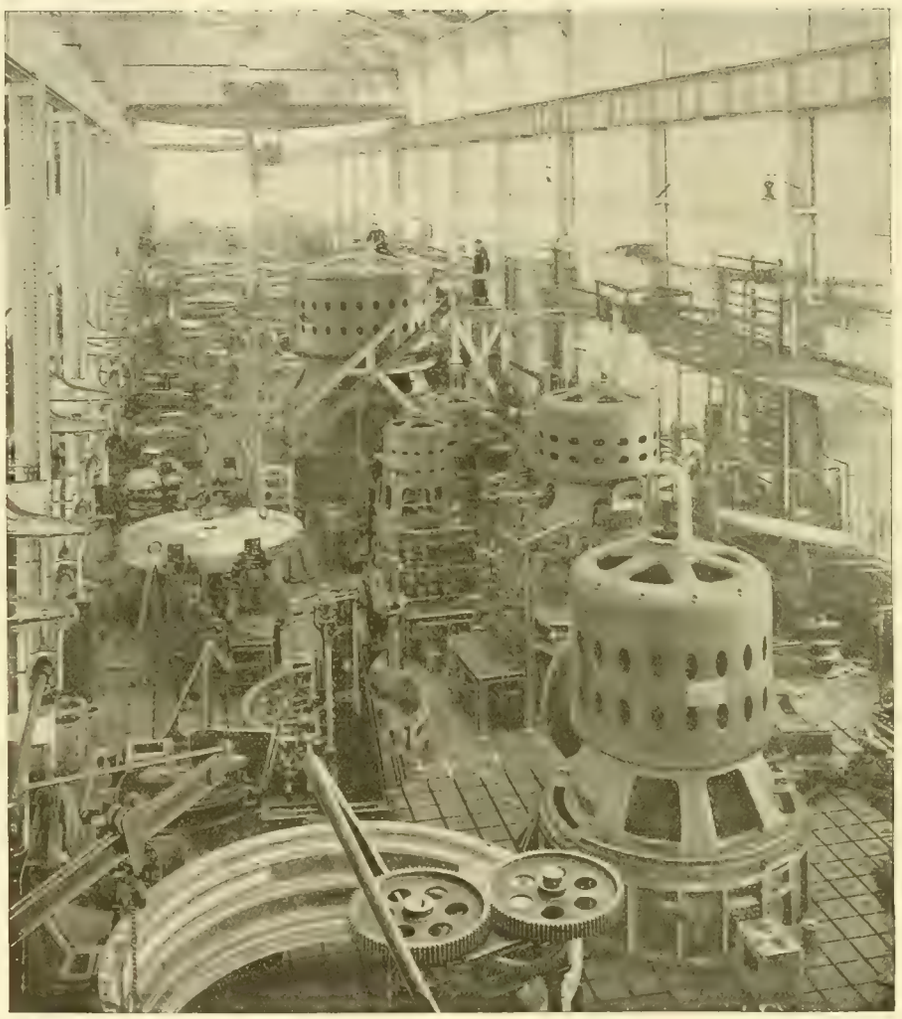

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U. S. Patent No. 537,693, April 16, 1895
U. S. Patent No. 726,293, April 28, 1903
U. S. Patent No. 444,530, Jan. 13, 1891
U. S. Patent No. 532,760, Jan. 22, 1895
U. S. Patent No. 754,251,

The rights of the owners of and licensees under these patents will be vigorously enforced.

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DO NOT INFRINGE PERKINS PATENT.

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The decision of the Circuit Court for the Eastern District of Pennsylvania, in the suit of the Perkins Electric Switch Mfg. Co. against J. F. Buchanan & Co. does not enjoin the selling of the Yost Socket; but on the contrary relates to socket known as the Dixon, manufactured by The Yost-Miller Company. The sockets manufactured and sold by THE YOST ELECTRIC MFG. CO. are essentially different in construction from the Dixon Socket which was involved in the suit referred to, and does not, as we have been advised by counsel, infringe any of the claims of the Perkins Patent. No such socket as that manufactured and sold by us has ever been brought to the attention of any court by judicial proceedings.

We give notice that we will fully protect all purchasers of sockets manufactured and sold by us and that we shall hold the Perkins Electric Switch Mfg. Co. responsible for any and all damages sustained by us following from any mis-statement of facts contained in the publications herewith referred to.

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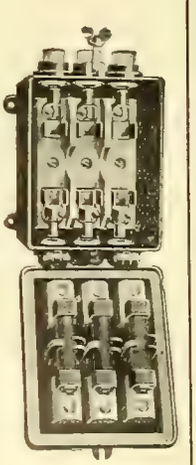

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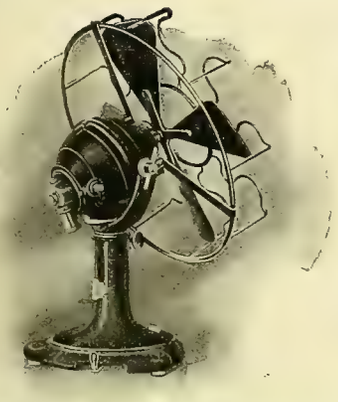

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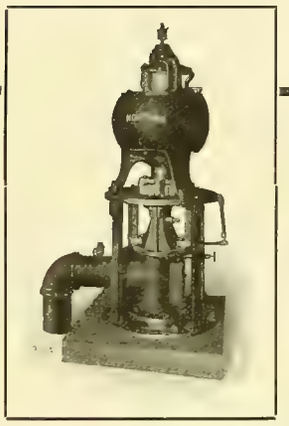

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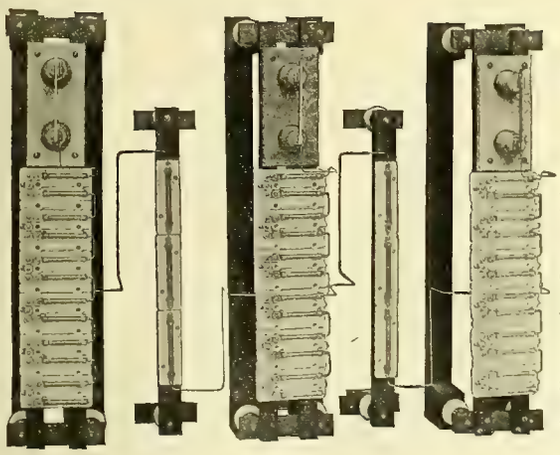
NORTHERN ELECTRICAL MFG. CO.
Engineers, Manufacturers MADISON, WIS., U. S. A.

GENERAL ELECTRIC COMPANY'S

Multiplex Arresters



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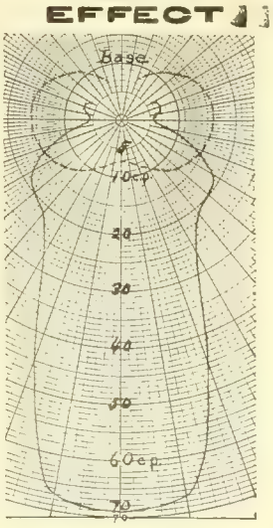

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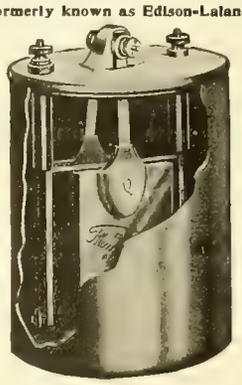

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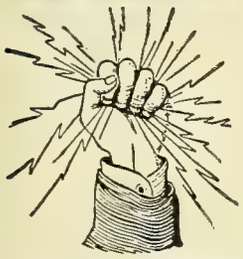

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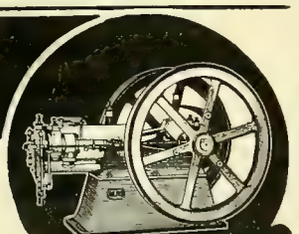

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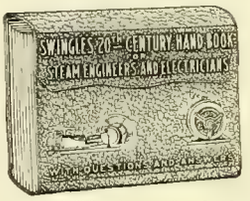

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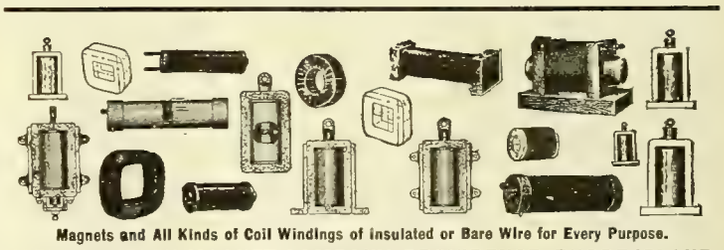

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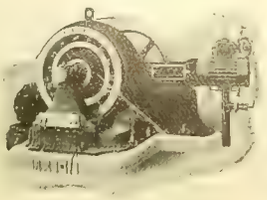

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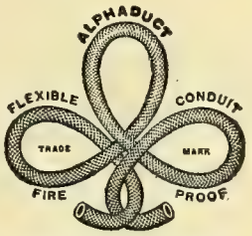

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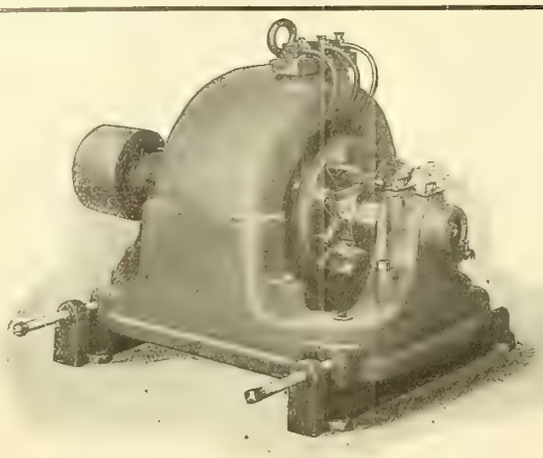

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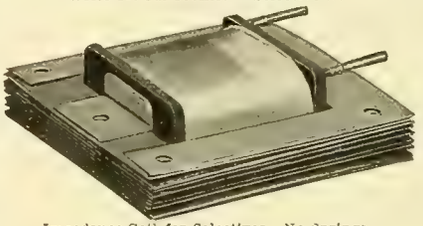

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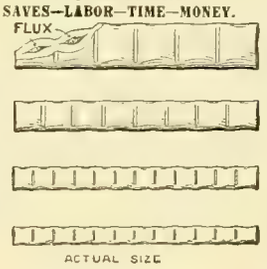

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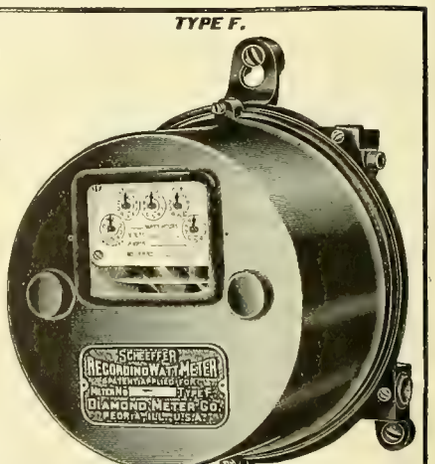

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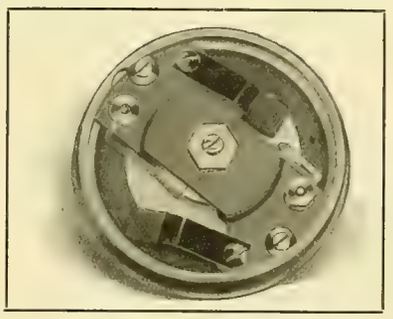

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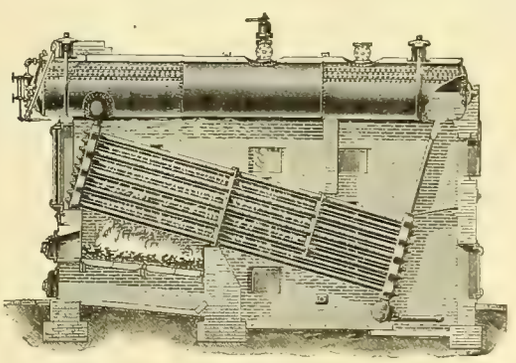

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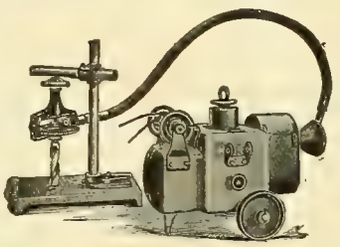
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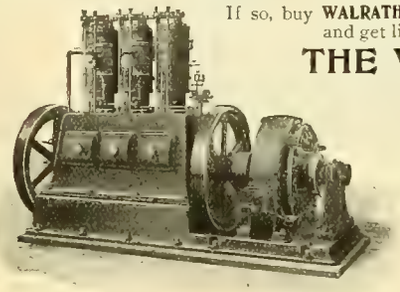
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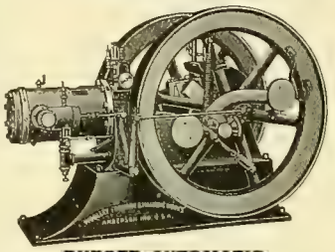
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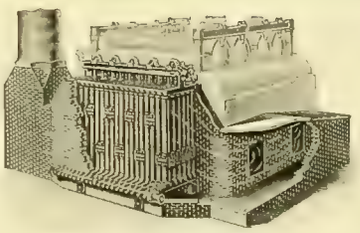
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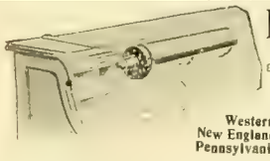
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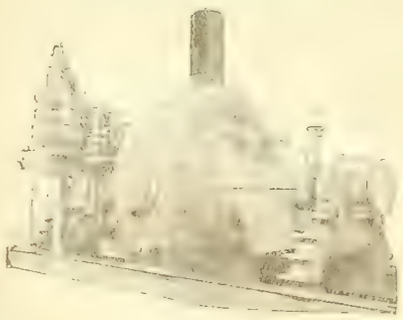
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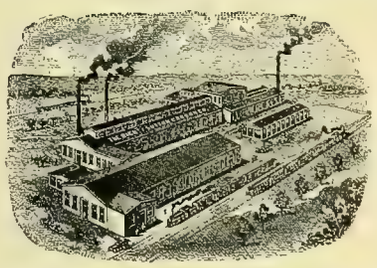

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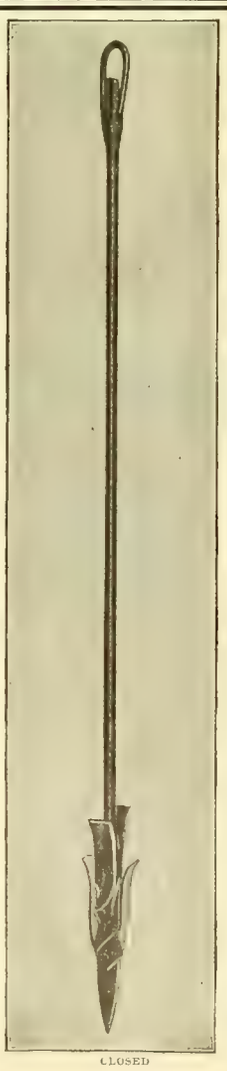
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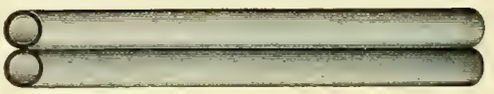
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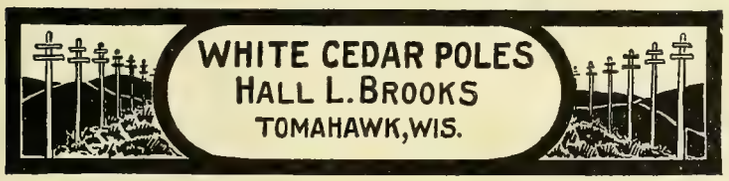

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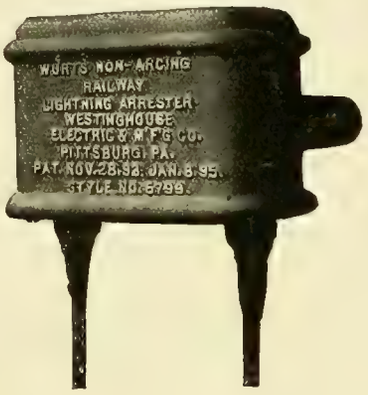

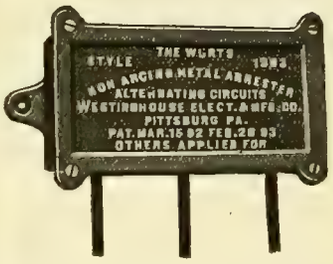

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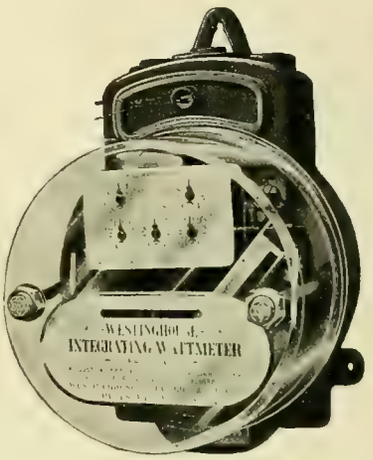

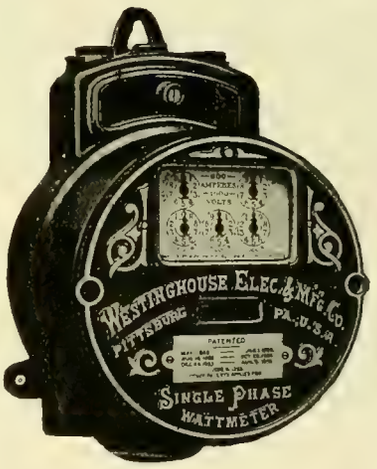

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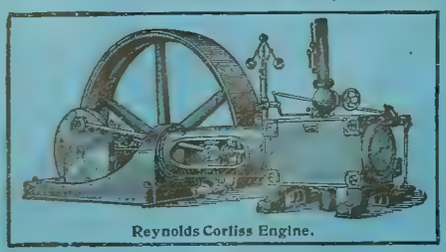
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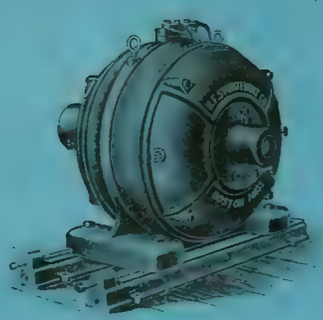

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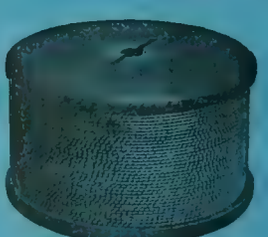

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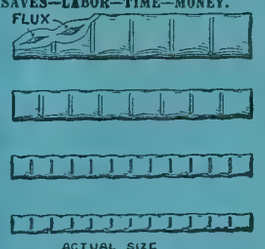

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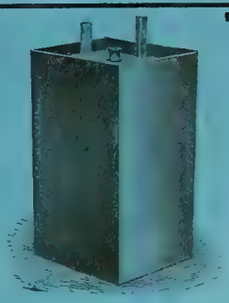
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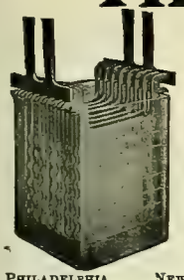

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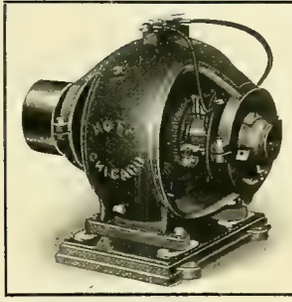

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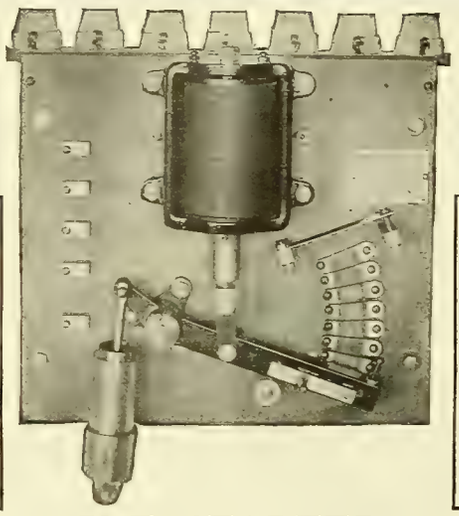

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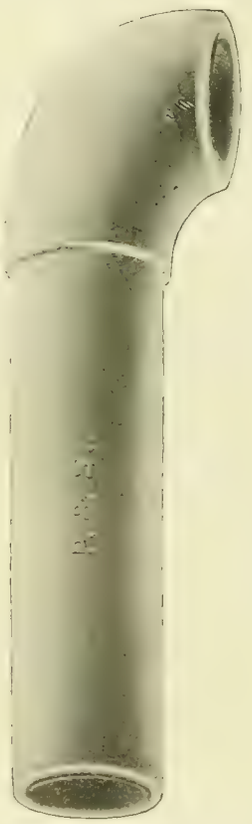

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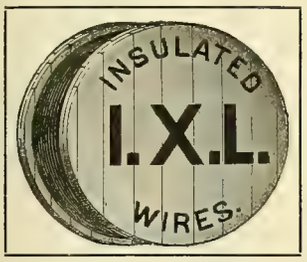

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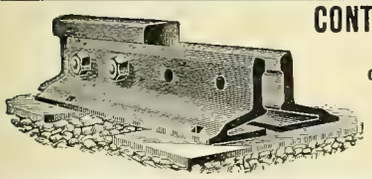

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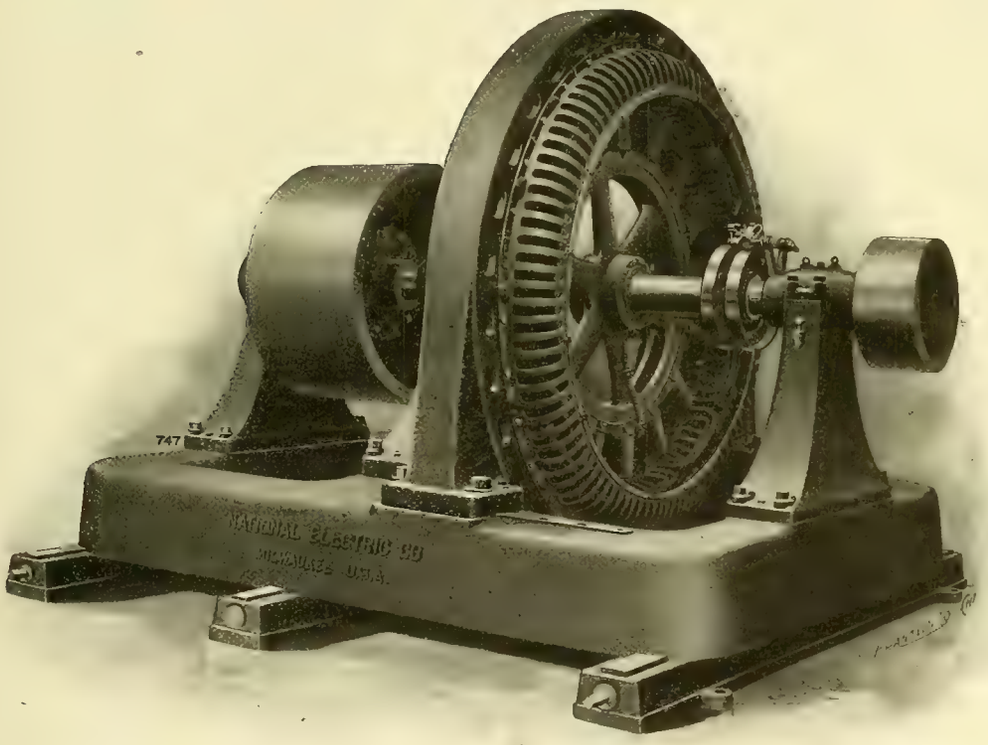

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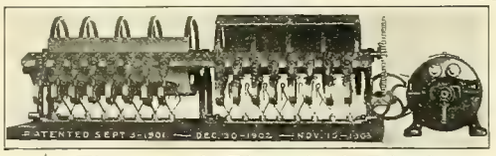

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Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

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Wesco Supply Co.
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Amer. District Steam Co.

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Munsell & Co., Eugene.
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Okonite Co., The.
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Standard Vitrified Cond. Co.
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General Electric Co.
General Inc. Arc Lt. Co.
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Wesco Supply Co.
Western Electric Co.
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(See Wires and Cables.)

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Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
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Munsell & Co., Eugene.

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Johnston, Thomas J.

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Platinum.
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Wesco Supply Co.
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For Alphabetical Index of Advertisements See Page 3.

Here
is an
advertisement
that
don't
need
headlines
or any
big type

Did you ever stop to think out the reason why so many—and increasingly many—of the big stations are buying Bryan-Marsh incandescent lamps?

Or did you ever pause and reflect why so many electrical engineers will have their specifications read: "Bryan-Marsh Imperial lamps or equally as good"

Did you ever?

Did you ever get a shipment of incandescent lamps and then wish you had ordered Bryan-Marsh Imperial instead?

Bryan-Marsh Company, Chicago, New York, Minneapolis, Cincinnati and Denver.

P. S.—Imperial Prismo Lamps the latest—and as usual about a year ahead of others in results accomplished

A MESSAGE FROM MARS

BETTER BUY BUCKEYE

31 RIGID INSPECTIONS

Buckeye Electric Company

Licensed Under	Patent 537693, April 16, '95	Patent 444530, Jan. 13, '91
	Patent 726293, April 28, '03	Patent 532760, Jan. 22, '95

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COLUMBIA LAMPS

THEY

Increase Profits.

Increase Sales.

Increase Customers.

THEY

Decrease Expenses.

Decrease Complaints.

Decrease Equipment.

Columbia Lamps are manufactured under a license to use the Chemical Exhaust Process of exhausting lamps. This process is vitally necessary in the production of the highest quality of lamp. Every package of Columbia lamps carries a label reading:

LICENSED UNDER
Patent No. 537,693, April 16, 1895
Patent No. 726,293, April 28, 1903
Patent No. 444,530, Jan. 13, 1891
Patent No. 532,760, Jan. 22, 1895

TRY 'EM

Write for Booklet on "That Question of Light."

THE COLUMBIA INCANDESCENT LAMP COMPANY,

ST. LOUIS, MO., U. S. A.

NEW YORK OFFICE: 1311 Havemeyer Building.
CHICAGO: Central Electric Co.
SAN FRANCISCO: Paul Seiler Electric Works.
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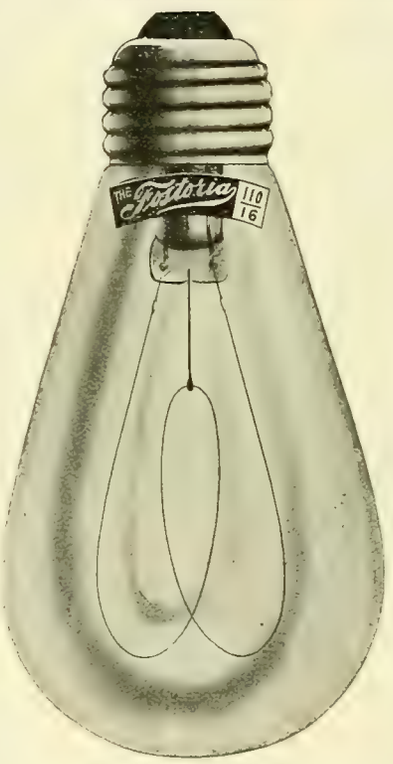
WE KNOW HOW

TO MAKE

TIPLESS LAMPS

We didn't learn how in a minute—and we don't make them like other people have TRIED to make them in the past. Our methods and machines are all covered by patents and so is the lamp.

This lamp is more perfect in mechanical construction than any tip lamp.



A Tipless Lamp has never heretofore been offered to the trade that had actual lamp qualities. We are now ready to furnish you with a tipless lamp that is unexcelled for actual lamp quality at prices which are as low as those of the best tip lamps, and at the same time save you from 3 to 12% less from broken tips and short life due to cracked and chipped tips.

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THE FOSTORIA INCANDESCENT LAMP CO.
FOSTORIA,
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The Holophane System of Illumination

was adopted EXCLUSIVELY by

THE SINGER MFG. CO.'S BOOTH, Section 23A, Manufactures Building

This system was selected after long and exhaustive tests of all the leading globes and shades on the market. The saving in current effected thereby over the system first adopted pays for the complete installation.

You will understand the WHY

when you visit our magnificent booth in

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Our exhibit covers nearly 2,500 square feet and our demonstrators will make comparative tests on any kind of globes you may select.

Some new ideas in the use of The Holophane System will be Footlights and Border lights in Theaters, etc. Seven-color scheme for sign work. Store Window lighting, etc., etc.

HOLOPHANE GLASS CO.

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SINGLE PHASE MOTOR FACTS

SOMETHING TO THINK ABOUT

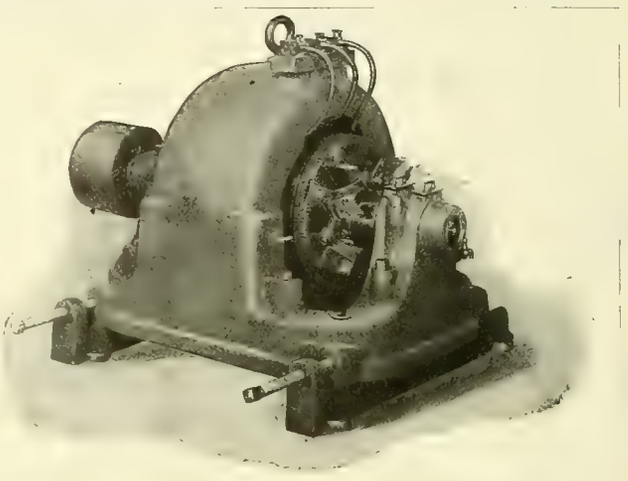
SPEAKING OF CENTRAL STATION POLICY

Do You Know

That, by using SINGLE PHASE, instead of two or three phase alternating-current motors, you can save from 15 to 50 per cent. of the first cost of your motor transformer installation?
That it costs you less to erect the ONE TRANSFORMER for a single-phase motor than two or three for a polyphase motor?
That in single-phase motor installations there is a SAVING of from 15 to 35 per cent. of TRANSFORMER LOSSES?
That at one per cent. per K. W. hour this means a saving of from TWO TO FIFTEEN DOLLARS A MOTOR per year?
That the increased loss in transformers for polyphase motors means TYING UP STATION CAPACITY?
That you can save from 10 to 50 per cent. of METER INVESTMENT by installing single-phase motors?
That you can save at least 50 per cent. of COST OF LABOR INSTALLING your meters?
That you can save 25 to 50 per cent. of the cost of labor in erecting your MAIN LINE WIRES by distributing single phase?

Do You Know

That you eliminate a portion of the expense of the conductors and save about 50 per cent. of CONDUIT OR CROSS-ARM SPACE, PINS, INSULATORS, ETC.?
That a prominent central-station man has found that for a 10-horsepower motor he can SAVE THE INVESTMENT of about one hundred dollars by distributing and supplying current to the motor single phase instead of polyphase?
That, therefore, SINGLE-PHASE SERVICE INSTALLATIONS ARE THE SIMPLEST, MOST ECONOMICAL AND THE LEAST EXPENSIVE INSTALLATIONS that central stations can put in for motor service?



Do You Know

That since the first of the year twenty-one of THE LARGER STATIONS east of the Alleghanies HAVE DECLARED IT THEIR POLICY TO INSTALL SINGLE-PHASE MOTORS exclusively, this decision entirely reversing their former policy in several cases?
That these changes in policy were decided upon after carefully considering the above questions?
That twenty of these stations are using WAGNER MOTORS EXCLUSIVELY?

WAGNER SINGLE PHASE MOTOR FACTS

SPEAKING OF MOTORS

Do You Know

That the WAGNER MOTOR is the only SINGLE-PHASE, ALTERNATING CURRENT MOTOR that will start and pull up its full load from rest?
That the WAGNER MOTOR develops a STARTING TORQUE of more than four times its full load running torque, having starting characteristics similar to that of direct-current series motors?
That the WAGNER MOTOR can develop TWICE FULL LOAD STARTING TORQUE with a starting current not to exceed 1¼ times full load current by using an inexpensive accessory?
That the WAGNER MOTOR IS PERFECTLY AUTOMATIC, and delivers its torque to its pulley at the instant the switch is closed?
That the WAGNER MOTOR will operate satisfactorily when connected to single, two or three phase circuit?
That the WAGNER MOTOR, on account of the above facts, has been largely instrumental in deciding a large number of polyphase central stations against polyphase distribution where single-phase motors of the desired capacity can be obtained?
That no CONDENSER is necessary in connection with the Wagner motor?

Do You Know

That a CONDENSER is one of the most UNRELIABLE AND DELICATE pieces of electrical apparatus in the market? It is liable to break down at any moment.
That a number of single-phase motors now on the market depend absolutely on the condenser for starting, and WHEN THE CONDENSER GIVES OUT THE MOTOR IS WORTHLESS?

Do You Know

That even with a condenser, such single-phase motors DEVELOP ONLY ENOUGH starting torque to START the armature WITHOUT LOAD?
That the WAGNER MOTOR does not bring its armature up to speed and then by means of a friction clutch start its load? Such a device cannot be safe, reliable or practical in every instance.
That a split-phase motor DOES NOT DEVELOP a full load starting torque, and, therefore, cannot be used in all cases?
That the phase displacing coil is HEAVILY OVERLOADED in starting, and can only be kept in circuit A SHORT TIME, otherwise it will burn out?
That the WAGNER MOTOR is without a phase-splitting device or a friction clutch pulley?

Do You Know

That the WAGNER SINGLE-PHASE MOTOR, manufactured by the WAGNER ELECTRIC MANUFACTURING CO., ST. LOUIS, MO., is the only single-phase motor on the market that FULFILLS THE REQUIREMENTS of A.-C. MOTOR SERVICE, having demonstrated its worth in over seven years of satisfactory service?

Have you received our catalogues on MOTORS AND TRANSFORMERS? If not, let us know.

If there is anything more that YOU WISH TO KNOW, write to the

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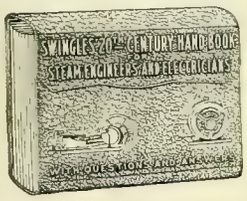
Three Extraordinary Books for Engineers and Electricians.

JUST FROM THE PRESS : : : New and Up to Date.

Written by Practical Engineers and Electricians in a language even a child can understand.

The 20th Century Hand Book for Engineers and Electricians.



A compendium of useful knowledge appertaining to the care and management of Steam Engines, Boilers and Dynamos. Thoroughly practical with full instructions. **By C. F. SWINGLE, M. E.** Formerly Chief Engineer of the Pullman Car Works. Late Chief Engineer of the Illinois Car and Equipment Co., Chicago.

ELECTRICAL DIVISION. The electrical part of this valuable volume was written by a practical engineer for engineers, and is a clear and comprehensive treatise on the principles, construction and operation of Dynamos, Motors, Lamps, Storage Batteries, Indicators and Measuring Instruments.

Swingle's 20th Century Hand Book for Engineers and Electricians. Over 300 illustrations. Handsomely bound in full leather pocket-book style. Size, 5x6¾x1 inch thick. **PRICE NET, $2.50.**

Dynamo Tending for Engineers, Or, Electricity for Steam Engineers,

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The most important book on Electrical Construction Work ever issued. Modern

Wiring Diagrams and Descriptions for Electrical Workers.

By HENRY C. HORSTMANN and VICTOR H. TOUSLEY.

This grand little volume not only tells you how to do it, but it shows you.

This book tells how to wire for call and alarm bells.
For burglar and fire alarm.
How to run bells from dynamo current.
How to install and manage batteries.
How to test batteries.
How to test circuits.
How to wire for annunciators, for telegraph, telephone and gas lighting.
It tells how to locate "trouble" and "ring out" circuits.
It tells about meters and transformers.
It contains 30 diagrams of electric lighting circuits alone.
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It gives "Compensator" and Storage Battery installation.
It gives simple and explicit explanation of the "Wheatstone Bridge" and its uses as well as volt-meter and other testing.

It gives a new and simple writing table covering all voltages and all losses or distances, etc.

160 pages. Over 200 illustrations. Full leather binding. Round corners. Red edges. Pocket size, 4 x 6. Price net, $1.50.

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Lang switches are a product of experience, skilled labor and the best materials. Large stock. Complete line.

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Panel Boards, Tablet Boards, Cabinets, Fuse Blocks, etc. : : : : : :

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Motor Starter with Automatic Release. Manufactured under our own patents.

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And Special Controlling Devices of all kinds. Send for catalogue and discounts.

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We offer every facility for the proper introduction of Electrical Specialties to the Russian trade

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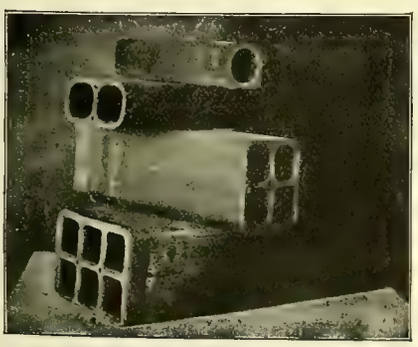
Manufacturers of



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IN 1, 2, 3, 4 AND 6 DUCT.

Superior Conduits for underground wires a specialty.

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Standard Vitrified Conduit Co.

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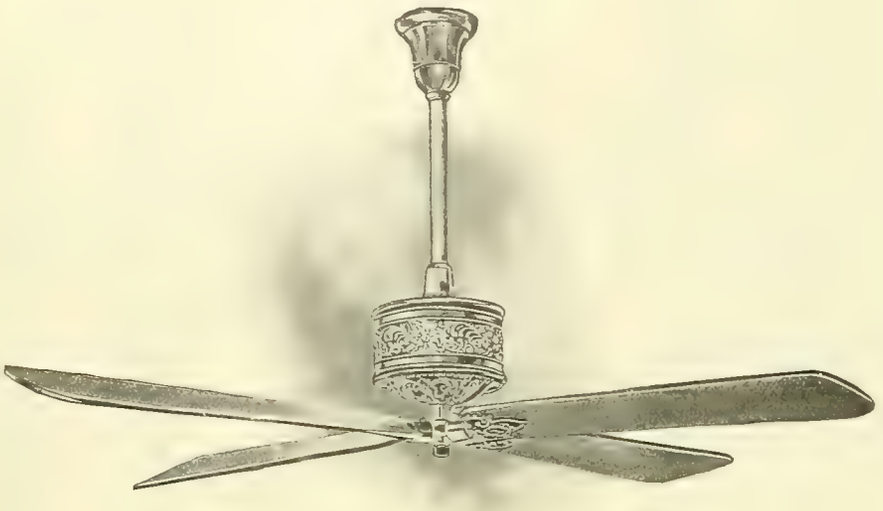
FOR 1904



Our new Type S Ceiling Fan is moderate in price, attractive in appearance and at the same time efficient, reliable and powerful. It has four blades of 58 inches sweep and a speed of 200 revolutions per minute. The black ornamental finish is black japan and the brass ornamental finish may be either brass or oxidized copper. For full description write for circular No. 30914.

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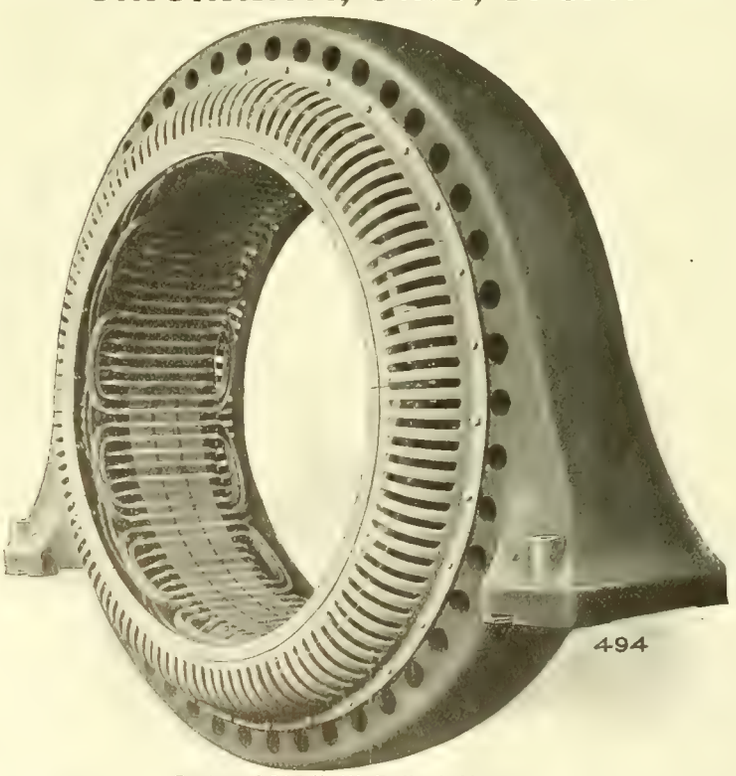

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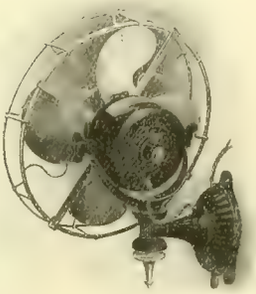
Builders of Direct and Alternating Current Apparatus

The Emerson Electric Mfg. Company

St. Louis, Mo.

Emerson Fan Motors

For Alternating Current.



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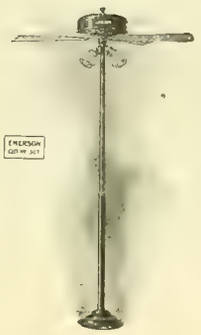
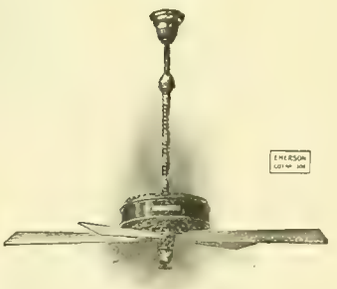
Two Speed. Automatic Start.
Highest Efficiency.

Two-Blade Ceiling and Column Fans.
Direct Connected.
Few Wearing Parts.



Four-Blade Ceiling and Column Fans.
Strong Breeze.
Two Speed.



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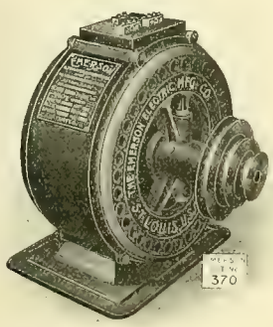

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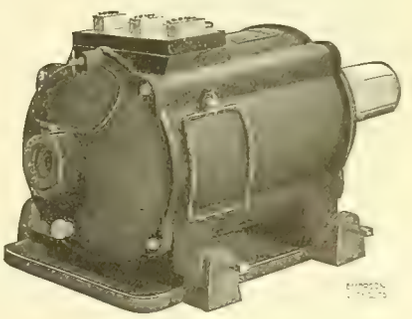

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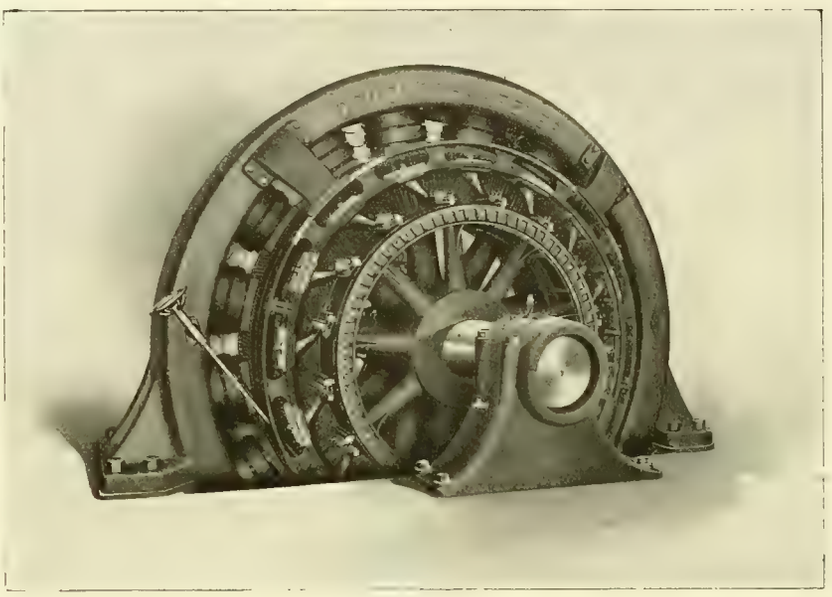
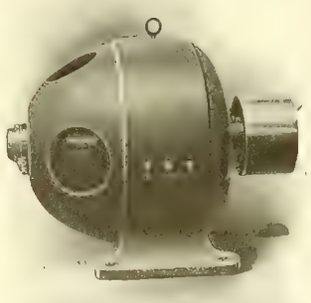


A 900-K. W. Generator

At our own exhibit and on many machine tools in various parts of the building will be seen C-W Motors operating under our

Multiple Voltage System of Power Distribution



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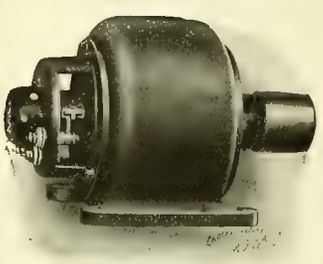

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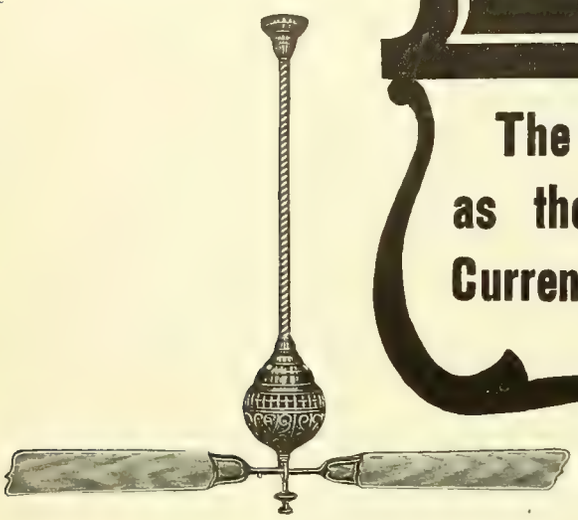

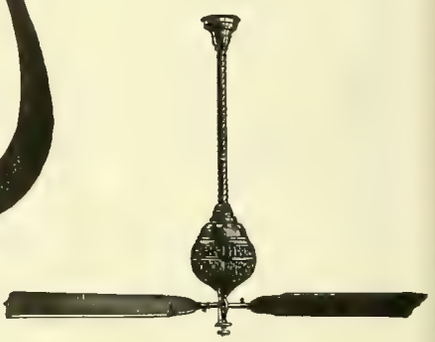

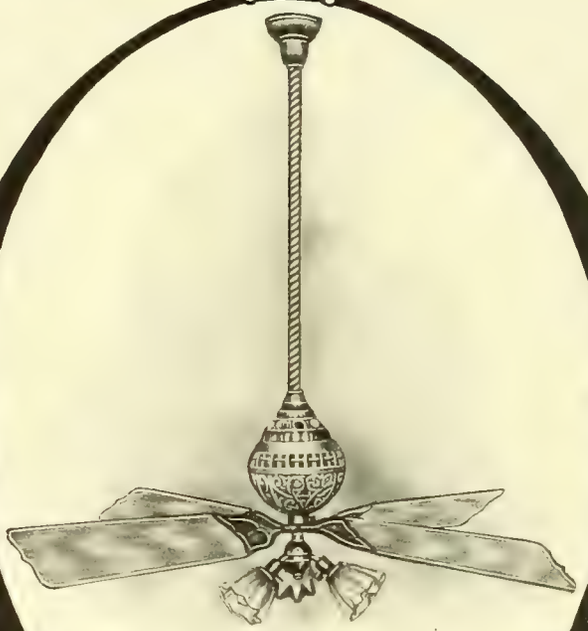

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Weston Patent Sustained and Jewell and Keystone Instruments Enjoined

The fundamental patent for the Weston Direct Current Electrical Measuring Instrument has just been sustained as valid by the United States Circuit Court for the Southern District of New York and as infringed by the direct-current instruments, both voltmeters and ammeters and of the portable and station type made by the Jewell Electrical Instrument Co. of Chicago, and by the Keystone Electrical Instrument Co. of Philadelphia.

On March 2nd, 1904, his Honor Judge Hoyt H. Wheeler held patent No. 392,387, dated November 6th, 1888, granted to Edward Weston for direct-current electrical measuring instruments and owned by the Weston Electrical Instrument Company, good and valid, and infringed by the various types of Jewell direct-current instruments.

The court said:—

"That this new arrangement of the coil upon pivots in this form of magnetic field, * * * was a great improvement on all or any prior electrical measuring instruments is very plain and obvious from an observation of the things which had gone before. It involved invention of high order and resulted in great success. Neither the anticipations relied upon, nor the alleged want of patentable novelty, seems to defeat or affect the validity of the patent for this improvement * *.

Decree for the plaintiff. Hoyt H. Wheeler, J."

On April 2nd, 1904, the same court by his Honor Henry E. Lacombe, Circuit Judge, granted a motion for preliminary injunction in Weston Electrical Instrument Co. vs. J. Franklin Stevens and another, doing business as the Keystone Electrical Instrument Co. The instruments involved were all of the various types of Keystone direct-current electrical measuring instruments.

The court said:—

"Without now making any decision as to the other claims it is held that 8, 12 and 13 are valid and infringed by defendant's structure, which certainly is as close if not closer, to device of the patent than was the infringing structure in the Jewell case."

The Weston Electrical Instrument Co. has granted no licenses to any other manufacturers to make or sell its movable coil, direct-current electrical measuring instrument and all such instruments are unauthorized and are an infringement of the Westonpatent No. 392,387.

All who deal in such infringing instruments and all who hereafter put into use any such infringing instruments, and also all who continue hereafter to use infringing instruments previously installed are guilty of infringement and will be held to strict accountability by the Weston Electrical Instrument Co.

The Weston Electrical Instrument Co. is prepared promptly to supply the entire demand for direct-current electrical measuring instruments of all types and for all uses.

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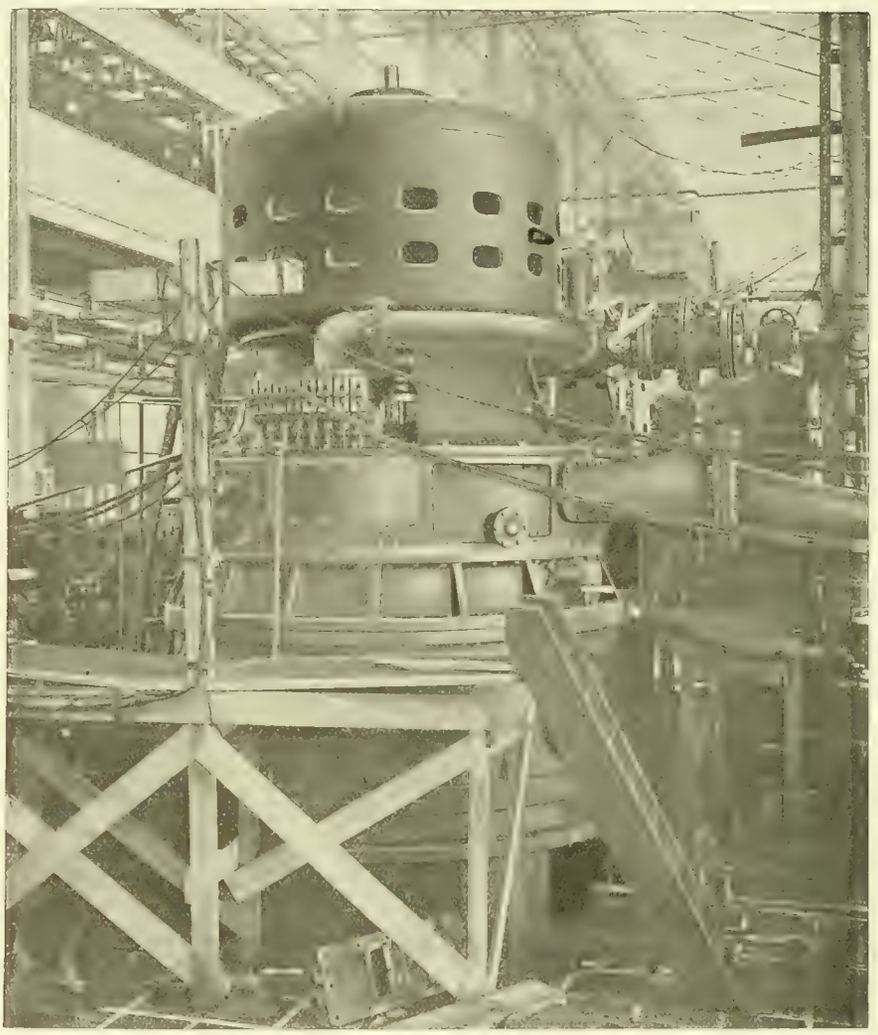

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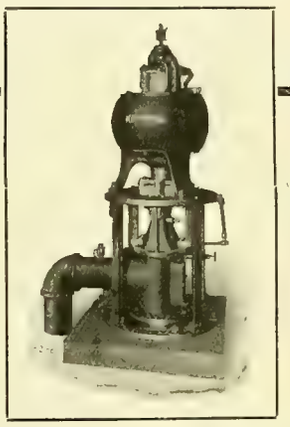

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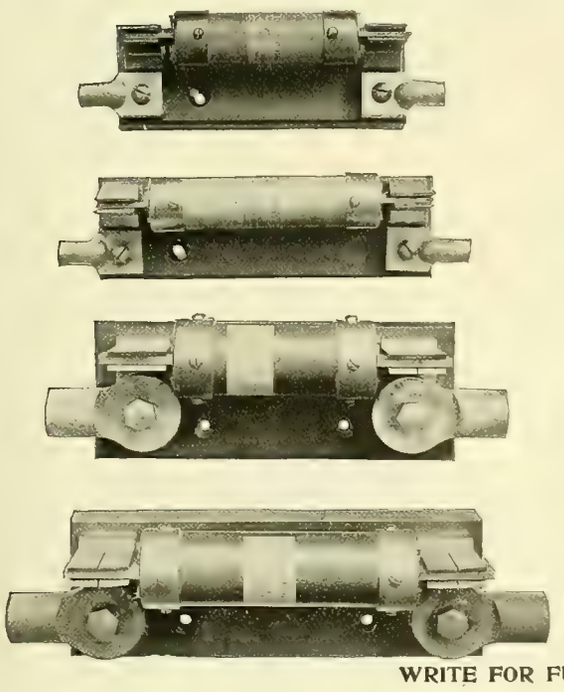

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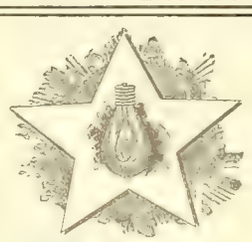

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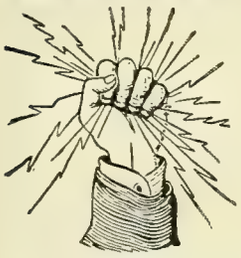

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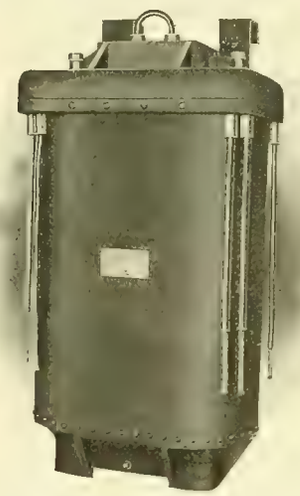

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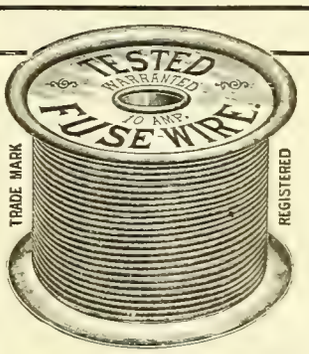

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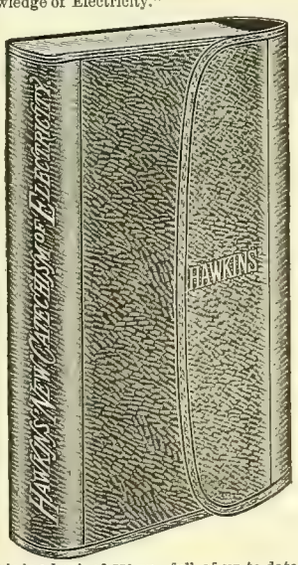

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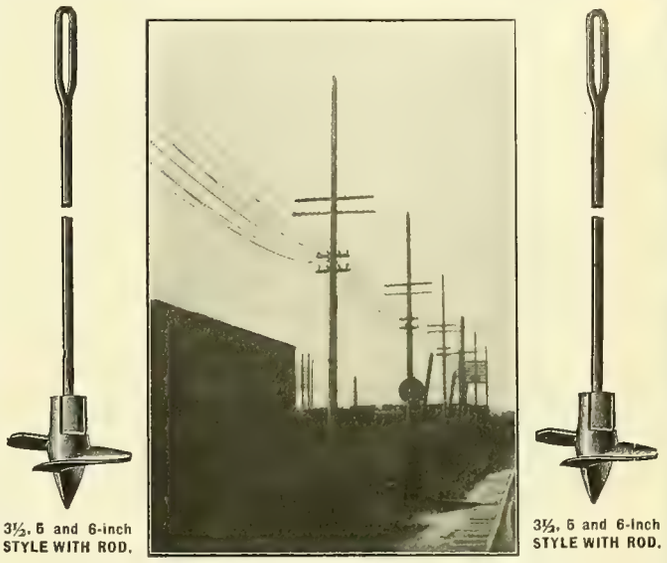

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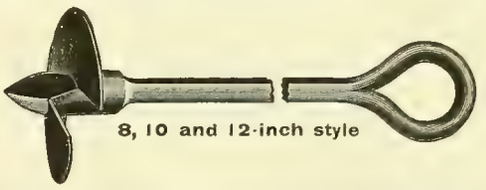

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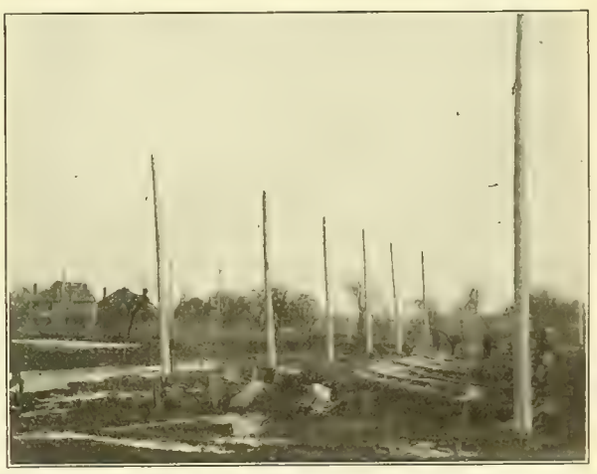

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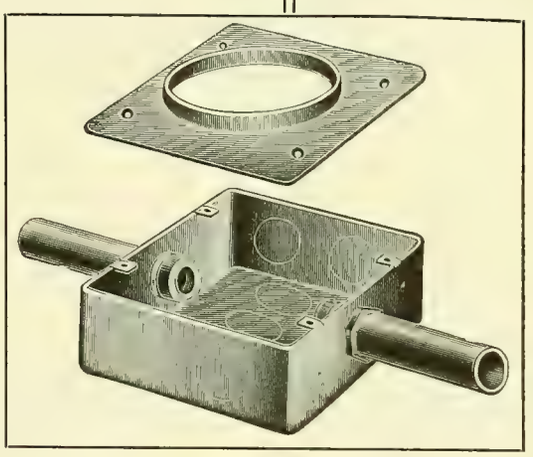

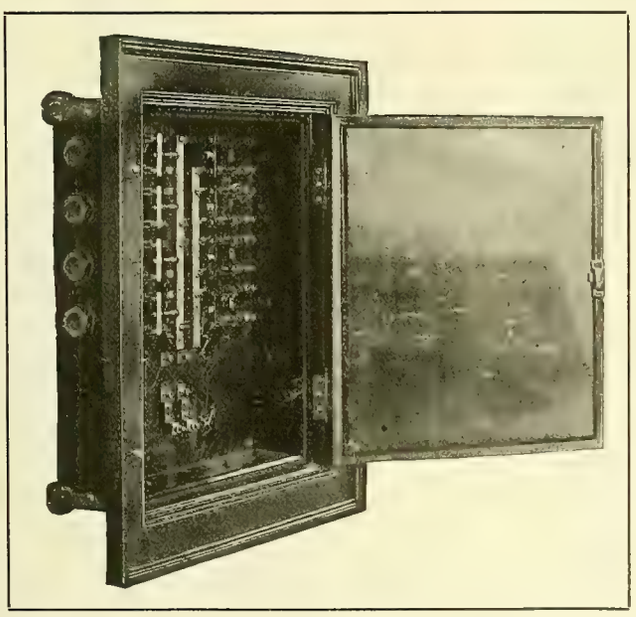

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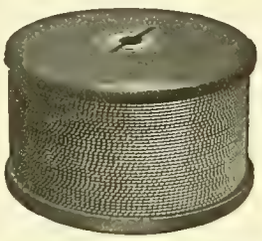

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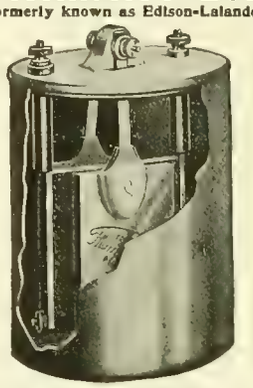

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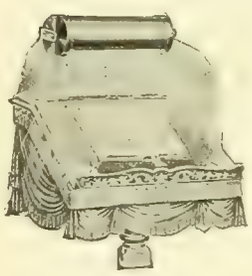
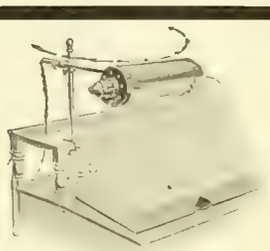


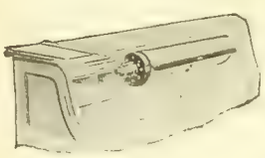
No. 16. Pulpit Lamp.



No. 24. Bookkeepers' Desk Lamp.

No. 22. Ward Portable Desk Lamp

No. 18. Portable Lamp.



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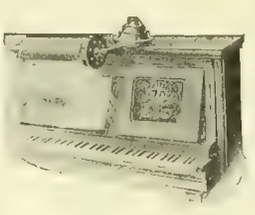
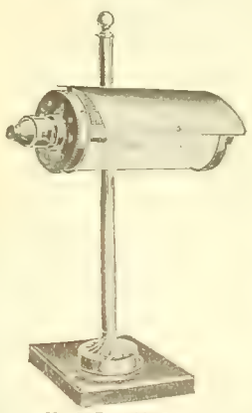
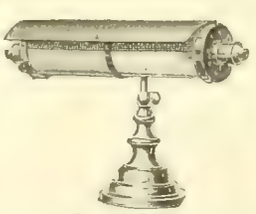


No. 9. Portable Lamp.

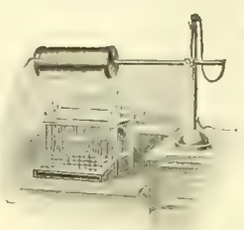


No. 5. Portable Lamp.

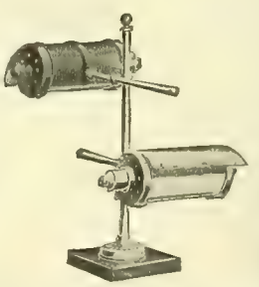
No. 1. Kinsman Desk Lamp.



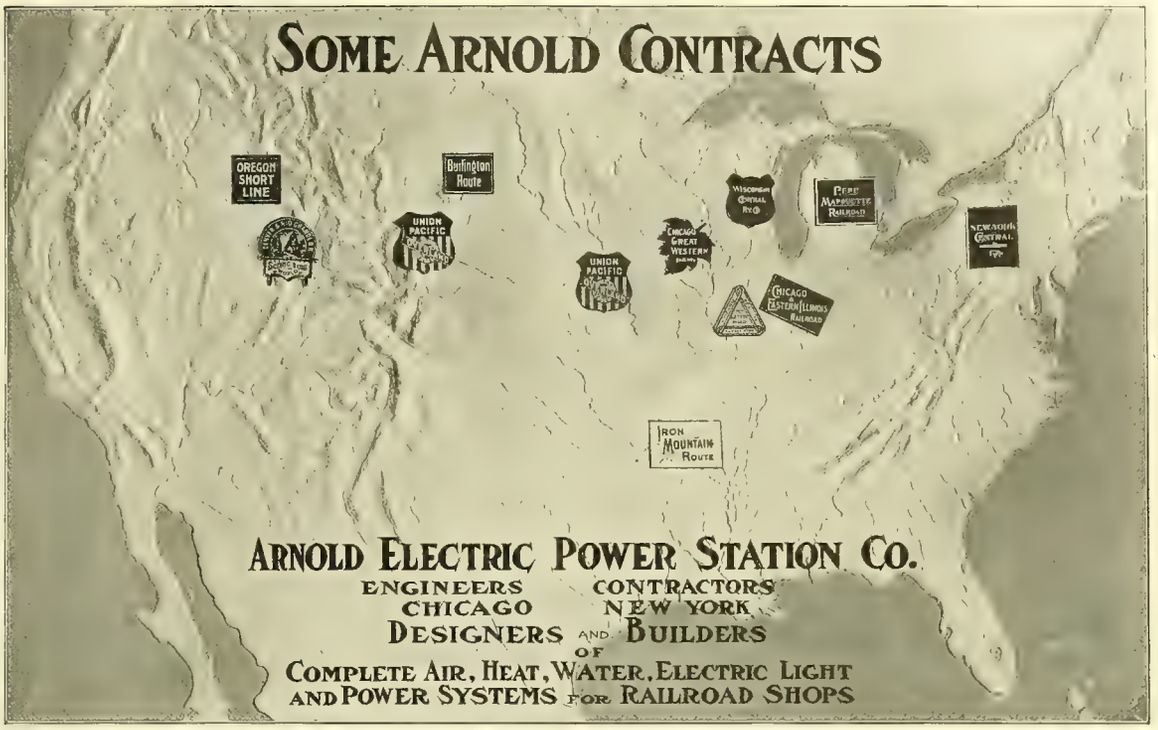
Portable Lamp.



No. 25. Typewriters' Desk Lamp.



No. 8. Double Head Portable Lamp



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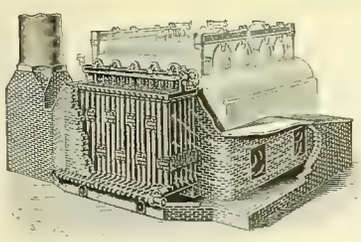

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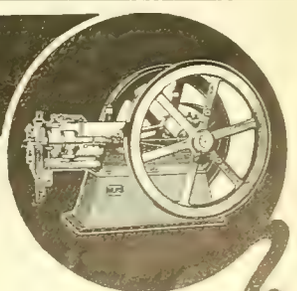

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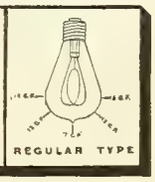

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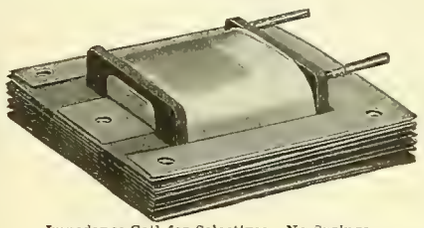

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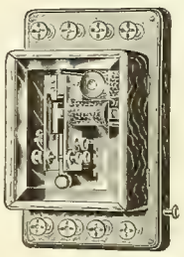

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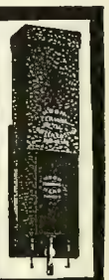

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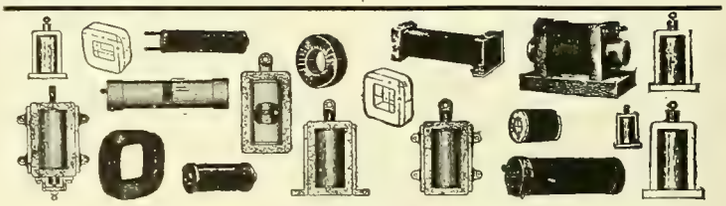

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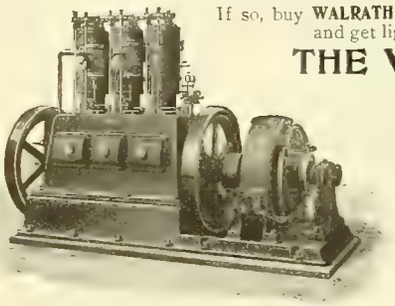
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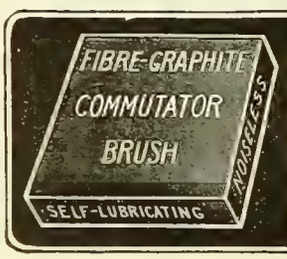

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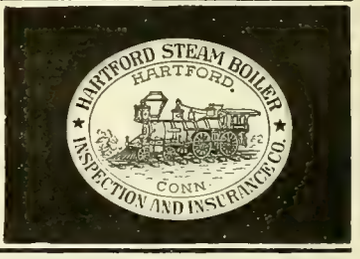

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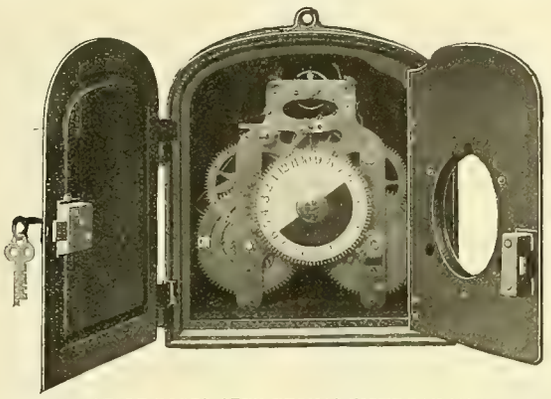

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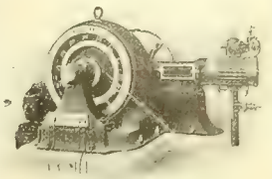

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In a recent advertisement we mentioned that the Perkins Socket Patent No. 626,927, had been sustained by a United States Circuit Court, which directed the issuance of an injunction against the defendants, J. F. Buchanan & Co., "selling the Yost sockets."

The Yost Electric Mfg. Co. of Toledo, Ohio, complains that we should not have said "Yost sockets," but should have said "the Dixon socket which had been manufactured by the Yost-Miller Co." We agree that it would have been correct to speak of the socket sold by the Buchanans when the suit was commenced in 1902, as the "Dixon socket which had been manufactured by the Yost-Miller Co." A year or more ago, as we understand, the Yost Electric Mfg. Co. succeeded the Yost-Miller Co., acquired from it the Dixon socket patent, and took up the defense of this Buchanan suit, after which the Yost Electric Mfg. Co., dropping the name "Dixon," put out under the name "Yost," a socket the same as the Dixon in all essential points now covered by the Buchanan decision. While, therefore, it would have been correct to speak of the enjoined socket as the Dixon socket, we believe it was not improper to indentify it by its other name of "Yost." However, the omission to use the name "Dixon" or the name "Yost-Miller Co." was not intentional.

We have now brought suit against the Yost Electric Mfg. Co. on this Perkins patent to enjoin the manufacture and sale of their "Yost" socket.

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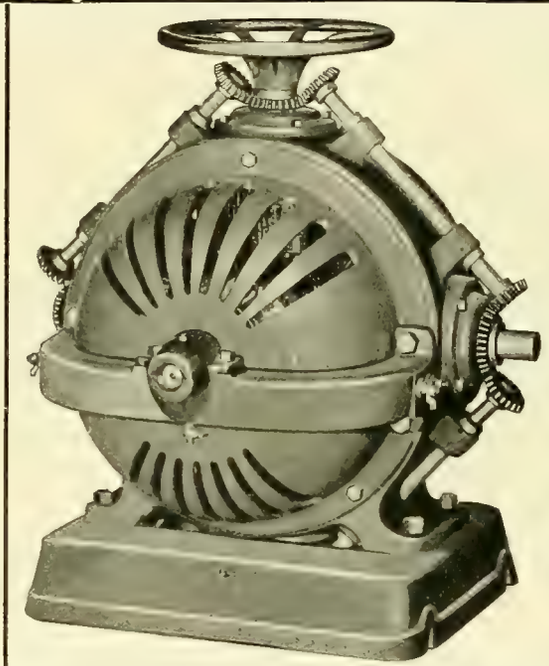

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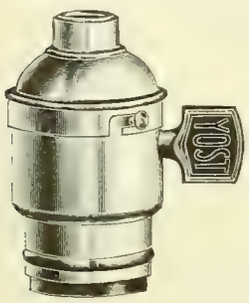

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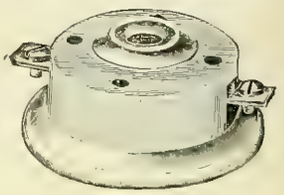

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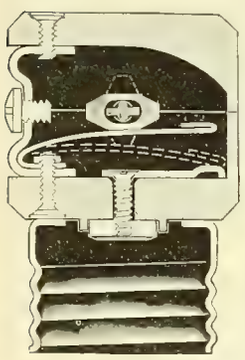

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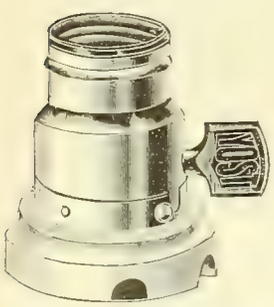

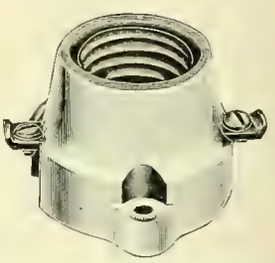

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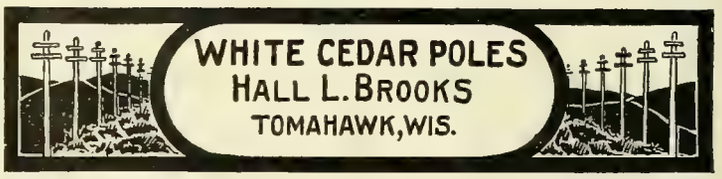

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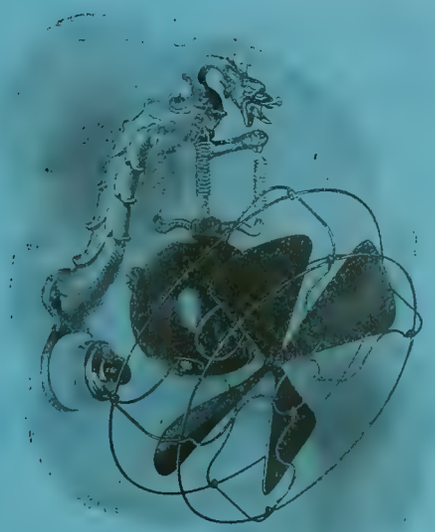

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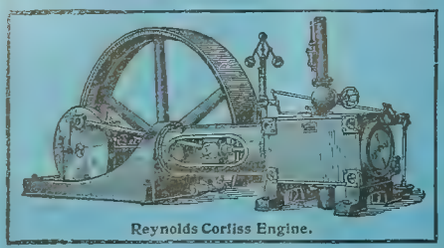
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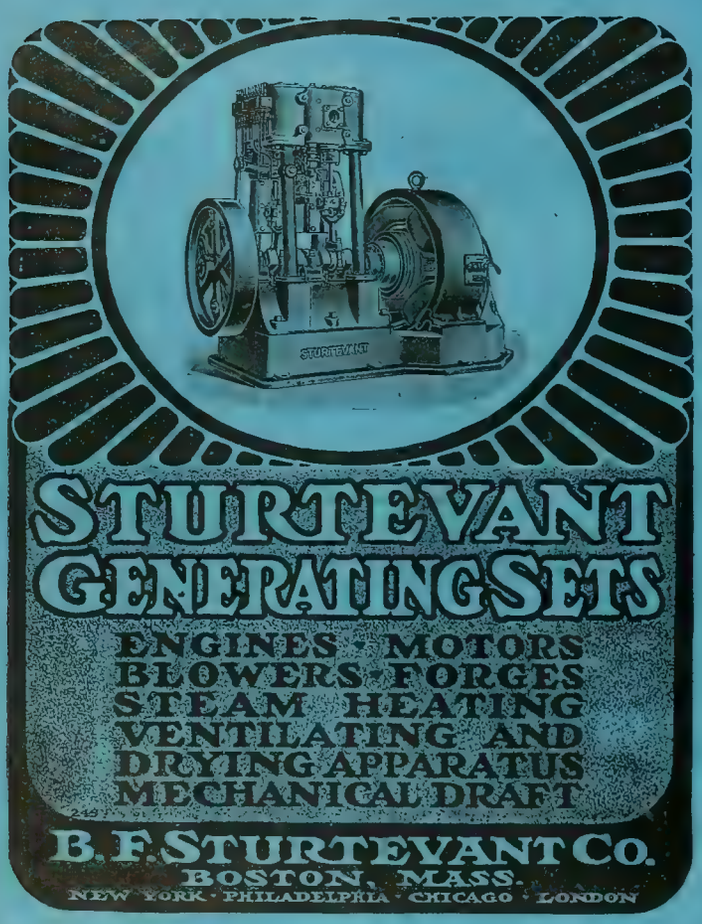

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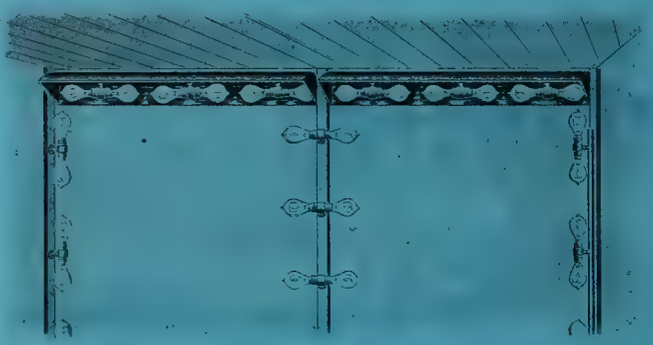

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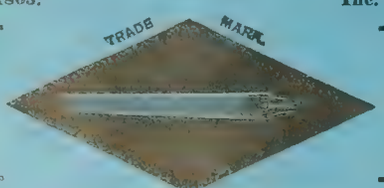

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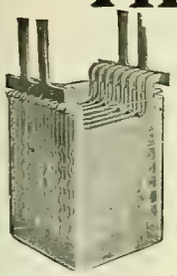

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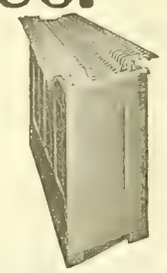

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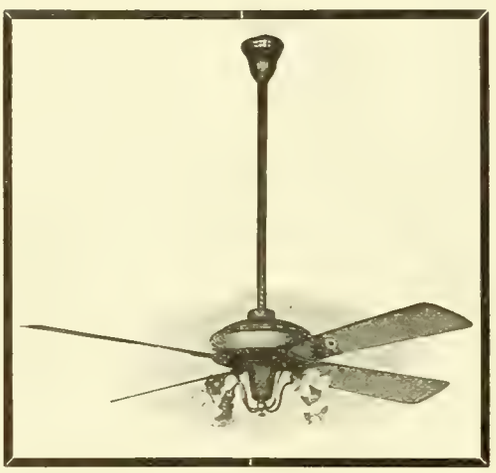

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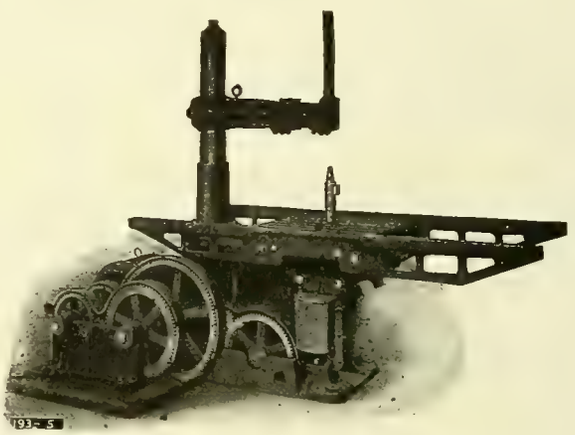

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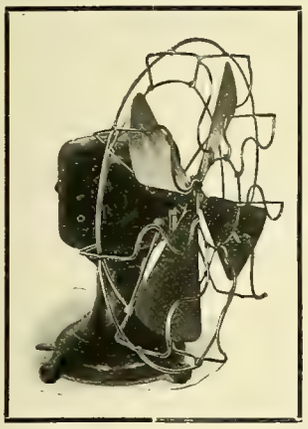

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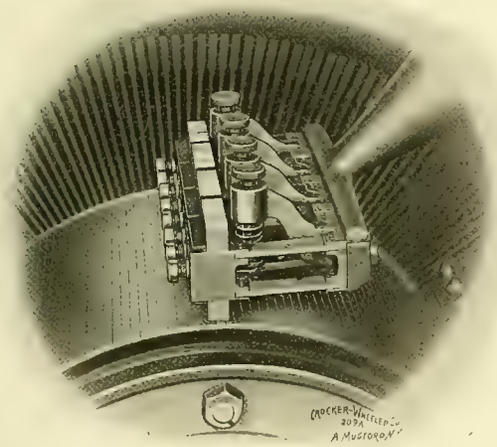

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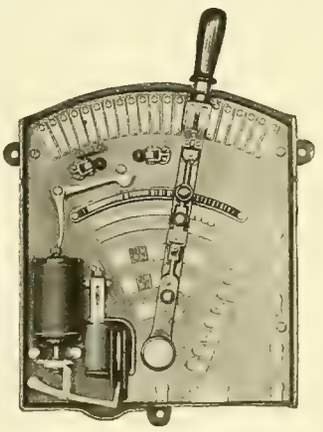

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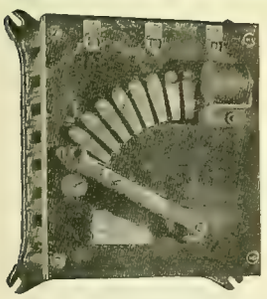

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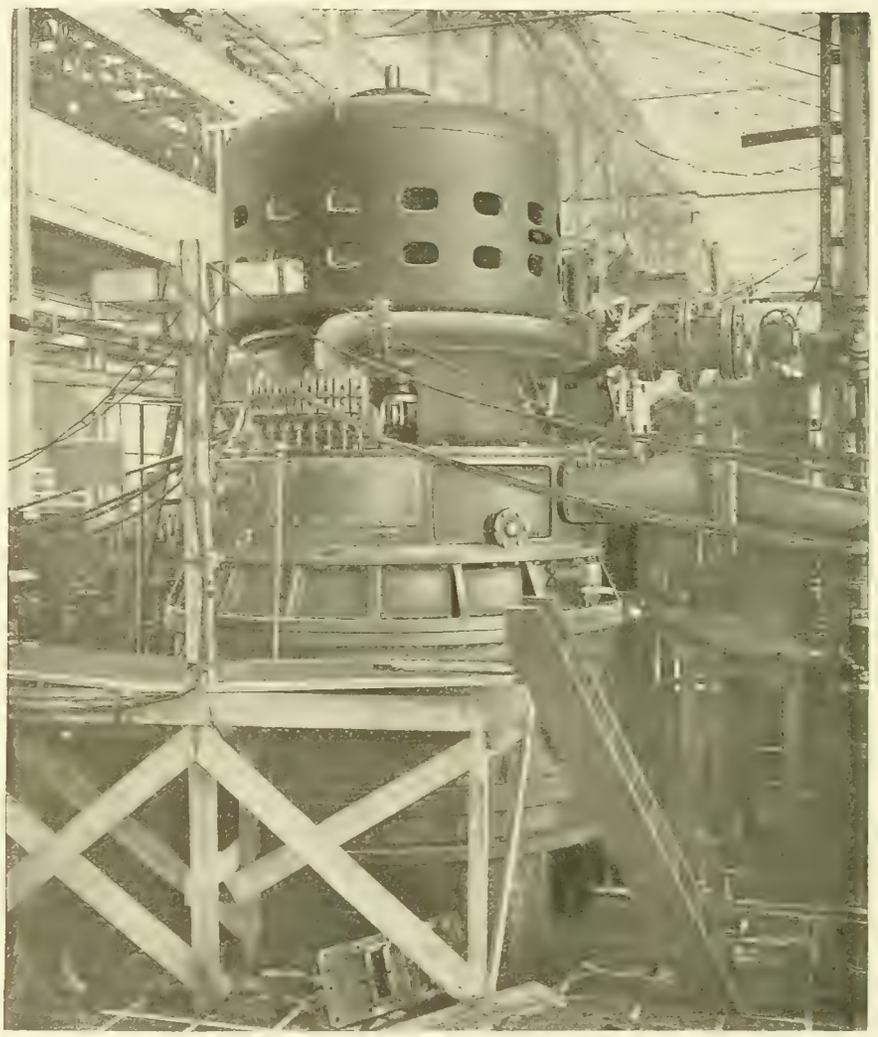

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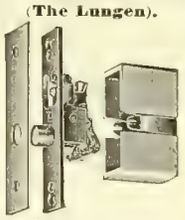

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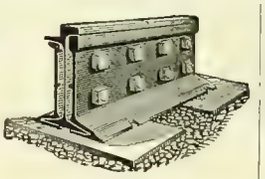

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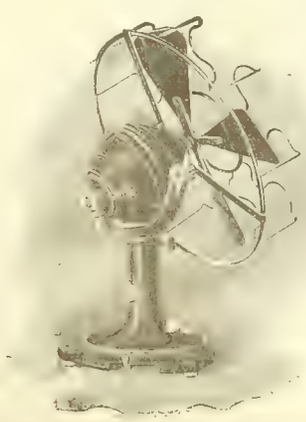

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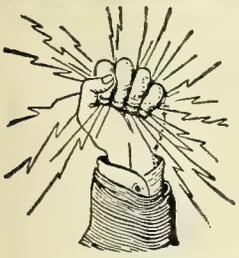

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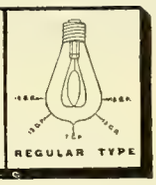

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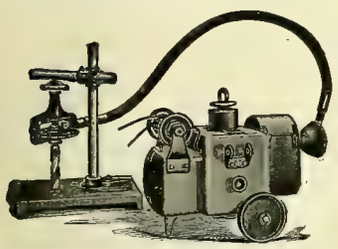

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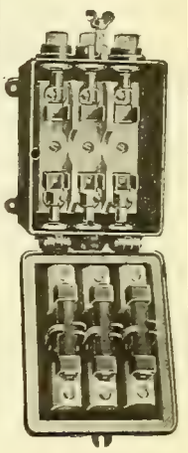

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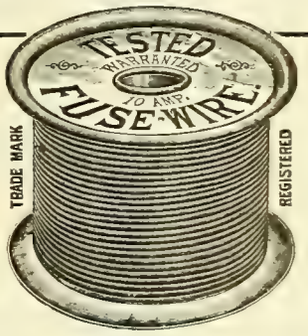

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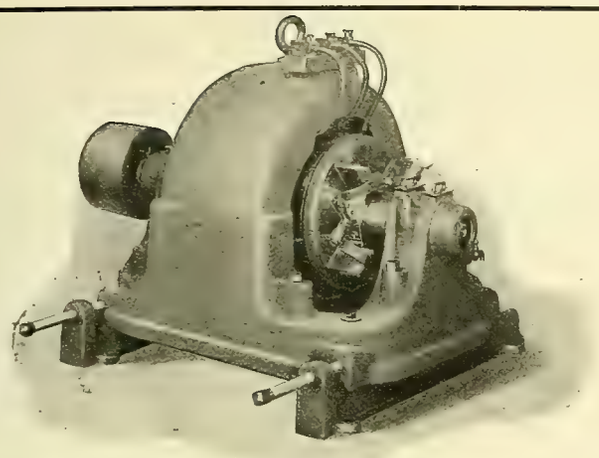

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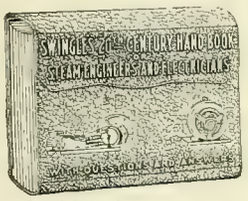

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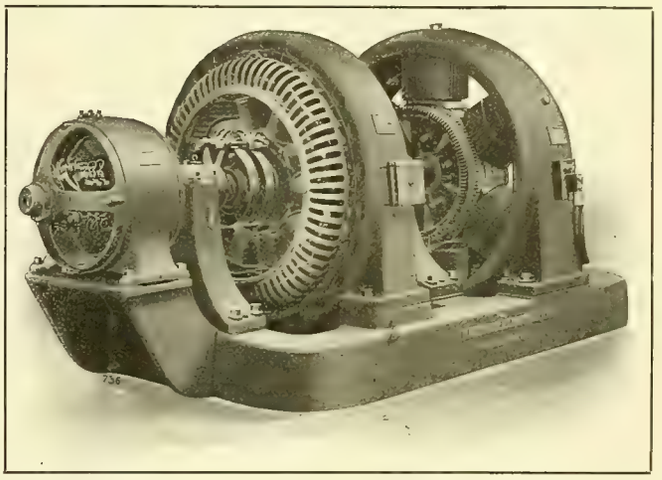

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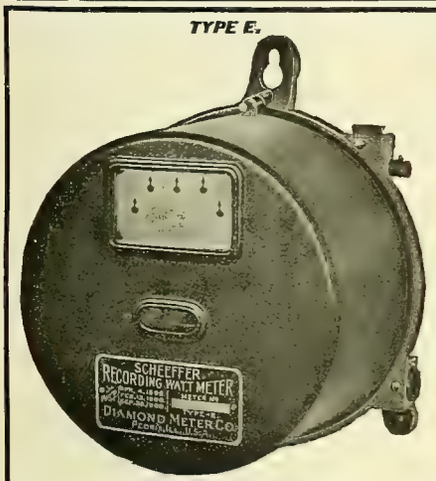

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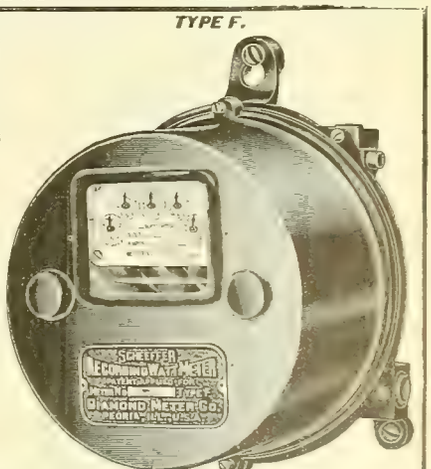

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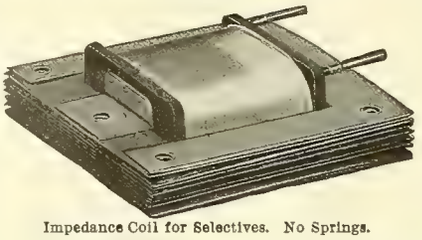

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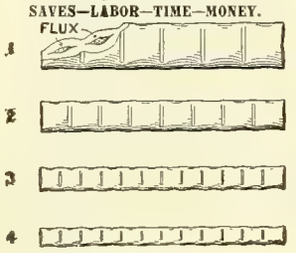

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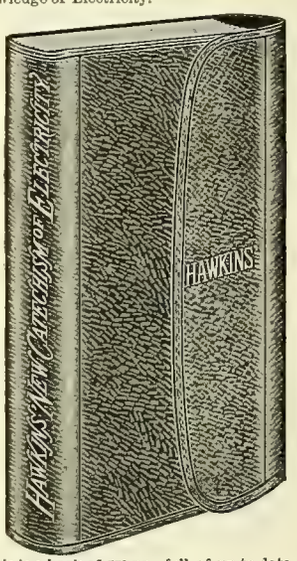

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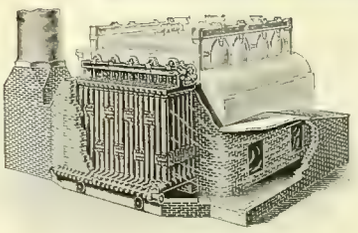

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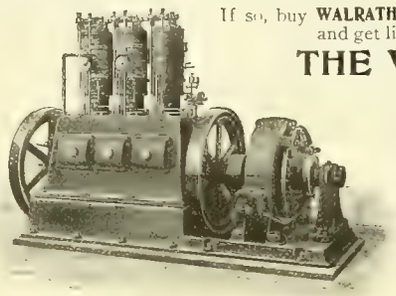

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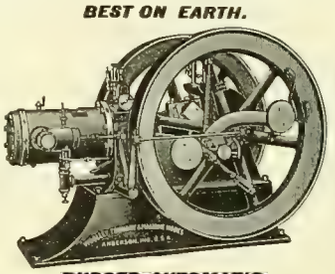

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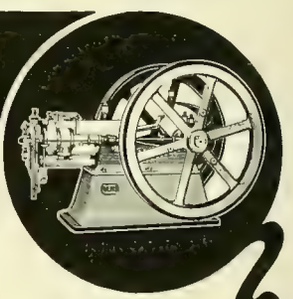

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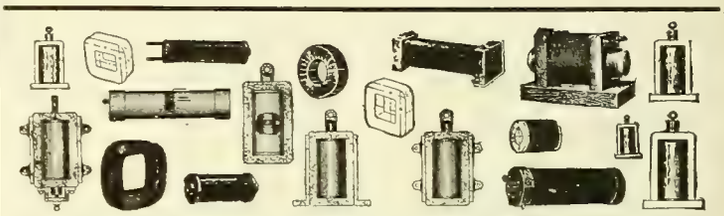
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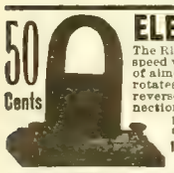
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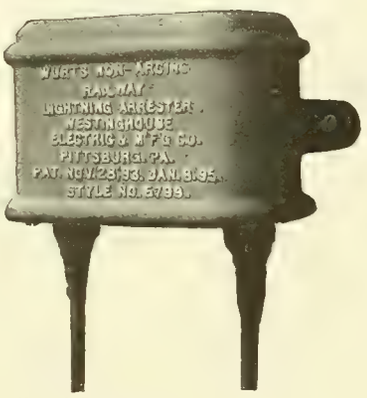
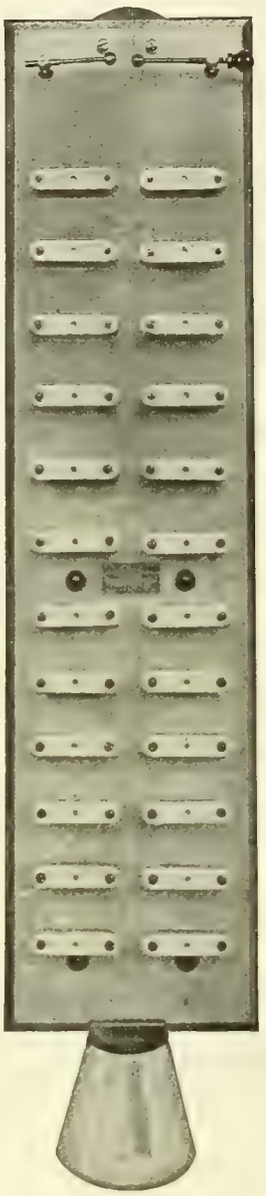


Type L Railway Arrester, Direct Current.



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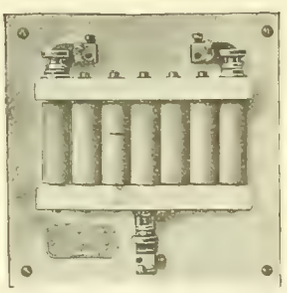
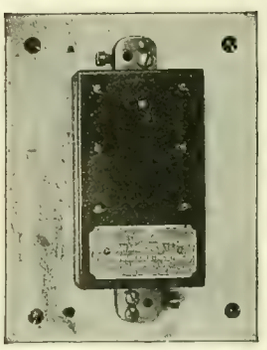


Type A Station Arrester, Alternating Current.



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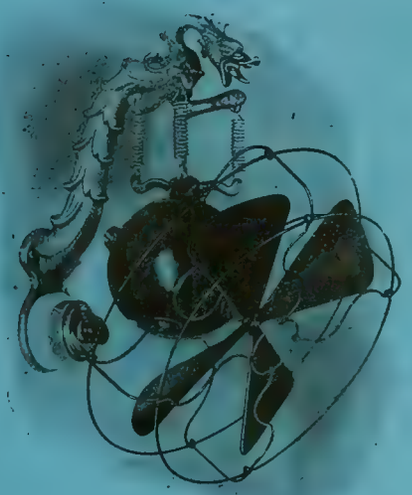

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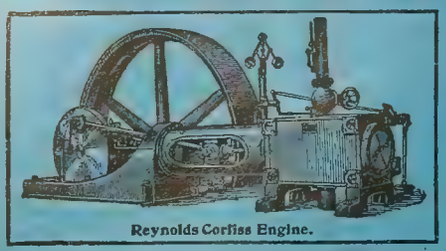
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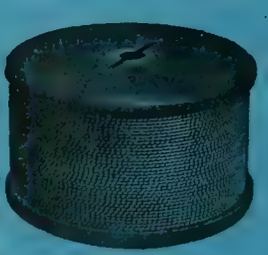

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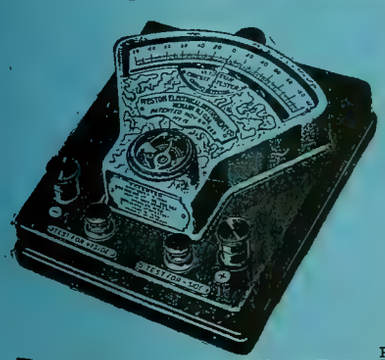

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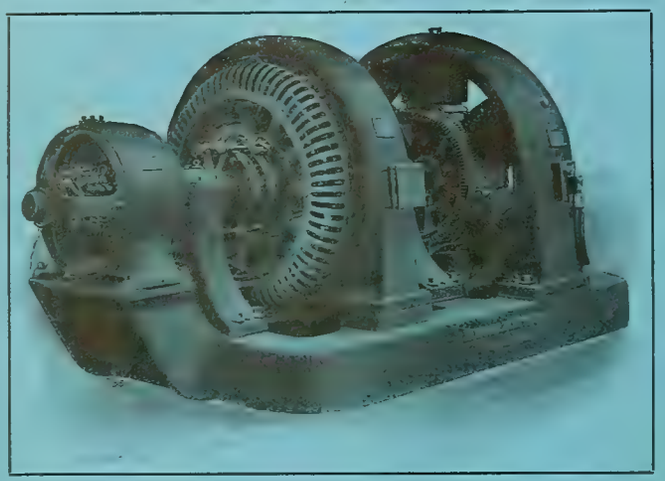

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As usual the WESTERN ELECTRICIAN will pay special attention to this annual event, and it will be covered by our issues of May 21st, May 28th and June 4th. The issue of May 21st, which will be distributed at the convention, will be a most pleasing one to every central station man and others interested in electric lighting and power work. It will contain specially written articles on up-to-date subjects, and other features which will make it one of the most interesting issues of the year.

Our issues of May 28th and June 4th will contain a complete report of the proceedings.

Every manufacturer and dealer wishing to increase his business should be largely represented in the advertising columns of these important numbers. Realizing the importance of this convention, a number of advertisers have already arranged for space in these issues.

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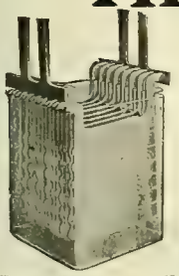

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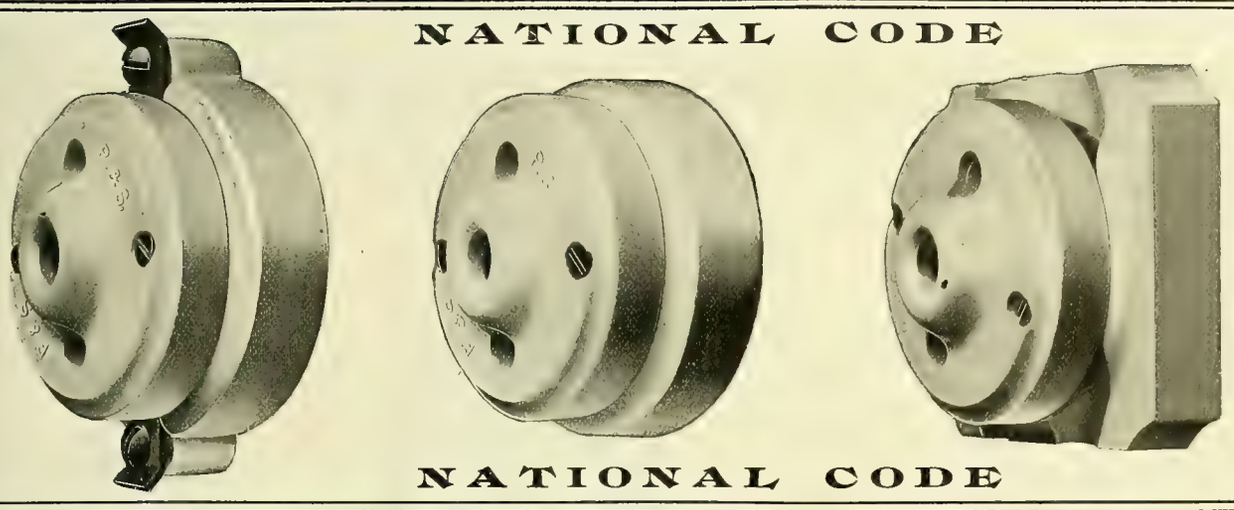

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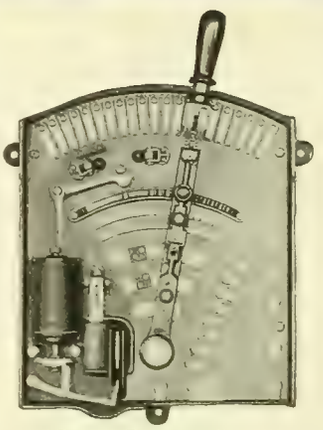

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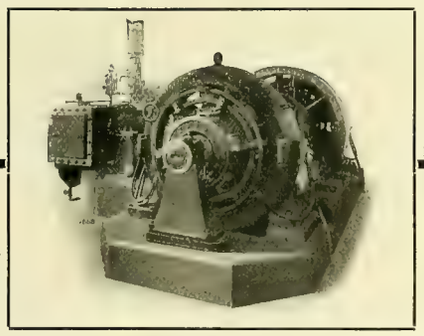

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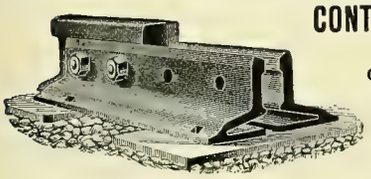

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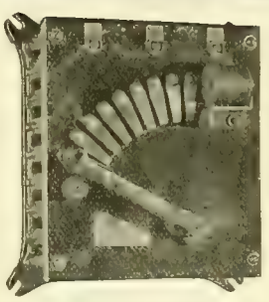

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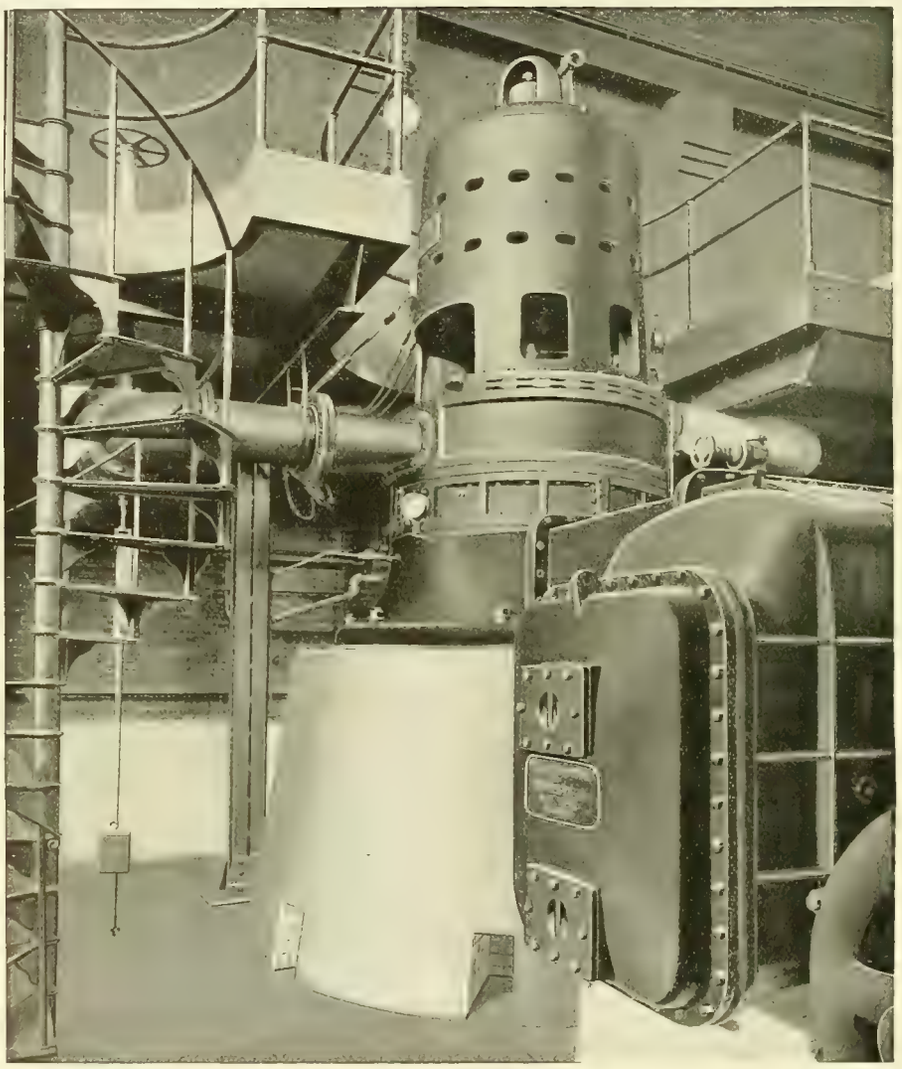

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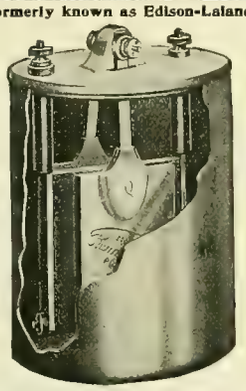

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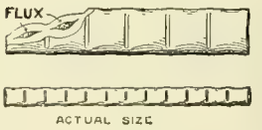

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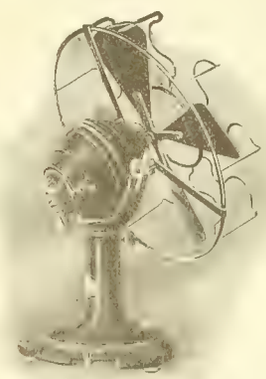

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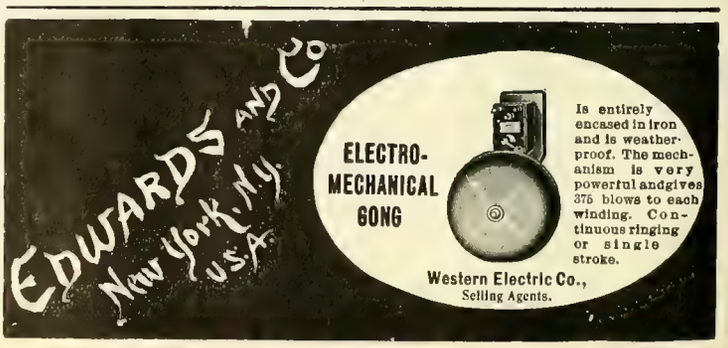

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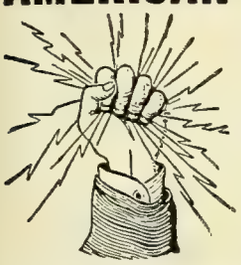

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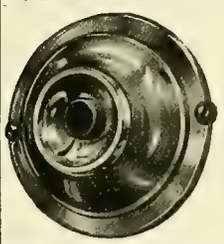

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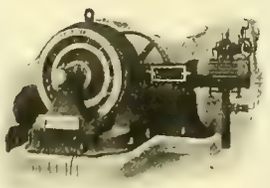

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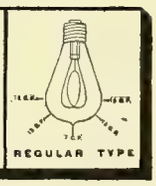

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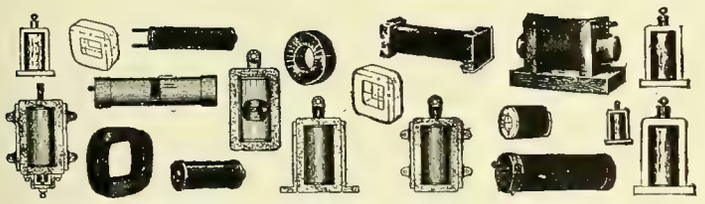

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POSITION WANTED.

Taking charge of an electric light plant, familiar with all branches connected with it. Capable of doing inside or outside wiring. If not entire charge in plant would like general construction work. Have had ten years experience. Good references can be given. Address BOX 341, care of Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By a young man of good character, first-class wire man and line man. Have completed course Int. Cor. Schools. Over three years' experience in wiring, line work, installing a. c. and d. c. motors, meters, arc lamps etc. Can calibrate meters. Best of references and will go anywhere. Good knowledge of engines and boilers and familiar with both a. and d. c. apparatus. Prefer position as chief electrician in plant of about 1,500 k. w. capacity. Will take position as superintendent of small plant. Address BOX 344, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By first-class electrician with vast experience with light and power plant, conversant with general repair of electrical machinery, thoroughly understands care and economical management of the same; strictly sober and reliable; best reference as to character and ability. Address BOX 343, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent of electric light or water works plant; have had 16 years' experience in electric light business, and 18 years in handling boilers engines and water works machinery and understand the business from the coal pile up. Will guarantee results as to economy and service furnished. Address BOX 342, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent of electric plant. Have had fifteen years' experience in various kinds of electrical work, and am competent to do wiring and all difficult repairing. Address BOX 346, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent or electrician of light and power plant, of 300 to 400 h. p., within 500 miles of Chicago. Have had four years experience in station equipment and six years in maintenance. A. C. work in all its branches. Storage batteries a specialty. References. Address BOX 347, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED

Young man (25) at present manager of power, lighting and waterworks plant, wishes change of locality and would like situation with some municipal plant or company. Steady. Good references. Address BOX 333, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

Capable young man (married), at present holding good position, desires permanent location as superintendent of lighting or power plant. Eleven years' experience with various systems in construction work. Good references Prefer central West or South. Address BOX 340, care of Western Electrician, 510 Marquette Bldg., Chicago.

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Three experienced incandescent lamp salesmen, by an old and well-established company not in the trust. Applicants will please state age, experience and salary wanted. Address BOX 198, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Engineer to take charge of new 10,000-horse power electric power plant. Applicant must have had experience operating large Corliss engines in electric power plants and have ability to handle men. Address BOX 339, care of Western Electrician, 510 Marquette Bldg., Chicago, stating fully past experience and salary wanted

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A-1 traveler to handle new electrical device as a side line. Good seller. One hundred dollars per month guaranteed. Must be willing to invest from one to two thousand dollars in light manufacturing business. References required. Address BOX 345, care Western Electrician, 510 Marquette Bldg., Chicago.

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IN CONJUNCTION WITH

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Allow me to compliment you on the circulation of the "Western Electrician" and its efficiency as an advertising medium. We had our plant advertised in other electrical journals, but the inquiries brought through our ad in your columns far exceeded in numbers those of any other paper.

Very respectfully,

Bruce H. Yowells.
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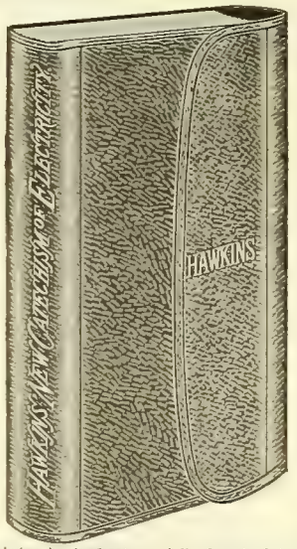

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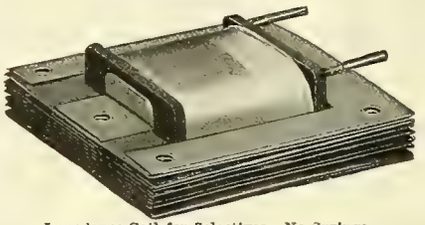

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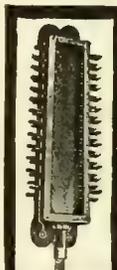

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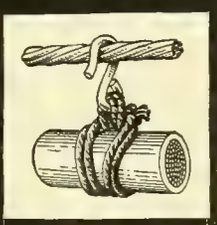

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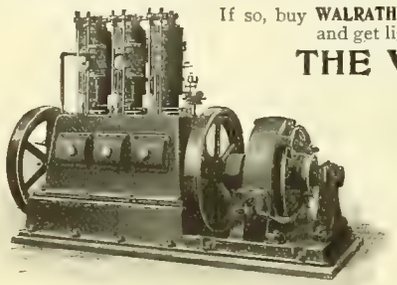

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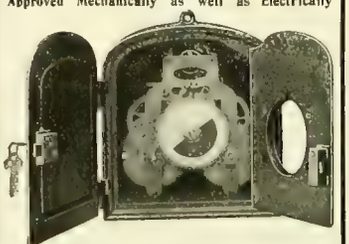

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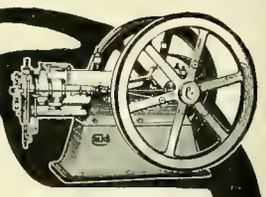

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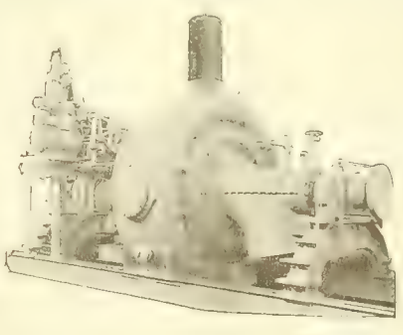

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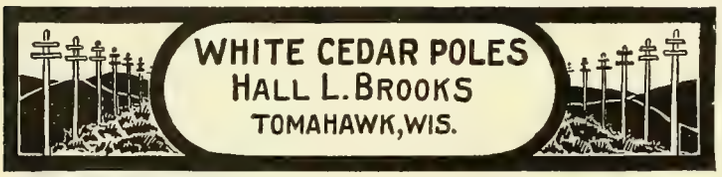

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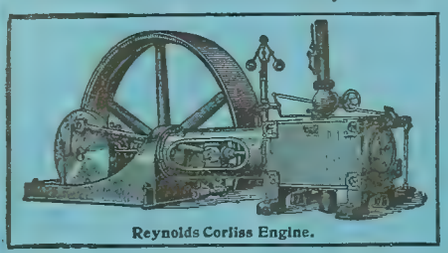
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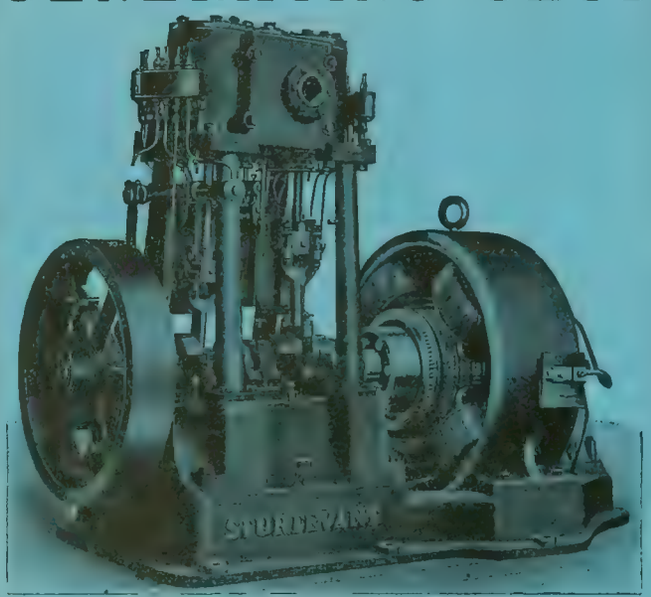

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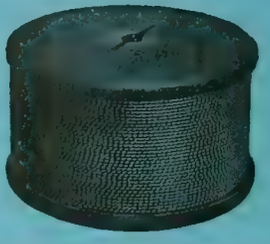

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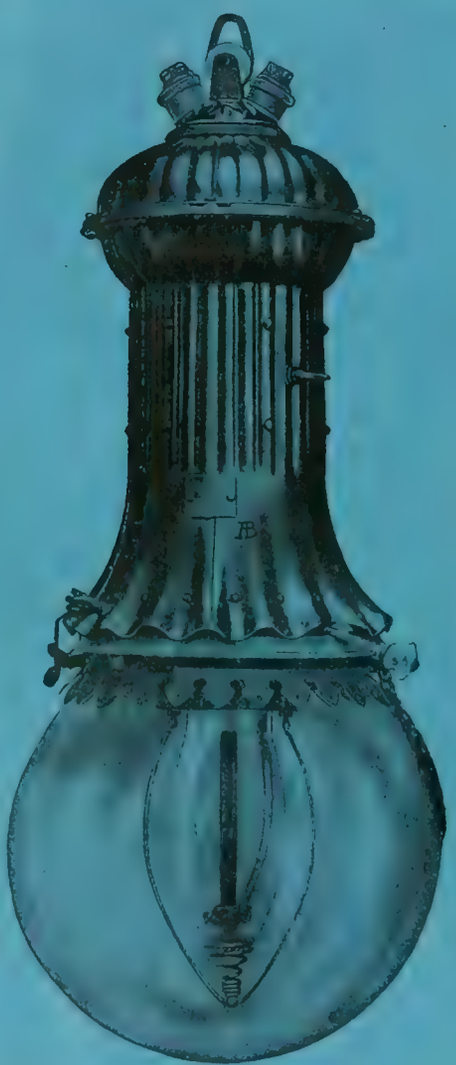

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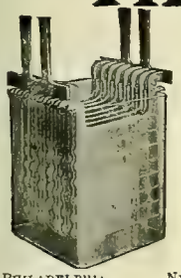

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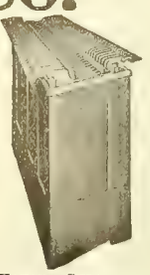

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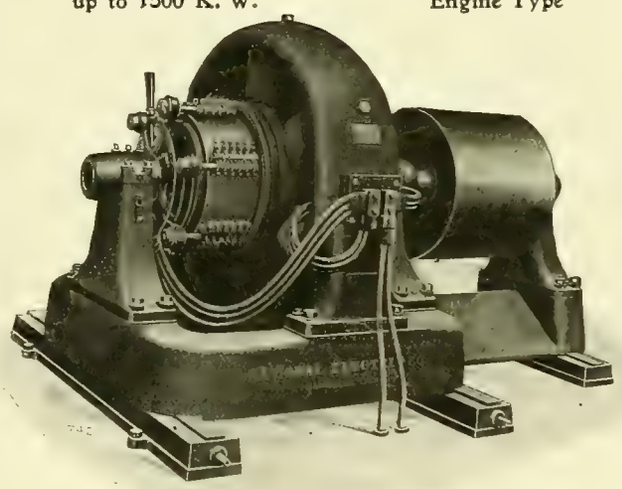

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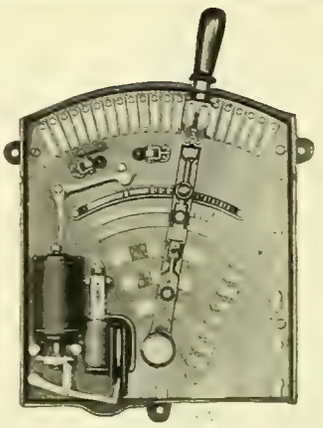

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No arcing on contact surfaces.
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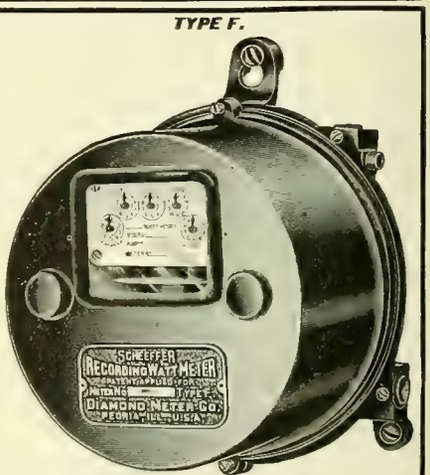

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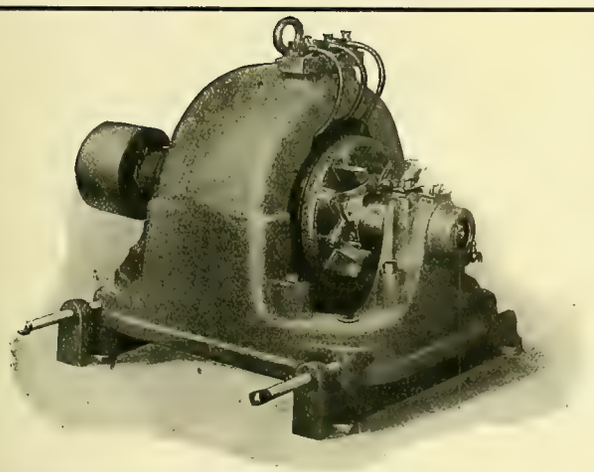

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Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

Wagner Electric Mfg. Co.

ST. LOUIS, MO., U. S. A.

Don't fail to be represented in the Western Electrician National Electric Light Convention number issue of May 21. May 28 and June 4.

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Recording Wattmeters For Alternating Current Circuits.

ROTATING PARTS FLOATING IN AIR

NO LOST REVENUE NO FRICTION NO WEAR

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JNO. MARTIN & CO., San Francisco
Colorado, Idaho, Montana, Wyoming, New Mexico, Utah.
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GOULD STORAGE BATTERY CO.

Complete Storage Battery Plants.

Railway Line and Regulating Isolated and Train Lighting, Central Lighting and Power, Electric Vehicles.

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WORKS: DEPEW, N. Y.

Bulletins.

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Belting.
Leather Preserver Mfg. Corp

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Simplex Elec. Heating Co.
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Sprague Electric Co.
Westinghouse El. & Mfg. Co.

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Sprague Electric Co.
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Wesco Supply Co.
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Western Elect. Supply Co.
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Beardslee Chandelier Mfg.Co.

Flashers.
Haller Machine Co.
Reynolds El. Flasher Mfg.Co

Flexible Shafts.
Stow Mfg. Co.

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Sturtevant Co., B. F.

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Central Electric Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg.Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

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Haller Machine Co.
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Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

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Holmes Fibre-Graphite Co.

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Amer. District Steam Co.

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Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

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Hartford Steam Boiler Inspection & Insurance Co.

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Hanson & Tunelius Mach.Co.
New England Butt Co.

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Kartavert Mfg. Co.
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Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
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Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Perkins Electric Switch Mfg. Co.
Shelby Electric Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

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Haller Machine Co.

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Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Western Electric Co.

Linemen's Climbers.
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Magnet Wires.
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Mica Insulator Co.
Munsell & Co., Eugene.

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Crocker-Wheeler Company.
General Electric Co.
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Western Electric Co.
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Klein & Sons, Mathias.

Novelties, Glass, Elec.
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Ithaca Elect'l Novelty Co.

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Bain, Foree.
Johnston, Thomas J.

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Phosphor Bronze Sm. Co.Ltd.

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Allen Co., Inc., L. B.
Hoffman, Geo. W.

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Jeffrey Mfg. Co.

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Continuous Rail Joint Company of America.

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Gt. West Smelt. & Refining Co

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Northwestern Electric Co.

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General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

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Electrical Engineer Inst.
Michigan College of Mines.

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Cent. Stat. Improvement Co.
Dustin Co., Chas. E.
Gregory Electric Co.
Matthews & Bro., W. N.
Northwestern Electric Co.
Walsh's Sons & Co.

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Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

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Monson Burmah Slate Co.

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Pass & Seymour.
Yost Elec. Mfg. Co.

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Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

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Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

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Speed Indicators.
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Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
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Central Electric Co.
Fahnestock Transmitter Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
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Stromberg-Carlson Tel. M.Co.
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Western Electric Co.
Western Elec. Supply Co.

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Hartford Time Switch Co.

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Western Electric Co.

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Central Electric Co.
Crawfordsville Electric Co.
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Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

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General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines Water Wheels
Leffel & Co., Jas.

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Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wireless Tel. App'tus.
Clark Wirel.Tel.&Tel.Co.T.E.
National Elec. Signalling Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble . Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

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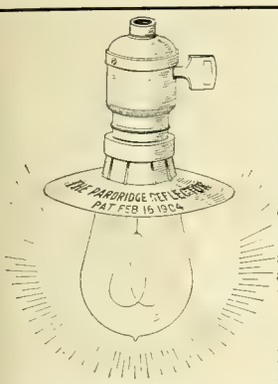


PARDRIDGE 4-inch Reflectors

Are the BEST Reflectors

Increases the light of any incandescent lamp 500 per cent. by scientific test.

Cheap, Small Indestructible

Fits on any incandescent lamp without a holder. Fits where no other reflectors will go. Just the thing for stores, show windows, show cases, offices, factories, private houses, railroads, elevated roads and electric surface lines. Two kinds, Nickel-plated and White Enameled.

SEND FOR CIRCULARS AND PRICE LISTS

THE PARDRIDGE EASY CORD ADJUSTER

Easiest, Cheapest and Best Cord Adjuster on the Market

Two samples free on receipt of 1 cent postage. Cards with winning numbers on must be returned to get prize: **1000** given to the holder of card No. **11150.** All other numbers in this list win from 10 to 100 Easies. Six cents postage must be sent with all cards drawing prizes.

PRIZE NUMBERS

12405	12404	12403	10234	10373	10429	10032	10256	12402	12368	12401
11001	11213	11036	10233	10122	10433	11412	10261	10761	10025	12429
10810	11239	11047	10227	10393	10432	11474	10265	11243	11798	12424
11496	11241	11052	10355	10401	10461	11726	10112	10131	10970	12425
11484	11242	11073	10357	10410	10191	11732	10119	10160	10846	12423
11427	11008	10987	10361	10420	10049	10476	10901	10052	10868	12419
11431	11018	10985	10874	10423	10035	10480	10908	10019	10465	12417
11192	11020	10983		10422		10254	12923	12924	10114	12416
11201	11026	10237							12120	12406
12371	11031									

SEND FOR CIRCULARS AND PRICE LIST

THE PARDRIDGE EASY LAMP CHANGER

Cheapest, Best and Easiest Lamp Changer on the Market

DON'T waste your time moving tables, chairs, ladders, or break your neck trying to get a lamp in a high place.
Take out life insurance if you do not use the Pardridge Easy Lamp Changer. Retail price $2.00, without pole. Postage prepaid to any address.

Send for Circulars and Price List Patented Jan. 1904

We want the Agency for all good Electrical Specialties. If you have a patent on any good electrical specialty, we will place it on the market and push it for you. Write to us for anything you cannot get any place else.

THE PARDRIDGE SHADE AND REFLECTOR CO., 183-185 DEARBORN ST., CHICAGO, ILL.

Standard Vitrified Conduit Co.

B. S. BARNARD, Manager

39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND

SEND FOR CATALOGUE

EDISON PRIMARY BATTERIES

Formerly known as Edison-Lalande

EXCELLENCE AND RELIABILITY GUARANTEED BY THIS TRADEMARK SIGNATURE

TRADE Thomas A Edison MARK

Write for Booklet 7

BEST BATTERIES ON THE MARKET FOR GAS ENGINES, SLOT MACHINES, RAILROAD SIGNALS, CROSSING BELLS, SMALL MOTORS, ETC.

EDISON MANUFACTURING COMPANY,
Factory, Orange, New Jersey, U. S. A.
New York Office, 83 Chambers Street, Chicago Office, 304 Wabash Avenue.

Your best business interests demand a representation in the advertising columns of the Western Electrician National Electric Light Convention Numbers – issues of May 21, May 28 and June 4.

STONE CONDUIT

For Underground Wires. The Only Conduit that Improves with Age.
AMERICAN STONE CONDUIT CO., Suite 29. 94 La Salle St., Chicago, Ill.

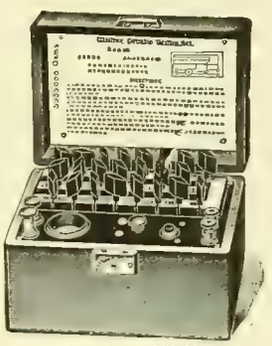
THE WHITNEY TESTING SET

here illustrated contains one of the most sensitive D'Arsonval galvanometers made and its resistance coils are guaranteed adjusted to ⅛ of 1 per cent. The range is .01 ohm to 5 megohms.

Write for details and discounts.

MACHADO & ROLLER,
203 BROADWAY, NEW YORK, N. Y.

General Agents of Whitney Electrical Instrument Co.



LIST PRICE $38.00.

Automatic Telephones.

Privacy

Promptness

Precision

Profits.

Automatic Electric Co., Chicago, U. S. A.

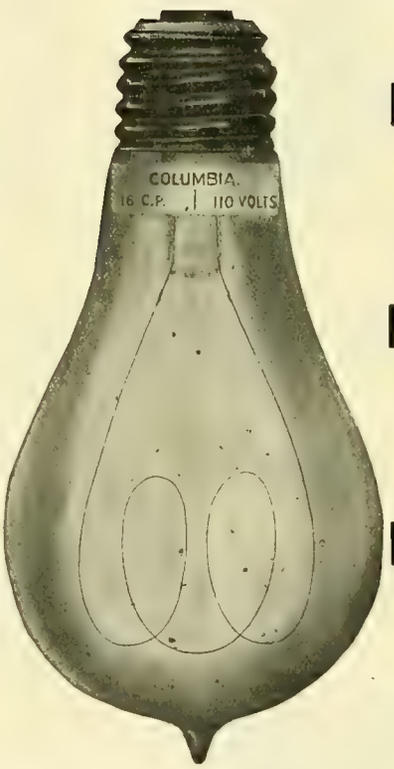
COLUMBIA LAMPS

THEY

Increase Profits.

Increase Sales.

Increase Customers.



THEY

Decrease Expenses.

Decrease Complaints.

Decrease Equipment.

Columbia Lamps are manufactured under a license to use the Chemical Exhaust Process of exhausting lamps. This process is vitally necessary in the production of the highest quality of lamp. Every package of Columbia lamps carries a label reading:

LICENSED UNDER
Patent No. 537,693, April 16, 1895
Patent No. 726,293, April 28, 1903
Patent No. 444,530, Jan. 13, 1891
Patent No. 532,760, Jan. 22, 1895

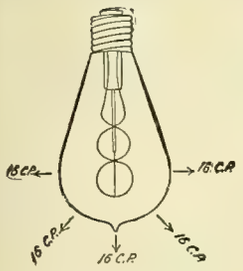
TRY 'EM

Write for Booklet on "That Question of Light."

THE COLUMBIA INCANDESCENT LAMP COMPANY,

ST. LOUIS, MO., U. S. A.

NEW YORK OFFICE: 1311 Havemeyer Building.
CHICAGO: Central Electric Co.
SAN FRANCISCO: Paul Seiler Electric Works.
PHILADELPHIA: 1227 Real Estate Trust Building.
BOSTON: Equitable Building.
MEMPHIS: 35 Equitable Building.
MINNEAPOLIS 638 Boston Block.



Pat. Feb. 1, 1902.

THE STERLING SPECIAL.

Side	16	Candle Power
Angle	16	" "
Tip	16	" "
Average	16	" "

16—ALL-WAYS THE SAME—16

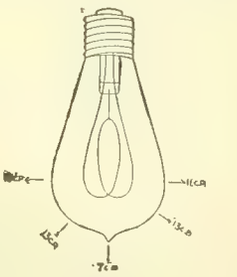
We belong to no trust or combination, but we manufacture under license that insures our patrons against all litigations, claims, royalties or damages.

Yours always for Equal-light, Economy and Life.

The Sterling Electrical Mfg. Co.

WARREN, OHIO.

NEW YORK. CHICAGO.



THE OTHER KIND.

Side	16	Candle Power
Angle	13	" "
Tip	7	" "
Average	12	" "

THE BABCOCK & WILCOX CO., 85 LIBERTY ST., N. Y.

BRANCH OFFICES:

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PHILADELPHIA, 1110-1112 NORTH AM. BLDG.
SAN FRANCISCO, 63 FIRST STREET.
PITTSBURG, 1218 FRICK BUILDING.
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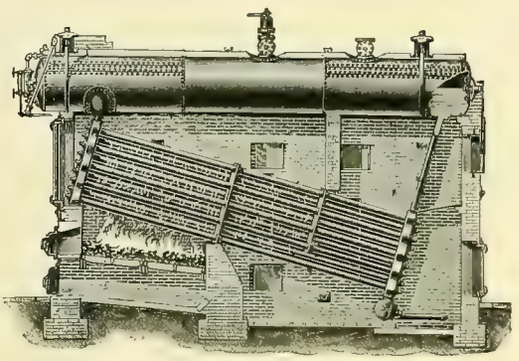

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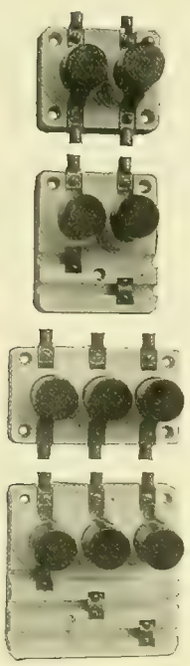

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THE Yost Electric Mfg. Co. now expressly or impliedly admits the correctness of our statements in a recent advertisement, that (a) it succeeded to the business of the Yost Miller Company which made the Dixon socket, recently adjudged by the United States Circuit Court to be an infringement of our Perkins Patent, (b) it took up the defense of the Dixon suit and (c) put out the same socket under the name "Yost." The Yost Electric Mfg. Co. claims, however, that it put out those "Yost" sockets same as the Dixon for a short time only, and that afterwards their socket was changed with the view to avoid infringement.

We are advised by competent counsel that this change in the "Yost" socket does not evade the patent and that the Yost socket remains to-day practically the same as the Dixon. To settle this question we have brought suit against the Yost Electric Mfg. Co., in Toledo, Ohio, for infringement.

In this connection it is pertinent to ask, why has the Yost Electric Mfg Co. now appealed the "Dixon" suit, if its "changed" socket does not infringe the patent?

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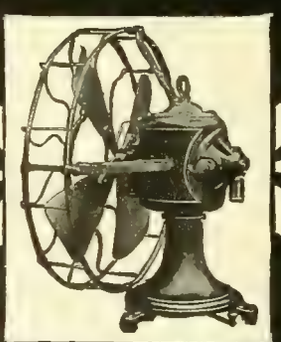

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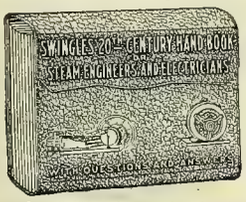

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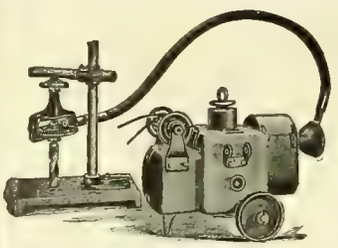

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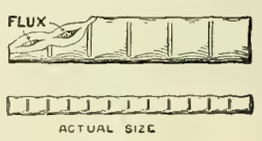

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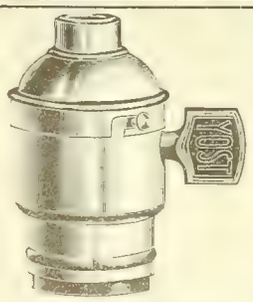

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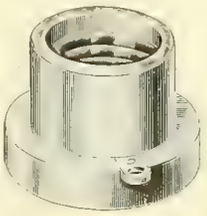

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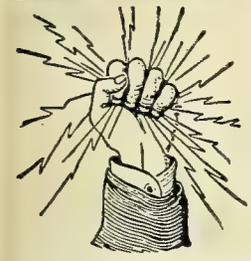

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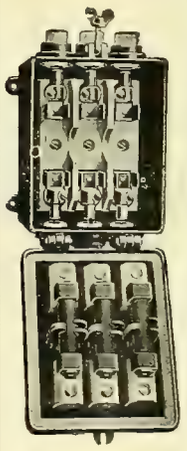

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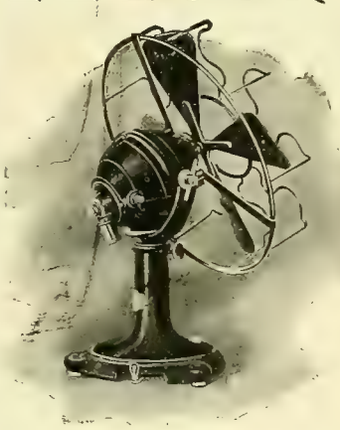

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2 H. P. General Electric, 1025 R. P. M.
2 H. P. Simpson, 2100 R. P. M.
1½ H. P. General Electric, 1800 R. P. M.
1 H. P. Lundell, 1200 R. P. M.
25 H. P. Crocker-Wheeler, 750 R. P. M.
15 H. P. Detroit, 1000 R. P. M.
10 H. P. General Electric, 1350 R. P. M.
10 H. P. Simpson, 2000 R. P. M.
7½ H. P. Crocker-Wheeler, 1575 R. P. M.
7½ H. P. Card, 775 R. P. M.
6 H. P. C. & C., 1030 R. P. M.
5 H. P. Westinghouse, 1050 R. P. M.
5 H. P. C. & C. 1600 R. P. M.
3 H. P. Jenny, 1600 R. P. M.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, CHICAGO.

It will pay you to be largely represented in the advertising columns of the Western Electrician National Electric Light Convention Numbers—issues of May 21 May 28 and June 4

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.

For tickets and further information apply to nearest ticket agent, or write

JAS. C. POND Gen'l Pass. Agt., Milwaukee, Wis.

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.

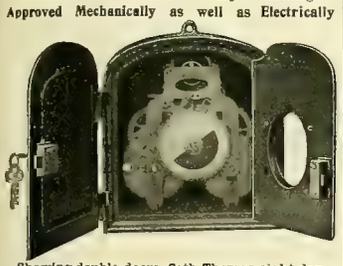
Machine and Carpenter Work of All Kinds. Correspondence Solicited.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

THE
Hartford Time Switch

A mechanically operated switch, which turns lights ON and OFF at such hours as the user desires with no further attention than the weekly winding.

Approved Mechanically as well as Electrically



Showing double doors, Seth Thomas eight-day movement, auxiliary cut-out, auxiliary hand-trip, and switch indicator.

For controlling current used for show window lights, electric sign lights, street lights, apartment house hall lights, motors, batteries, burglar alarms. :: 10, 20, 35 and 50 Amperes. 250 Volts. 1, 2 and 3 Poles.

Consult us regarding any requirements

SEND FOR CATALOGUE

The Hartford Time Switch Co.

440 Asylum St., HARTFORD, CONN., U.S.A.

New York City:
A. Hall Berry, 97-99-101 Warren Street

London, England:
Veritys, Ltd., 31, King Street, Covent Garden, S. W.

HANSON & TUNELIUS MACHINE CO.

—Designers and Builders of—

Insulating, Cabling

and Special

MACHINERY FOR ELECTRICAL PURPOSES.

232-234 S. Clinton St., Chicago.

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for descriptive Circular.

AMERICAN BATTERY CO.,

EST'D 1889. 171 S. Clinton St., Chicago.

DO YOU WANT THE BEST?

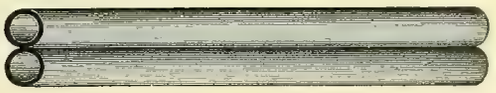
Then ALWAYS buy

THE MAXSTADT PATENT JOINT

Manufactured and sold by the owners of the Maxstadt Patent No. 655,905.

This is the best Joint on the market and gives entire satisfaction wherever used.

No. 882 represents the Joint ready for use.
Patented August 14, 1900, in the United States and Foreign Countries.



No. 882.

No. 884 represents the Joint, twisted, complete on the line.

No. 884.

These Joints are furnished in copper for copper wire and in tinned steel for galvanized iron wire. Samples and prices will be sent, without charge, upon request.

SOLE OWNERS OF THE MAXSTADT PATENT IMPROVED AMERICAN JOINT.

CHICAGO DIE & ELECTRIC COMPANY, 87-91 West Lake Street, CHICAGO, ILL.

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

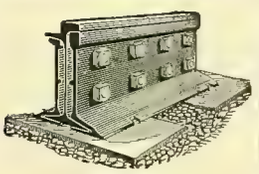
CONTINUOUS RAIL JOINT CO. OF AM.

GENERAL OFFICES: CENTURY BUILDING

NEWARK, N. J.

OVER 20,000 MILES IN USE

Highest Award at Paris Exposition, 1900, Buffalo, 1901



Warren Alternator

Do not be content with a tolerably good Alternator. **GET THE BEST.**

When you have tried the "WARREN" you will be able to judge.

We Guarantee What We Sell

AND . . .

Sell What We Guarantee

Warren Electric Mfg. Co.

Sandusky, O.

"LAKE SHORE" SPECIAL
TO
BOSTON CONVENTION

of National Electric Light Association, meeting May 24, 25, 26, 27, Hotel Vendome.

For the exclusive use of delegates, supplymen and their friends who will attend the above meeting, the

Lake Shore and Michigan Southern Railway

IN CONJUNCTION WITH

New York Central & Hudson River R. R.

will provide a train of special sleeping cars, which, with dining and buffet library cars, it is proposed to run as the first section of the New England Express, leaving Chicago at 2 p. m. Sunday, May 22d, arriving Boston at 5 p. m. Monday.

To enable us to provide desirable sleeping car accommodations for you, please advise us as early as possible what space you will require.

A rate of one and one-third fare for the round trip, on the certificate plan, has been authorized for this meeting, which will also be available leaving Chicago as early as May 20th, and good returning, leaving Boston not later than May 31st. Applications for sleeping car reservations (which should be made early) or any additional information, may be addressed to L. F. Vosburgh, G. A. P. D., 180 Clark Street, Chicago, or

P. S.—"First come first served" on the "lower" berths.

C. F. DALY, Chief Asst. Gen. Pass. Agt., Chicago

A Spring Binding Post

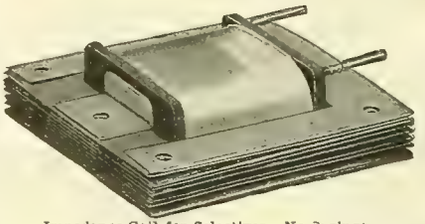
Grips any size wire and holds it so firmly that a loose contact is impossible. Wire cannot jar loose. Just the thing for all kinds of wire connections. Cheaper than any good screw post on the market, and can take the place of an expensive one. Send for sample.

The **Fahnestock Transmitter Co.**
132 Havemeyer Street
BROOKLYN, N. Y.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."



Impedance Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

M. KLEIN & SON
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

ELECTRICAL BOOKS.
All Kinds.
ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette Bldg., CHICAGO

Your best business interests demand a representation in the advertising columns of the Western Electrician's National Electric Light Convention Numbers—issues of May 21 May 28 and June 4.

"INTERNATIONAL" PATENT TELEPHONES SWITCHBOARDS
FOR ANY SIZE EXCHANGE ALL WE ASK IS YOUR REQUEST FOR SAMPLE AND QUOTATION.
INTERNATIONAL TELE. MFG. CO.
Harrison and Clinton. Chicago, U. S. A.

Electric Light Convention

THE twenty-seventh convention of the National Electric Light Association, perhaps the most important electrical event of the year, will be held in Boston, May 24th to 27th inclusive. It is predicted that this will be the largest and most successful meeting ever held. The association has enrolled hundreds of new members during the past year, and its prospects are brighter than ever before.

As usual the WESTERN ELECTRICIAN will pay special attention to this annual event, and it will be covered by our issues of May 21st, May 28th and June 4th. The issue of May 21st, which will be distributed at the convention, will be a most pleasing one to every central station man and others interested in electric lighting and power work. It will contain specially written articles on up-to-date subjects, and other features which will make it one of the most interesting issues of the year.

Our issues of May 28th and June 4th will contain a complete report of the proceedings.

Every manufacturer and dealer wishing to increase his business should be largely represented in the advertising columns of these important numbers. Realizing the importance of this convention, a number of advertisers have already arranged for space in these issues.

We urge you to take advantage of these important issues, and trust you will reserve a space immediately in order to obtain a choice location.

WESTERN ELECTRICIAN
510 MARQUETTE BLDG., CHICAGO

The Exposition Buildings at St. Louis will be Equipped with . . . . .

KELLOGG TELEPHONES

The ONLY Telephones which will be used at the Exposition. . .

Write us for our latest Bulletins, No. 8 and No. 9. You will find them full of interesting information.

ADDRESS

Kellogg Switchboard and Supply Co.,

Green and Congress Streets,

CHICAGO.

Electric Building, CLEVELAND.

Keystone Telephone Building, PHILADELPHIA.

THE FIRST COST

Some people when buying switchboard apparatus look at the first cost with both eyes wide open, but look to the future with one eye half open.

The old saying "penny wise and pound foolish" is usually proved to such parties in a way they don't like—of course.

The first cost of our

Generator Call Visual Signal

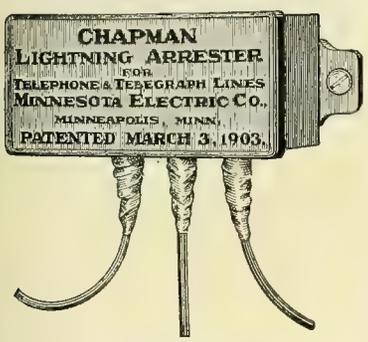
is somewhat higher than an ordinary or self-restoring drop. It's reasonable that it should be. The additional first cost takes care of the future. Gives as rapid service as any lamp signal system and not half as complicated. Each signal self-contained.

Let us know your requirements
We know we can interest you

Stromberg-Carlson Telephone Mfg. Co.

General and Eastern Sales Office
ROCHESTER, N. Y.

Sales Department
CHICAGO, ILL.



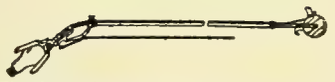
WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.

27 W. MONROE ST., CHICAGO.



The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.

Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

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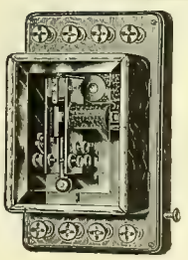


SIMPLE
EFFICIENT
RELIABLE
DURABLE
NOISELESS
ECONOMICAL

THE

ILLINOIS POLE CHANGER

THE LATEST RINGING DEVICE

Produces Both Alternating and Pulsating Currents.....

Broadly guaranteed. Write for circulars.

Illinois Electric Specialty Co.
171-173 South Canal Street .... Chicago

BITUMINIZED FIBRE CONDUIT

FOR

ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.

Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.

There has never been a gas explosion in our conduits nor the slightest evidence of electrolysis.

Abrasion of the cables is an impossibility.

It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.

Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.

All sizes from one inch to ten inches interior diameter. Bends of all angles.

The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required

PROMPT DELIVERIES

FACTORIES: Philadelphia, Chicago, Los Angeles

American Conduit Company

SEVENTH FLOOR, 170 BROADWAY, NEW YORK

336 Macy St., Los Angeles, Cal. *Manhattan Bldg., Chicago*

VEGETABLE FEED-WATER TREATMENT,

Proportioned to suit the Mineral Analysis of the water, will keep your boilers clean, free from corrosion, and effect great saving in repairs and operating expense.

DEARBORN DRUG & CHEMICAL WORKS,

120 LIBERTY STREET NEW YORK. 15 BRANCH OFFICES IN U. S. 27-34 RIALTO BUILDING, CHICAGO.

DIXON'S PURE FLAKE GRAPHITE

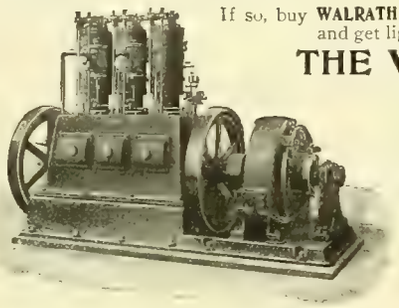
has helped to solve in a practical way more difficult problems in lubrication than any other one substance known to science.
Write to-day for booklet 125 C and sample.

JOSEPH DIXON CRUCIBLE CO., - Jersey City, N. J.

All Supply Houses

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND
absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5 00 per doz.
J. J. Egan Sole Mfg., 683 W. Ohio St., Chicago

ARE YOU LOOKING FOR MONEY?



If so, buy **WALRATH GAS OR GASOLINE ENGINES** and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable.
Send for Catalogue W.

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
MacKay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

JEFFREY Elevating, Conveying, Power Transmission, Screening, Crushing Dredging, Rock and Coal Drilling, Coal Cutting, Hauling and Washing Machinery.
OUR CATALOGUES ARE YOURS FOR THE ASKING.
The JEFFREY MANUFACTURING CO., Columbus, O., U. S. A.

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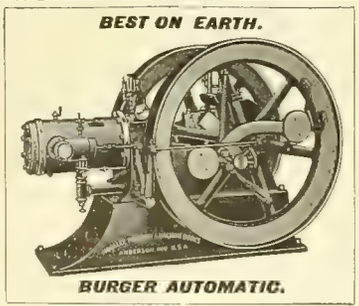
BEST ON EARTH.



BURGER AUTOMATIC.

For Electric Work

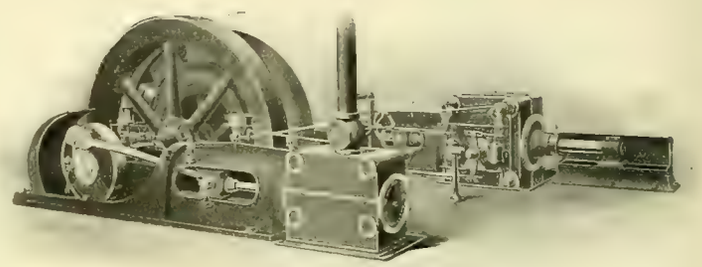
REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

Woolley
Foundry & Mach. Works
Box 400, Anderson, Ind. U. S. A.

THE WILLIAM TOD CO.



BUILDERS OF

CORLISS AND HIGH-SPEED

Automatic Engines

FOR ELECTRICAL PURPOSES.

MAIN OFFICE AND WORKS: YOUNGSTOWN, OHIO.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

SAMSON TURBINE

The illustration shows the large NIAGARA design, HORIZONTAL SHAFT TURBINES recently installed by us, for the NIAGARA FALLS HYDRAULIC POWER & MFG. CO., Niagara Falls, N. Y. Tests conducted by competent engineers developed as follows:—

Head.	Gateage.	Speed.	H. P.	Generator Effcy.	Turbine Effcy.
213 ft.	½	257 r. p. m.	1750	95%	730%
213 ft.	¾	257 r. p. m.	3000	95%	856%
213 ft.	Full	257 r. p. m.	3500	95%	815%

These results have never been equaled by any turbine of the Horizontal Shaft Design, operating under equally HIGH HEADS. The test was made after turbines were installed to position, direct coupled to Generators. Francis' weirs and formulae for discharge were used. The original test reports on file at our offices. These turbines are all fitted with our SAMSON BALANCED GATES.

WRITE DEPT. D FOR CATALOG.

JAMES LEFFEL & CO., SPRINGFIELD, OHIO, U. S. A.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO.
NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street. CHICAGO, ILL.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
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ELECTRIC RAILWAYS.
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BYLLESBY, H. M. & Co.
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ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
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SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
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ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
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BROWN ELECTRICAL CONSTRUCTION CO.
CONTRACTING ELECTRICAL ENGINEERS
505 Ellsworth Building, 355 Dearborn Street CHICAGO
Telephones Harrison 3698, Automatic 3698

THE M. P. BYRNE CONSTRUCTION CO.
GENERAL CONTRACTORS,
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CONSULTING ENGINEER.
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Electric Power Transmission.
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STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
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M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

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ELECTRICAL CONTRACTORS AND ENGINEERS
112 Dearborn Street - CHICAGO
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KOHLER BROS.,
Contracting Electrical Engineers,
Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building,
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CONSULTING ENGINEER
Mechanical and Electrical Engineering of Power Plants, Shop Management, Design and Equipment, Reports, Modernizing Plants, Machine Design, Elevators, Traveling Stairways, Technical Patent Solicitation and Litigation.
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MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

You should not fail to be represented in the Western Electrician's National Electric Light Convention Numbers — issues of May 21, May 28 and June 4.

MAINE SLATE FOR ELECTRICAL PURPOSES PLAIN OR ENAMELED.
THE MONSON BURMAH SLATE CO.
PORTLAND, ME.

READ THE BLUE ELECTRICAL PAPER.

REMEMBER THAT

PILLSBURY A.C. CEILING FANS

1st. Will stir more air than any other fan on the market.
2d. All are equipped to operate at two speeds.
3d. They are furnished in either plain or ornamental finish.
4th. They are thoroughly guaranteed.
5th. THE PRICE IS RIGHT.

MANUFACTURED BY

CENTURY ELECTRIC CO.,

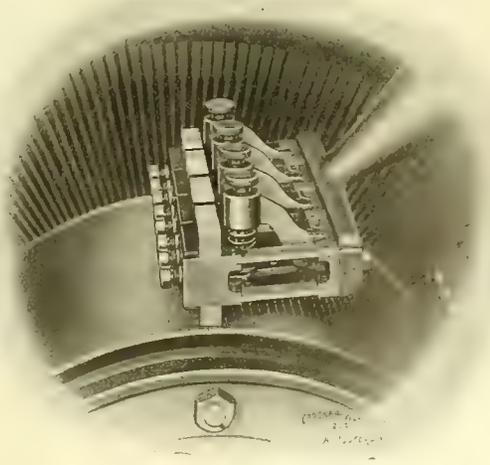
1007-9-11 Locust St., - - St. Louis, Mo., U. S. A.

CROCKER-WHEELER COMPANY

Manufacturers and Electrical Engineers

AMPERE, N. J.

Branch Offices in all Principal Cities



A simple and efficient brush-holder is one feature contributing to the reliable operation of our dynamos and motors.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER WIS
PESHTIGO "

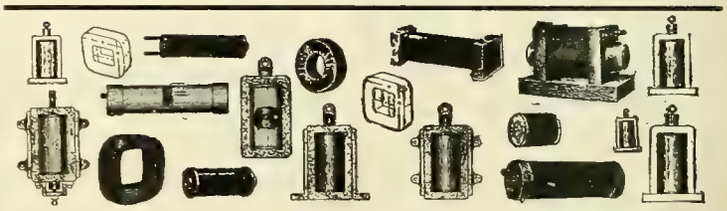
SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

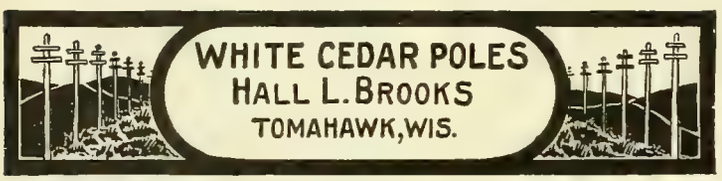
C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

WISCONSIN TIMBER AND LAND COMPANY
Cedar Poles and Posts
Not how Cheap, but how Good
Large Stock, Quick Shipments
MATTOON, WIS.

You should not fail to be represented in the Western Electrician's National Electric Light Convention Numbers – issues of May 21, May 28 and June 4.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand


Magnets and All Kinds of Coil Windings of Insulated or Bare Wire for Every Purpose.
VARLEY DUPLEX MAGNET COMPANY, PROVIDENCE, RHODE ISLAND.



POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

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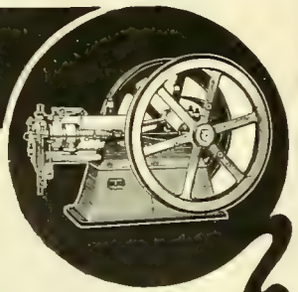

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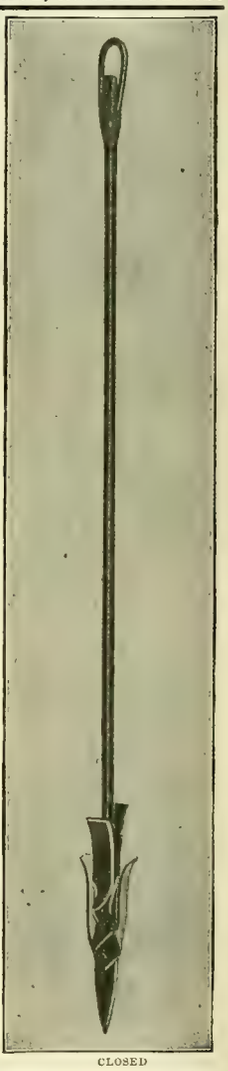
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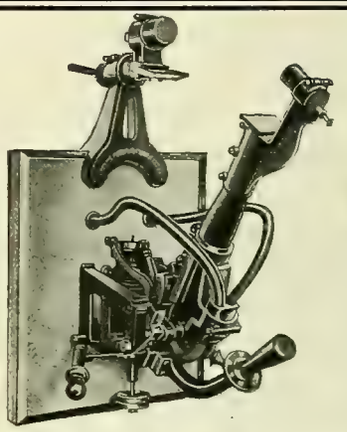

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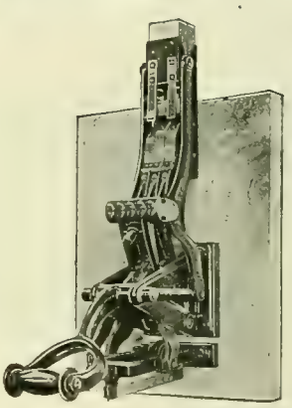

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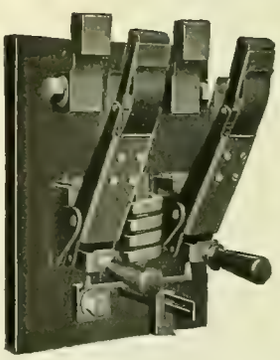

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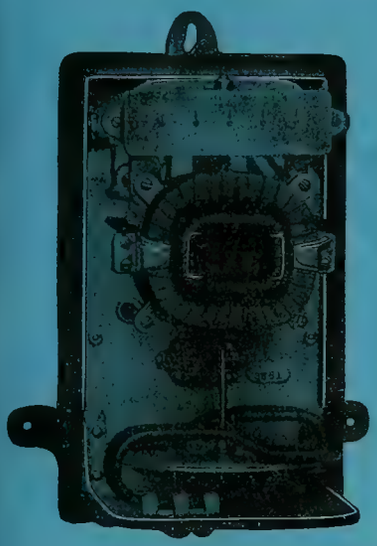

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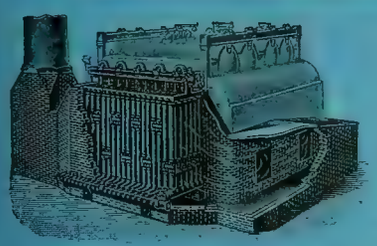

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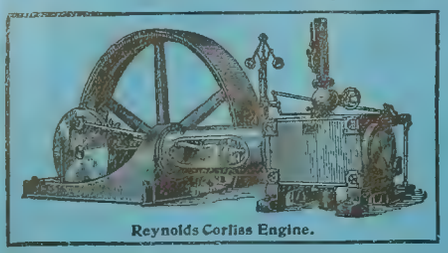

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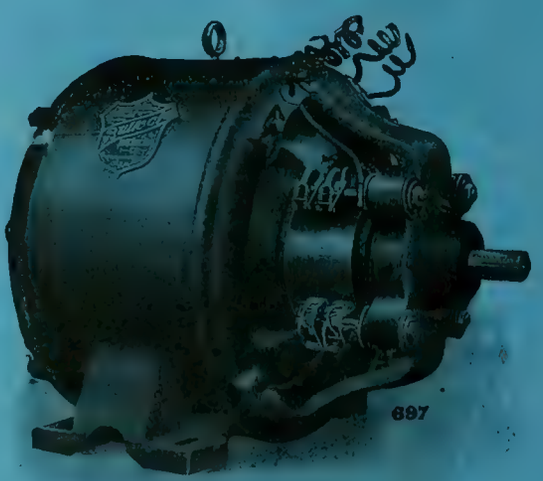

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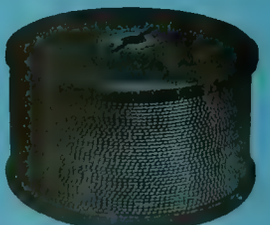

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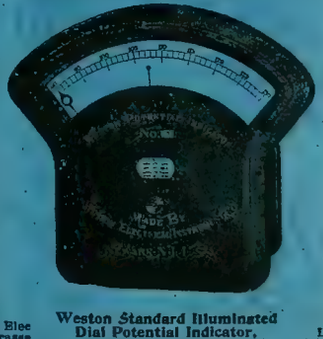

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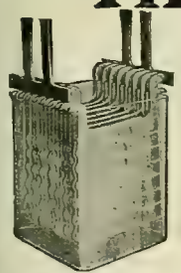

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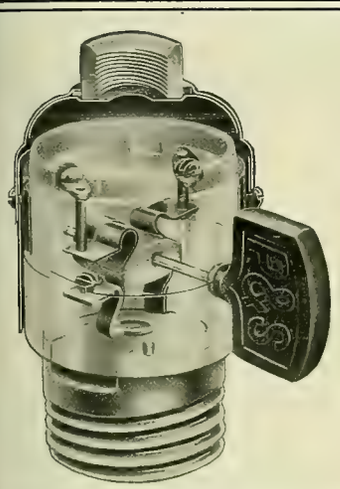

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As usual the WESTERN ELECTRICIAN will pay special attention to this annual event, and it will be covered by our issues of May 21st, May 28th and June 4th. The issue of May 21st, which will be distributed at the convention, will be a most pleasing one to every central station man and others interested in electric lighting and power work. It will contain specially written articles on up-to-date subjects, and other features which will make it one of the most interesting issues of the year.

Our issues of May 28th and June 4th will contain a complete report of the proceedings.

Every manufacturer and dealer wishing to increase his business should be largely represented in the advertising columns of these important numbers. Realizing the importance of this convention, a number of advertisers have already arranged for space in these issues.

We urge you to take advantage of these important issues, and trust you will reserve a space immediately in order to obtain a choice location.

WESTERN ELECTRICIAN

510 MARQUETTE BLDG., CHICAGO

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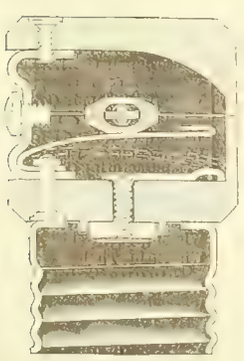
VERSUS

The Perkins Electric Switch Mfg. Co.



Sectional View of Interior of Yost Socket.

What the above company claims we admit and what we do admit can only be reconciled in the following manner:

We do not admit that we ever made the Dixon Socket, neither do we admit, but we absolutely deny, that we ever made anything like the Dixon Socket bearing the name "Yost," notwithstanding their claim to the contrary. But what we do admit is, that we are making the Yost Socket under our own patents, and we maintain on good authority, that it is not an infringement on any of their patents.

The Dixon patent is our property, the validity of which has only been assailed, but not determined; therefore, our appeal from the lower Court, which is pertinent to the situation.

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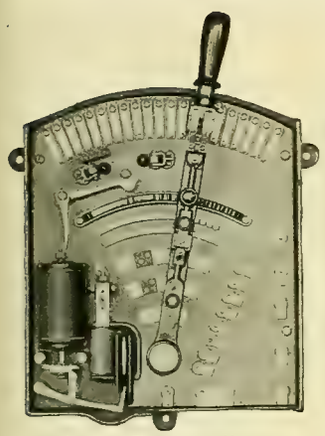

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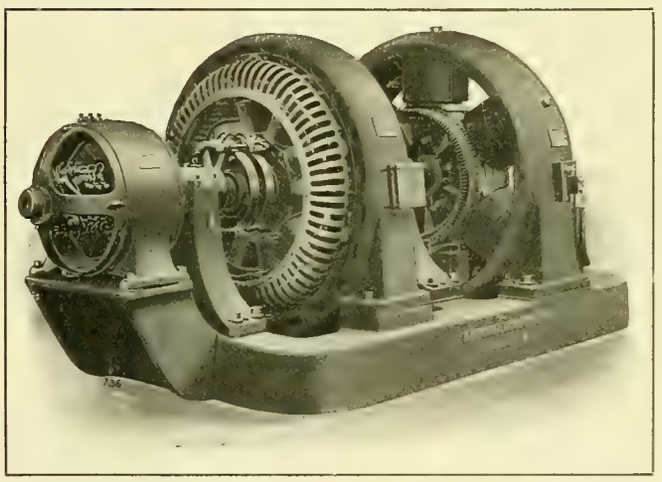

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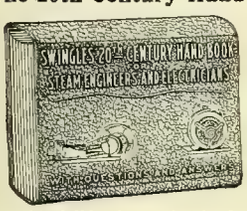

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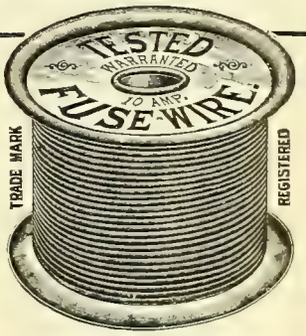

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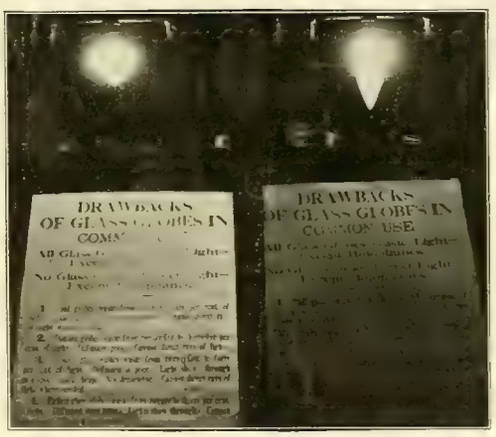

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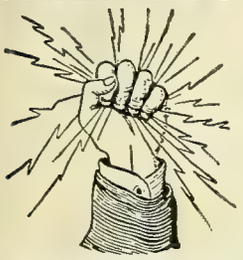

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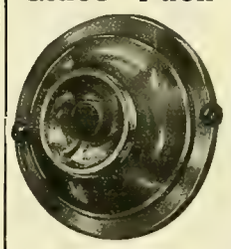

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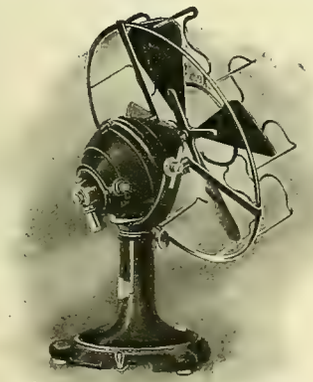

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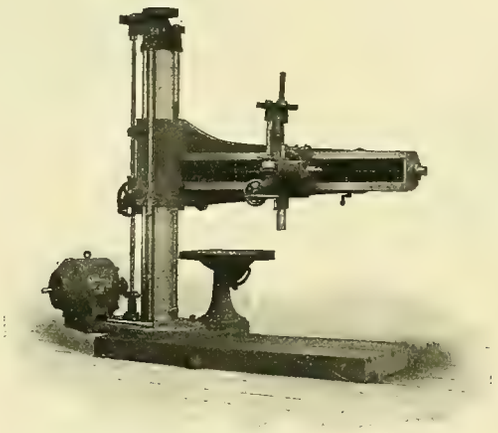

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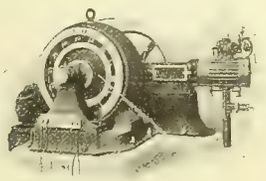

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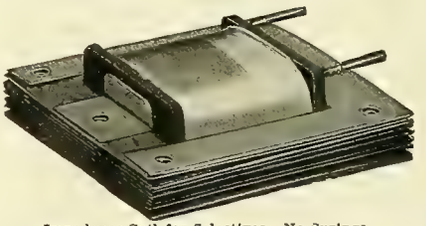

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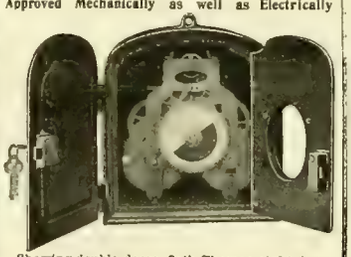

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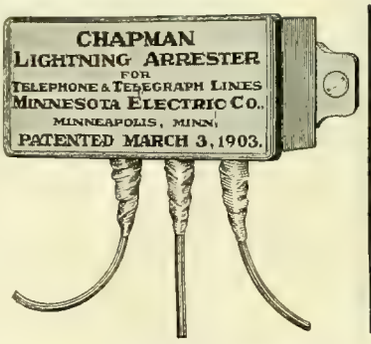

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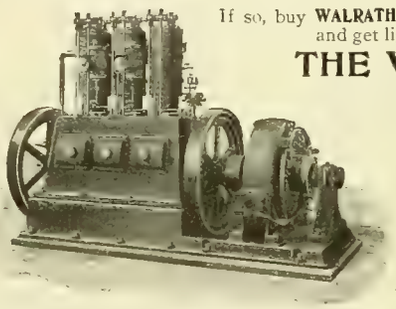

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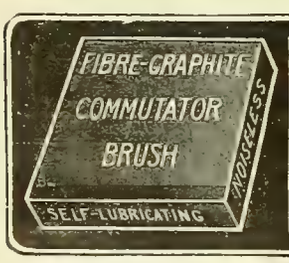

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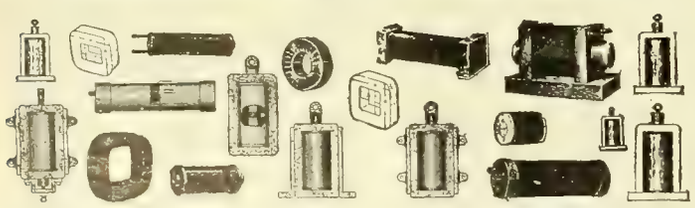

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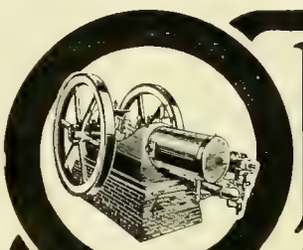

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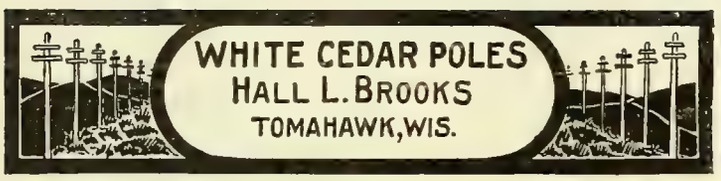

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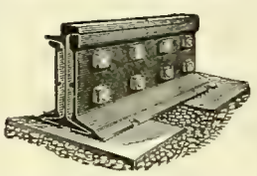

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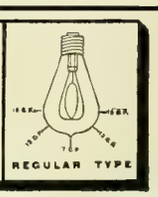

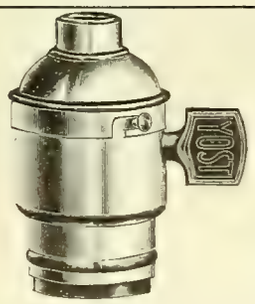

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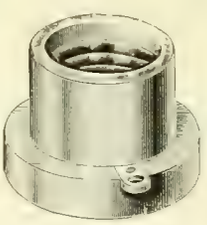

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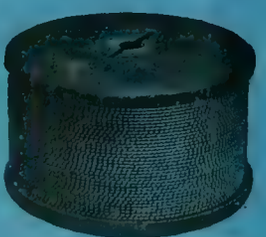

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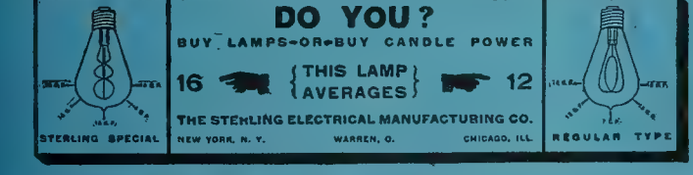

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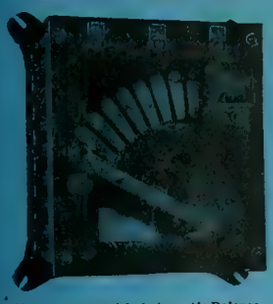

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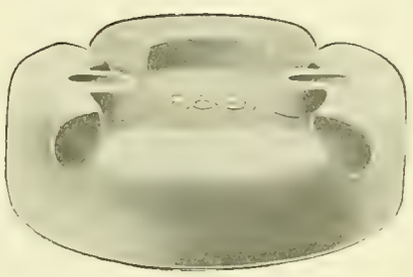

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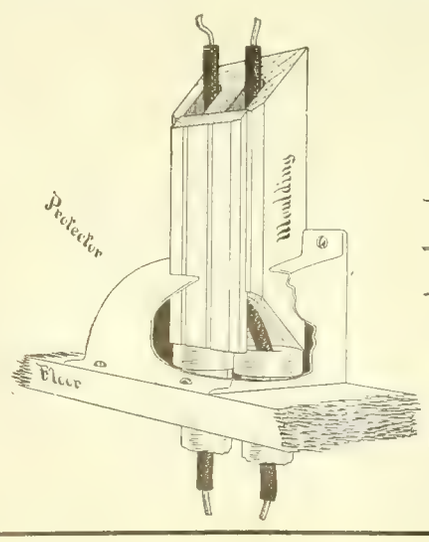
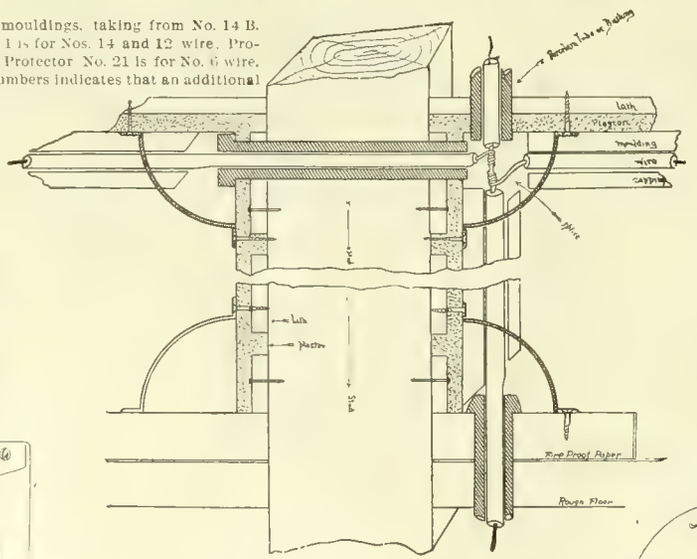
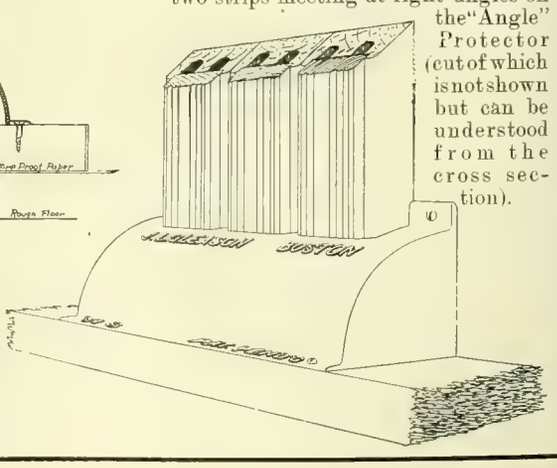




as its name implies and as shown in the cuts, is designed to protect insulating tubes from mechanical injury where passing through floors in connection with so-called "moulding work;" and also to furnish sufficient area and concealment for splicing at junction of ceilings and partitions where an ordinary mitre joint would not cover the splices or conceal the breakage of woodwork or plaster caused by boring for tubes. These protectors are made of cast iron, japanned for use at floors, and can be furnished of sheet metal to match finish of hardware or fixtures for use at ceilings. Provisions are made for recesses opposite each other to admit two strips meeting at right angles on the "Angle" Protector (cut of which is not shown but can be understood from the cross section).



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Gregory Electric Co.
Hobart Elec. Mfg. Co.
National Electric Co.
Northern Electrical Mfg. Co.
Northwestern Electric Co.
Sprague Electric Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Brown Elect'l Const. Co.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
Byrne Const. Co., M. P.
Freeman & Co., Ernest.
General Engineering Co.. The.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Jackson, D. C. & W. B.
Kohler Brothers.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments.
(Recording and Testing.)
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Eldredge Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Elec. Specialty Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Am. Diesel Engine Co.
Dustin Co., Chas. E.
Sturtevant Co., B. F.
Tod Co., Wm.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Thomas & Sons Co., R.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Phelps Co., The.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Mouldings.
Wright & Crayeroft.

Nippers and Pliers.
Klein & Sons, Mathias.

Novelties, Glass, Elec.
Ithaca Elect'l Novelty Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co Ltd

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Carney Bros. Co.
Columbia Mfg. Co.
Coolidge Co., Marshall H.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lewis Lumber & Mfg. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Lumber Co.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Western Lumber & Pole Co.
Wisconsin Timber & Land Co.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Protectors, Tube.
Gleason, John L.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Miller Electric Co.
Northwestern Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Schools and Colleges.
Electrical Engineer Inst.
Michigan College of Mines.
Rose Polytechnic Institute.

Second-Hand Mach'y.
Cent. Stat. Improvement Co.
Dustin Co., Chas. E.
Gregory Electric Co.
Matthews & Bro., W. N.
Northwestern Electric Co.
Walsh's Sons & Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.
Lang Electric Co., J.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Fahnestock Transmitter Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Murdock & Co., Wm. J.
National Elec. Signalling Co.
Stromberg-Carlson Tel. M.Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wireless Tel. App'tus.
Clark Wirel. Tel. & Tel. Co. T. F.
National Elec. Signalling Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

A DIFFERENCE IN STANDARDS

is what makes

A Mexican Dollar a poor substitute for a **United States Dollar**

and it's the same difference, as applied to the measurement of electrostatic capacity that makes a telephone cable rated by the

Inferior Standard of **Mutual** Electrostatic Capacity

a poor substitute for one of an equal number of microfarads rated by the

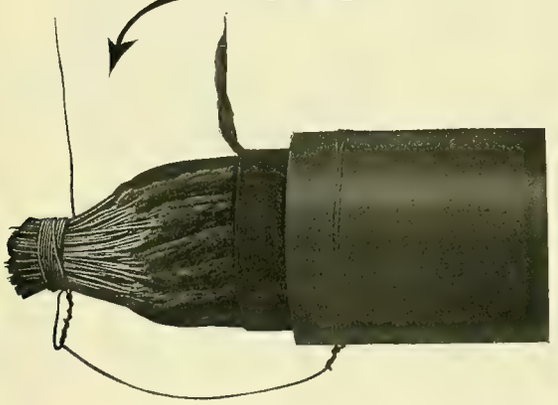
Regular Standard of Electrostatic Capacity

But ignorance of this difference or the use of specifications lacking definiteness as to the manner of making tests allows unscrupulous sellers to take advantage of the confidence you repose in them

AND

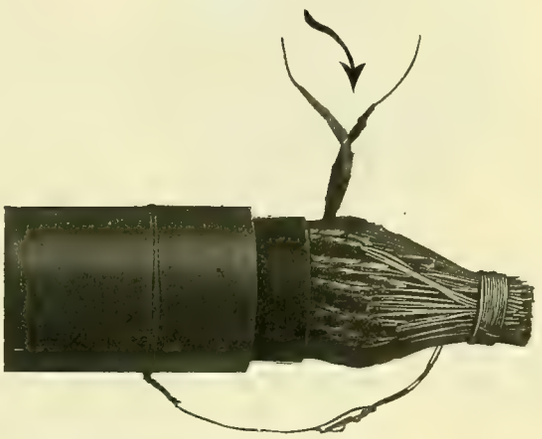
although you pay for, and are therefore entitled to receive, this regular old trade standard

.08



you may get this cable (known to the trade for years as .12 mf.) which by an **inferior standard** is also rated

.08



The relative talking merit of the two cables is

100 —to— **66**

and relative cost of manufacture

$1.00 —against— 85c to 90c

THAT'S WHY IT'S DOLLARS IN YOUR POCKET TO SPECIFY

Average REGULAR Electrostatic Capacity measured "one wire against all the rest grounded to the sheath,"

OR

Average MUTUAL Electrostatic Capacity measured "between the wires of a pair when all the remaining wires are grounded to the sheath,"

And to test your cables to see that the Specifications are being complied with.

The same cables measured by the two methods show the following results:

Average Regular Electrostatic Capacity		Average Mutual Electrostatic Capacity
.08 mf.	equals	.054 mf.
.10 mf.	equals	.066 mf.
.12 mf.	equals	.08 mf.

ASK US FOR PRICES BOTH WAYS

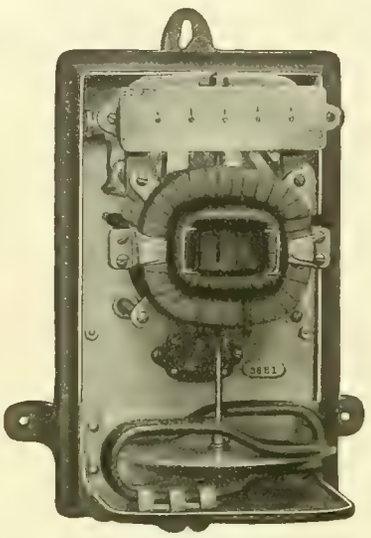
Send for "Pointers on Telephone Cable Specifications"

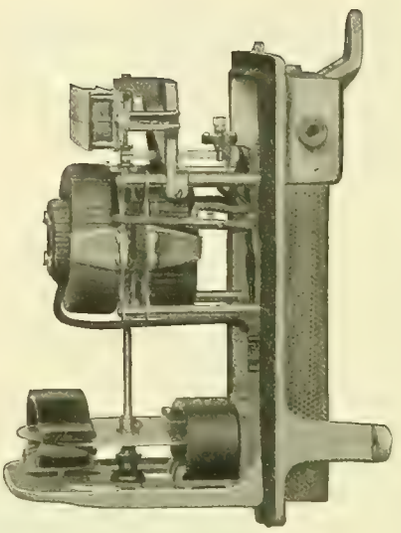
STANDARD UNDERGROUND CABLE COMPANY

NEW YORK BOSTON PHILADELPHIA PITTSBURG CHICAGO ST. LOUIS SAN FRANCISCO

BARE AND INSULATED WIRES AND CABLES, AND CABLE ACCESSORIES OF ALL KINDS

DUNCAN
DIRECT CURRENT
WATTMETERS





COMBINE THE
NEWEST FEATURES
OF THE METER ART

"A FAULTLESS METER," CENTRAL STATION MAN'S VERDICT

VISUAL BEARING (something absolutely new); hollow nickel-steel spindle; range of 60% increase in drag; no burning or charring of resistance; fire-proof and dust-proof binding posts; large porcelain direct reading dials; detachable non-tension-changing brushes; artificially aged magnets and commutator; case absolutely dust, insect and moisture proof; threadless jewel post that can be removed and inserted again in an instant; and

An entirely new means of compensating for friction and vibration on light loads by using a small multipoint switch in connection with the compensating coil. By moving the switch arm over the points of contact, any desired range of compensation can be secured instantly.

It is the simplest, quickest and most effective means yet devised and is absolutely permanent. These are some of the new features.

MANUFACTURED BY THE

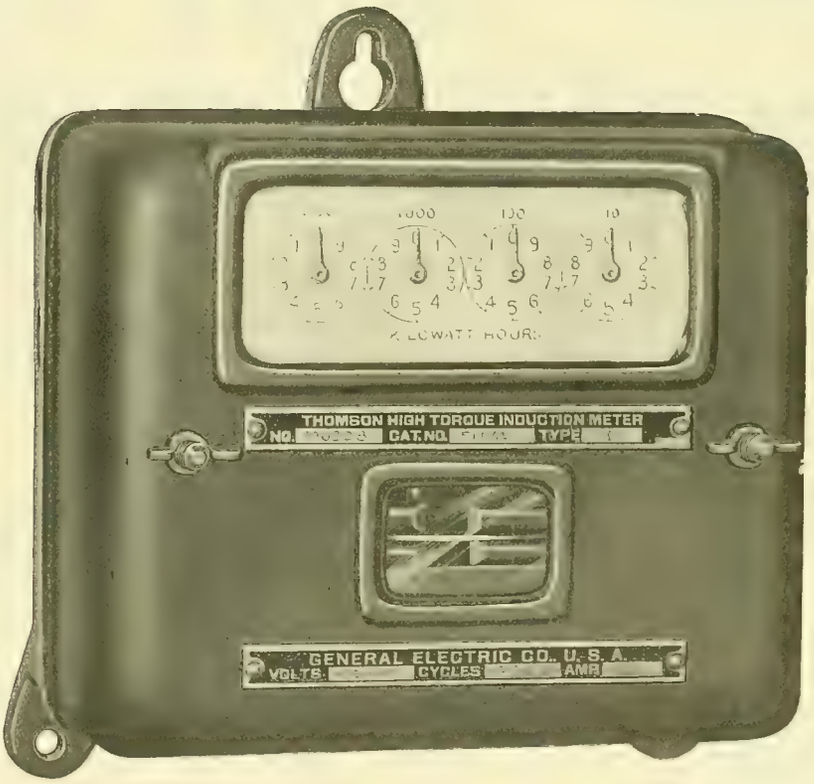
DUNCAN ELECTRIC MANUFACTURING CO.,

LAFAYETTE, IND.

General Electric Company

Thomson High Torque Meter

For Alternating Current Circuits



High Torque. Light Moving Element. High Ratio of Torque to Weight. Small. Compact. Simple Adjustment. Reads Direct in Kilowatt Hours.

PRINCIPAL OFFICE - SCHENECTADY, N. Y.

CHICAGO OFFICE, Monadnock Block BOSTON OFFICE, 84 State Street

SALES OFFICES IN ALL LARGE CITIES

24 TYPES OF HIGH VOLTAGE INSULATORS

ILLUSTRATED IN OUR NEW CATALOG.

BUT (IMPORTANT):

In Addition to the types shown in this catalog, we invite new designs, and realizing that engineers who are actively engaged in this transmission work are in position to know better the requirements, we shall at all times be pleased to receive drawings and specifications from which to quote and furnish samples.

THE
R. THOMAS & SONS CO.
EAST LIVERPOOL, O.

FACTORIES

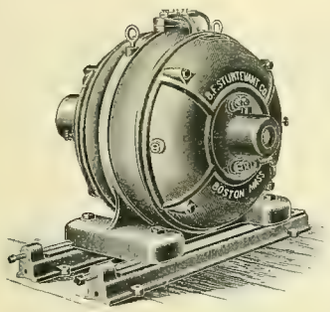
EAST LIVERPOOL, OHIO, U. S. A. LISBON, OHIO, U. S. A.

SALES OFFICE

39 and 41 Cortlandt Street, NEW YORK, N. Y., U. S. A.

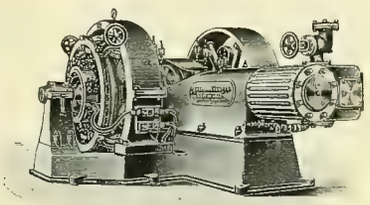
STURTEVANT

Motors



All types and sizes from ¼ to 125 h. p. to meet any requirement

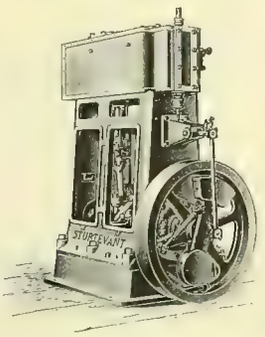
Generating Sets



All types and sizes between 1½ and 250 k. w.

We build both engine and generator

Engines



Over 100 types and sizes from 2 to 400 k. w., horizontal and vertical

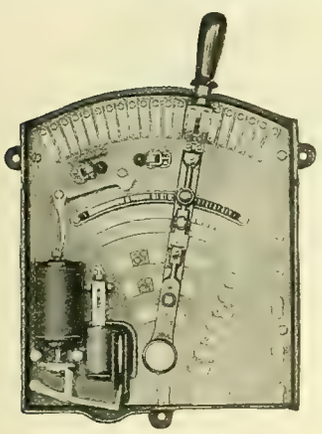
B. F. STURTEVANT CO.

Boston
New York
Philadelphia

Hyde Park, Massachusetts

Chicago
London

369



(Cover Removed)

C & H

"Carpenter" Type

Press Controllers

Switch parts completely enclosed.
No arcing on contact surfaces.
Overload device positive and effective.
The most compact, easily installed and complete device on the market.

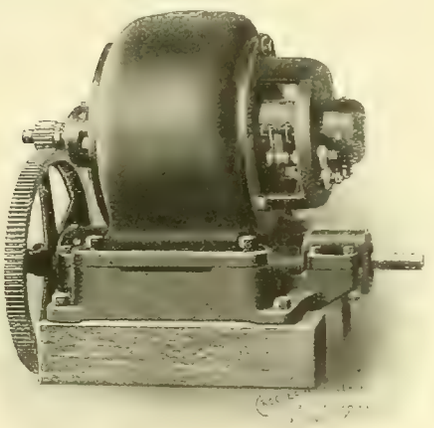
The Cutler-Hammer Mfg. Co.,

MILWAUKEE, WIS.

NEW YORK 136 Liberty St.
CHICAGO 1232 Monadnock Bldg.
PITTSBURG 322 Frick Bldg.
BOSTON 176 Federal St.

Small Motors

Standard frame with countershaft base for attachment to machines and tools. The finest small motor in the market.



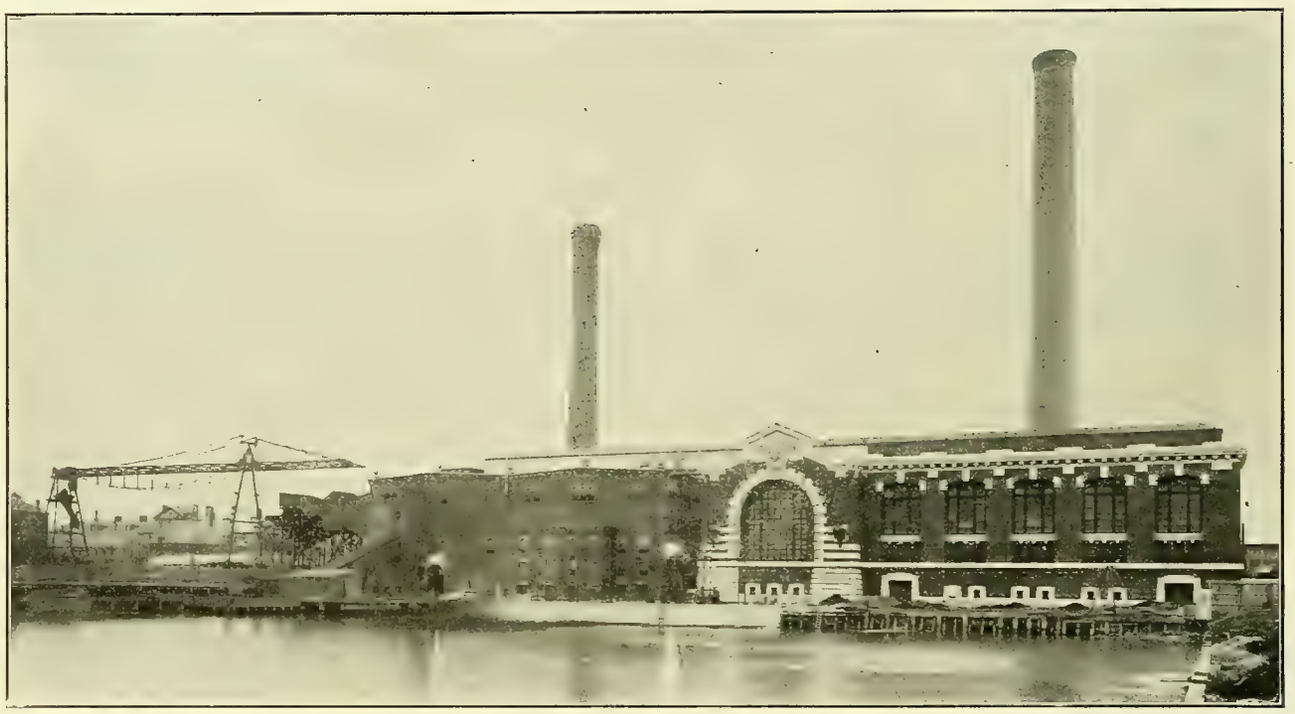
Crocker-Wheeler Company

Manufacturers of
Generators and Motors
AMPERE, N. J.
Branch Offices in Sixteen Principal Cities.

NEW TURBINE STATION

OF THE

Edison Electric Illuminating Company of Boston



This station is located on the N. E. corner of L. Street and E. First Street in South Boston, and is planned for *Twelve 5,000 K. W. Units.* Together with the old station, will have a total capacity of 69,000 K. W. and covers *160,066 square feet of ground.*

Two 5,000 K. W. Turbines are now installed occupying a floor space of 296 square feet each, with a height of 30 feet, being somewhat less than one-half the space occupied by one of the 1,500 K. W. units now installed in the old station.

The present coal-storage capacity at this station is 70,000 tons, capable of being increased to twice that amount.

THE EXHIBITION DEPARTMENT

OF THE

Edison Electric Illuminating Company of Boston

One of the objects which the Edison Co. of Boston had in view in opening this department, was to furnish the manufacturers of electrical apparatus an opportunity to show their product *free of charge,* and under *the most favorable conditions.*

The exhibit is open to the public; is vigorously advertised, and is visited by thousands.

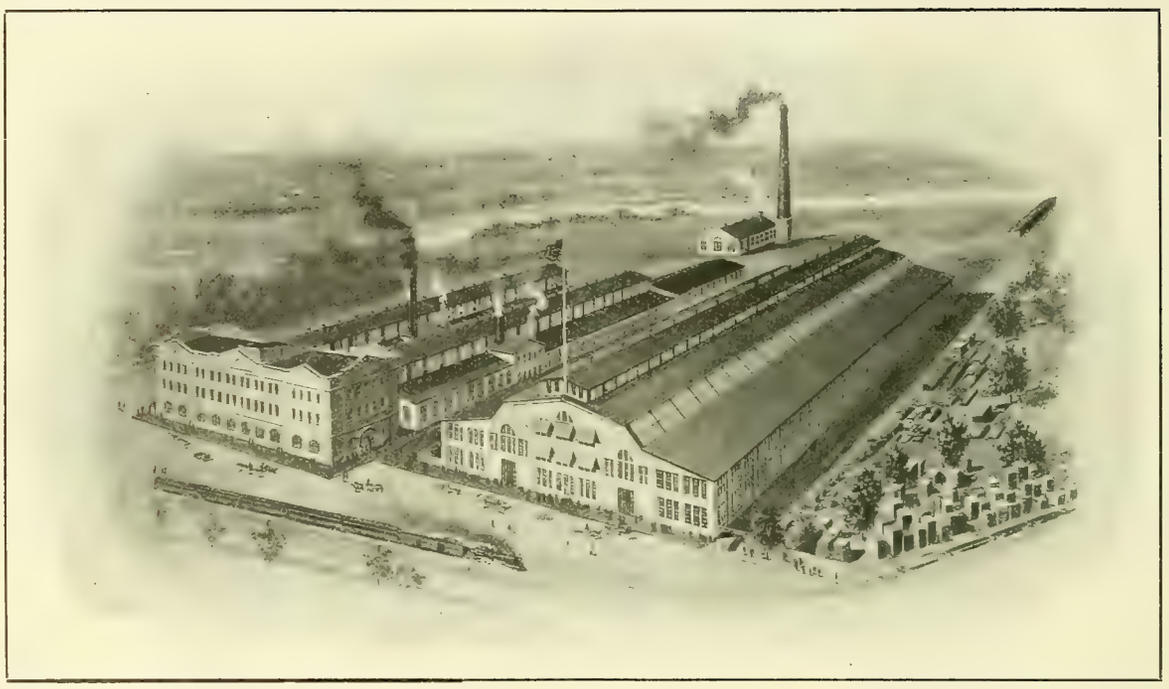
All manufacturers will be allowed space as far as the capacity of the department will permit.

National Electrical Machinery

Built in Capacities up to

1,500 K. W.

For Lighting, Power and Railway Service



OUR WORKS—MILWAUKEE

See our exhibit at the Louisiana Purchase Exposition and the National 1,500 K. W. Alternator in operation.

Write for Catalogues.

National Electric Company

New York: 135 Broadway.
Charleston, W. Va.: Agnew Electric Co.
Philadelphia: 1509 Land Title Bldg.
Pittsburg: Gellatly & Co.

General Sales Office and Works,

MILWAUKEE

Chicago: Old Colony Bldg.

Seattle and San Francisco: Kilbourne and Clark Co.

HYLO

16 to 1 Candle

LONG DISTANCE

HYLO

The special three-conductor cord snaps on the Long Distance lamp with clips like a glove fastener. Anybody can put it in place.

When the switch lever is to the right the light is on full.
When the lever is in the middle the light burns low, one or one-half candlepower.
When the lever is at the left the light is out entirely.

Use the long distance in porch lanterns, ceiling clusters or wherever the bulb is too high to reach easily.
To turn the light up before going upstairs.
To turn the light down after going down stairs.
To control the light without getting out of bed.
Long Distance **HYLO** Lamps sold by all first-class electric supply dealers.

Price to Consumers

Lamp - - -	60c
Clips and cord, 2 ft. long	20c
L. D. 3-point switch	45c
Extra length special cord per ft. - . -	5c

——THE——

PHELPS COMPANY

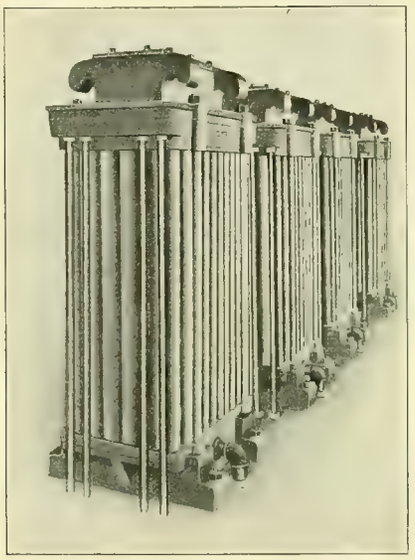
50 State Street, DETROIT, - MICH.
529 and 530 Monadnock Bldg. CHICAGO, ILL.

HYLO

"HORNBERGER-IRWIN" TRANSFORMERS

This type from 75 K. W. to 500 K. W.

Submit your specifications for large sizes.

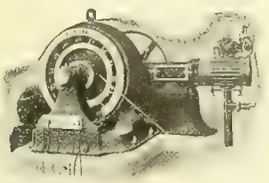


300 K. W.
Type I. AIR BLAST "HORNBERGER-IRWIN" TRANSFORMER.

The feature of this type is its low operating temperature, low iron losses, and close regulation in operation of inductive loads of low power factor. Catalogue on application, explaining details in full.

MANUFACTURED BY **CRAWFORDSVILLE ELECTRIC CO.**
CRAWFORDSVILLE, INDIANA, U. S. A.

Warren Alternator



It's not the
Old-Fashioned
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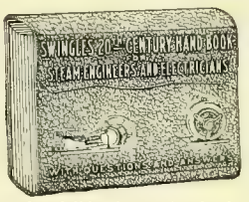

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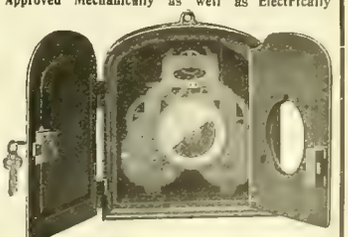

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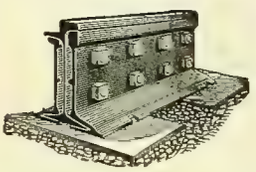

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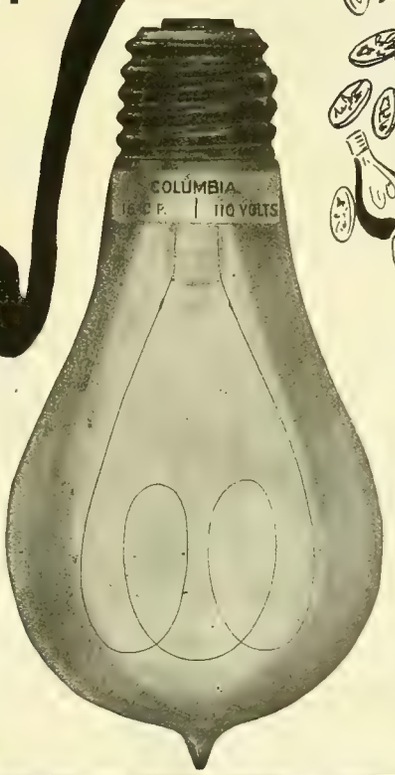

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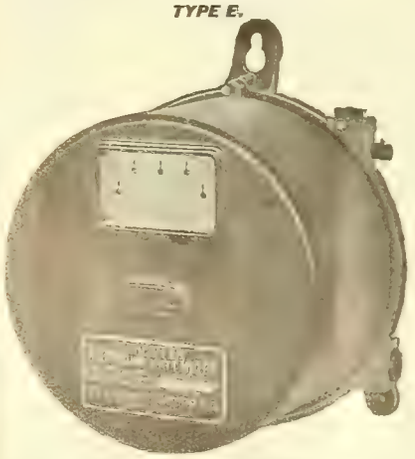

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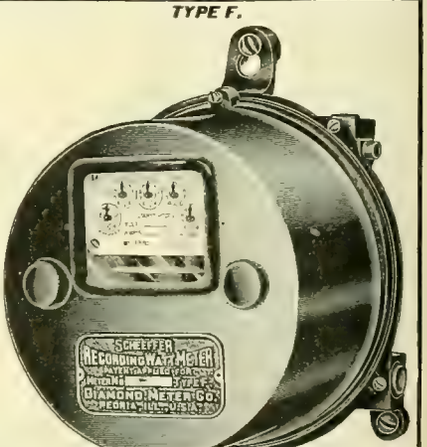

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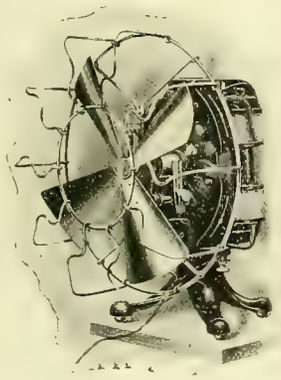

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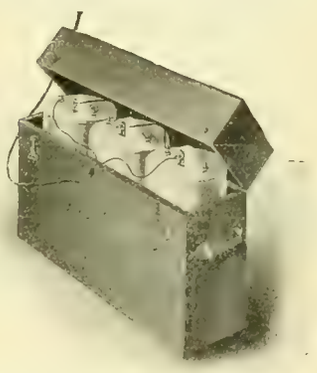

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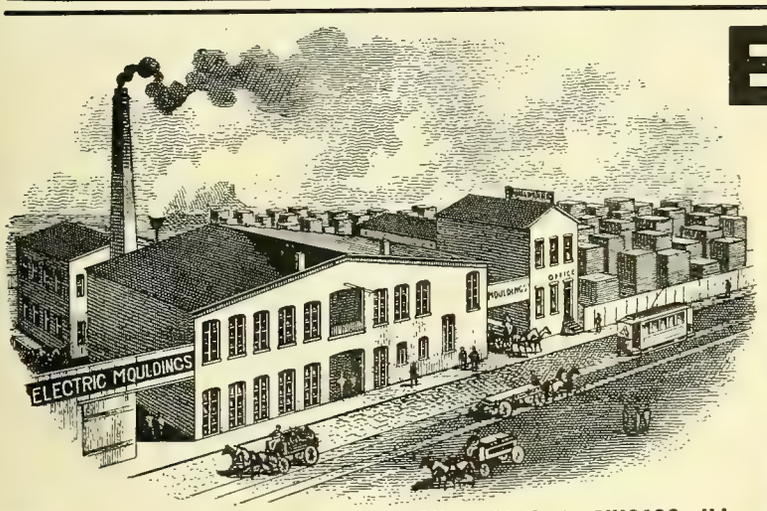

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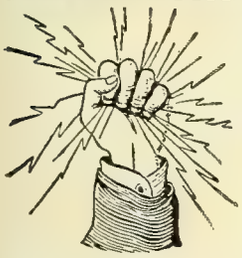

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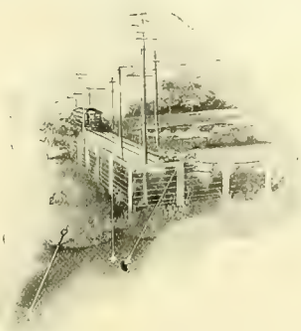

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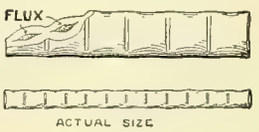

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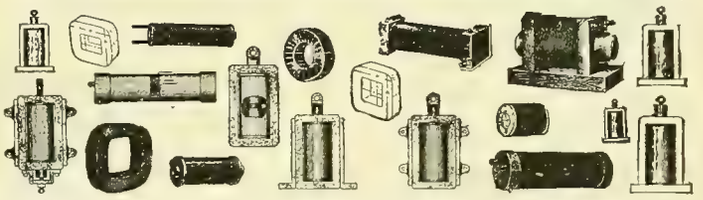

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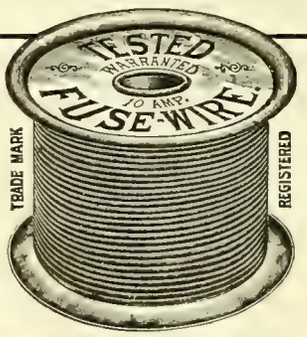

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The proceedings of the annual meeting of the National Electric Light Association which will be held in Boston next week, will be of special interest to every central station man. The **Western Electrician** of May 28th and June 4th will contain the report of this important meeting, and it will be the **most complete** report published.

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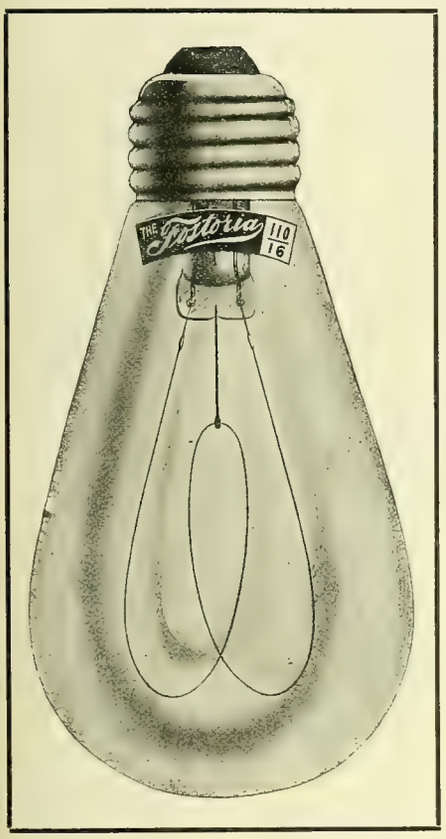

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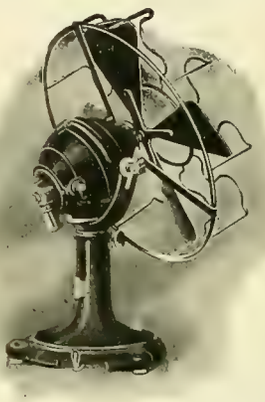

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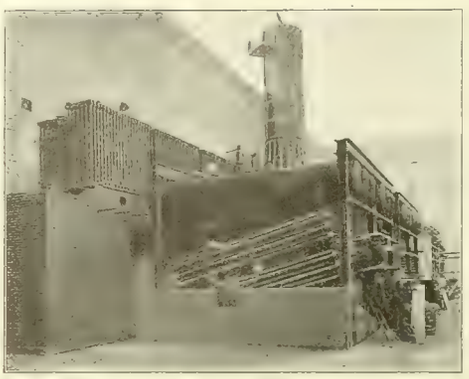

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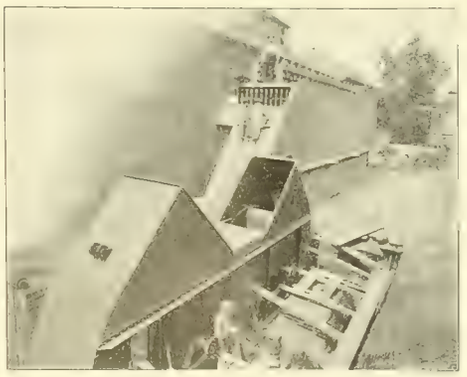

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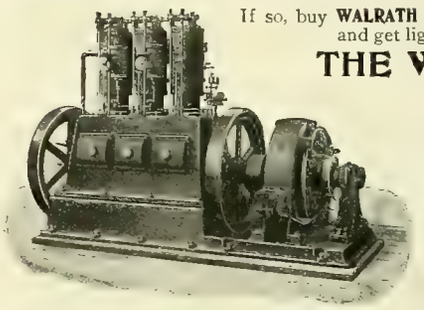

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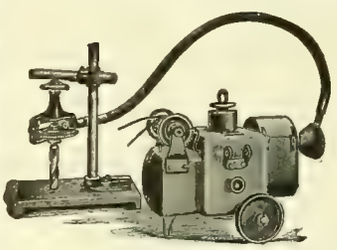

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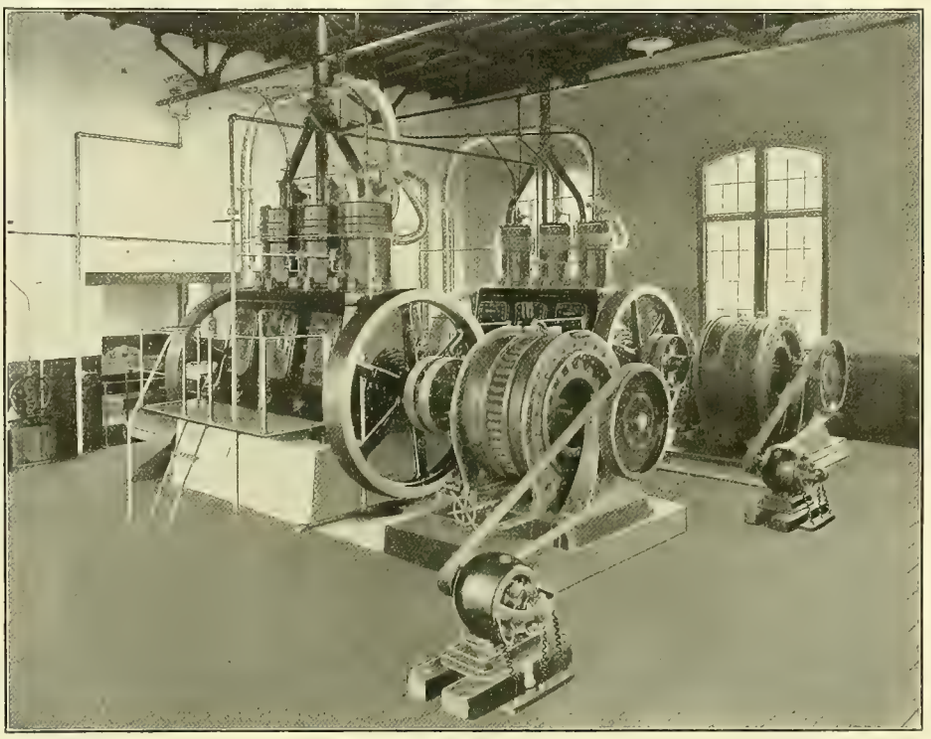

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6	2000	24	48		
6.30	"	26	52		
7	"	25½	51	5¾	21.6
7.30		26	52		
8	"	25½	51	5¼	19.7
8.30		26	52		
9		25½	51	5½	20.6
9.30		24½	49		
10		23	46	5	18.75
10.30		23	"		
11		23	"	5	18.75
11.30		23	"		
A. M.					
12		23	"	5½	20.6
12.30		22½	45		
1		"	"	4½	16 9
1.30		"	"		
2		"	"	5	18.75
2.30		"	"		
3		"	"	5	18.75
3.30		"	"		
4.30		"	"		
6		"	"	13½	50.6

Total Hours	Total KW H's.	Aver. KW.	Total Oil	Total Cost
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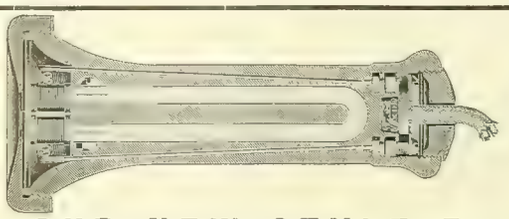

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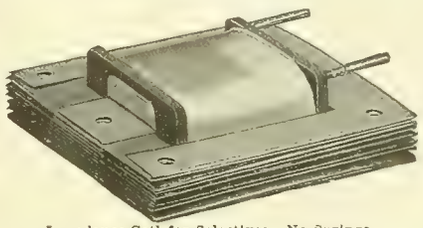

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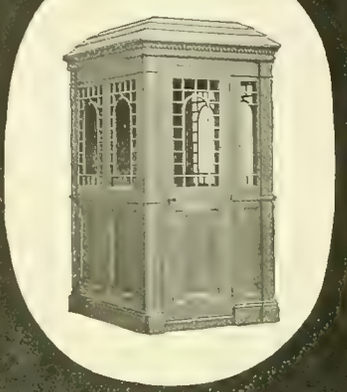

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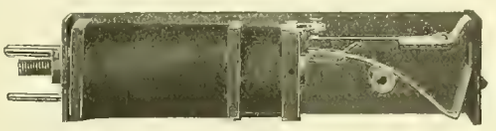

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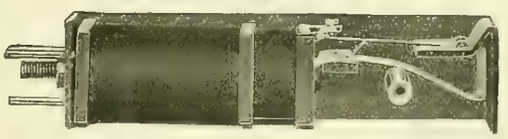

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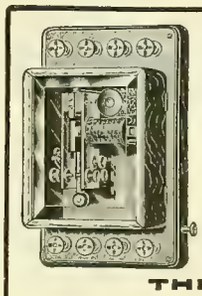

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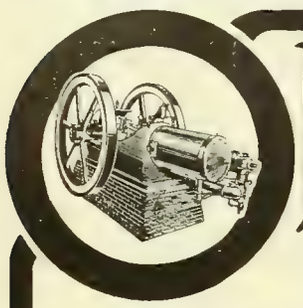

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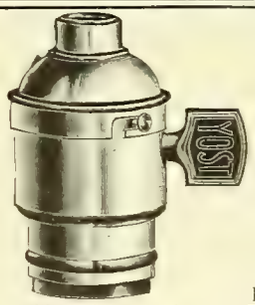

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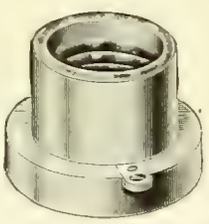

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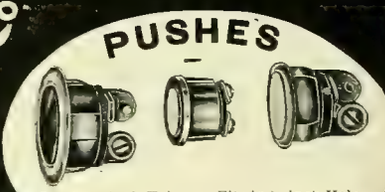

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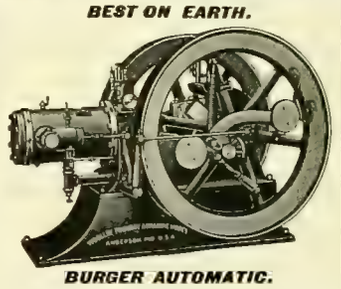

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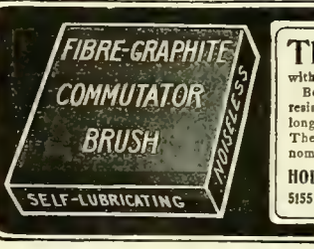

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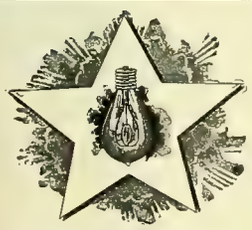
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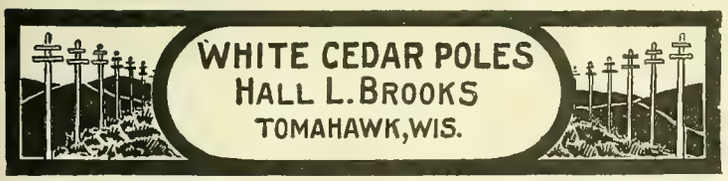

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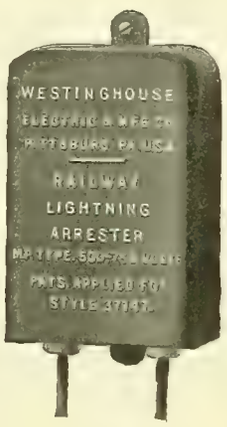

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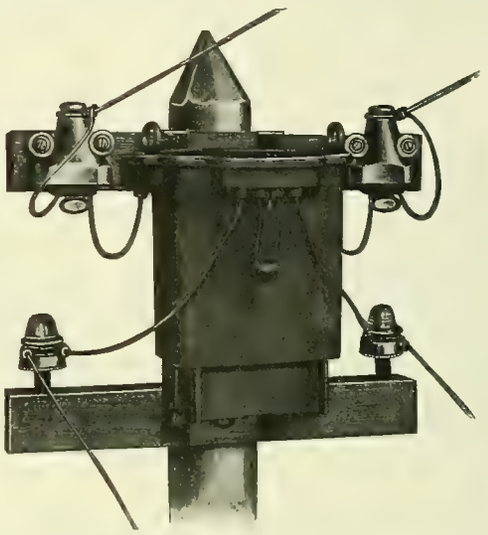

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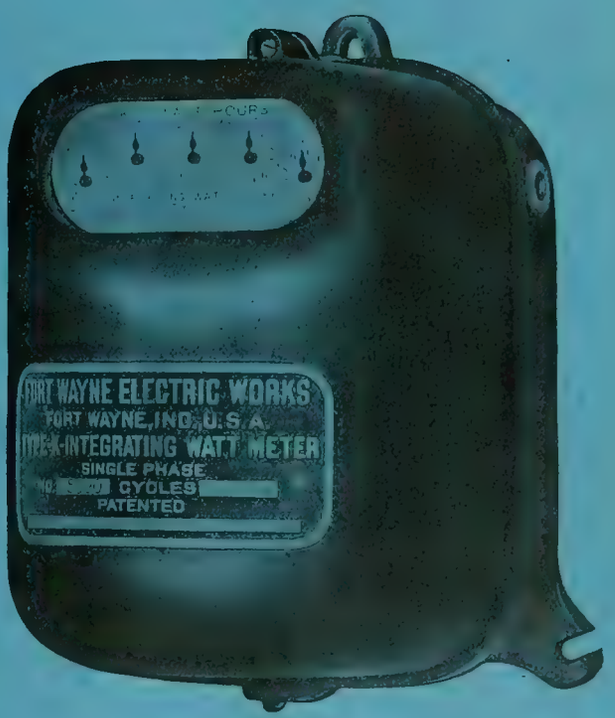

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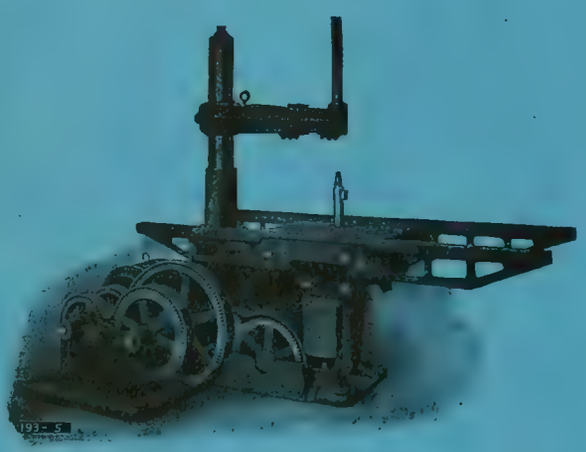

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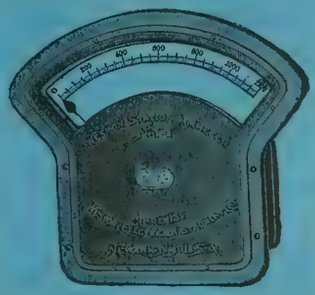
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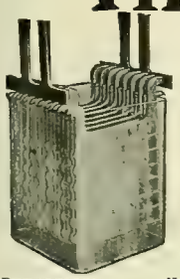

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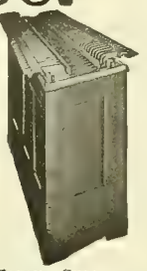

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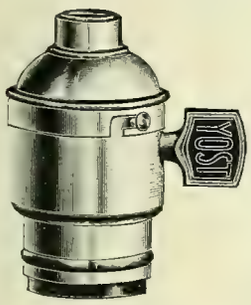

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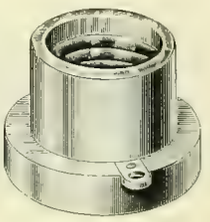

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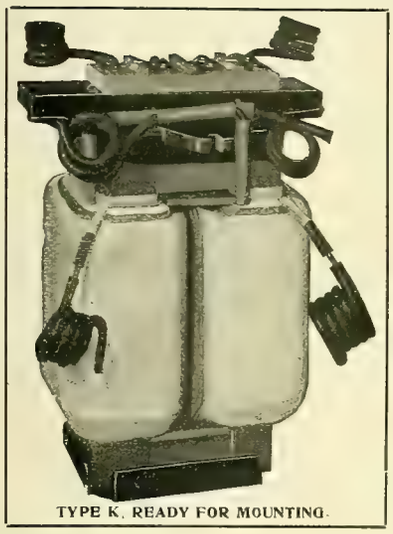

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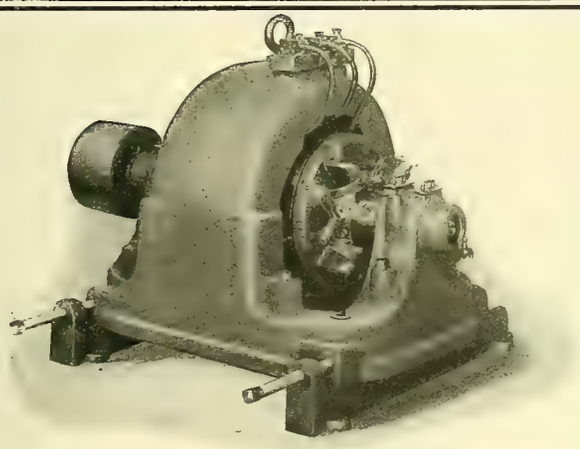

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Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Roche, Wm.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Sturtevant Co., B. F.

Blow Pipes.
Turner Brass Works.

Boiler Compounds.
Dearborn Drug & Chem Wks.

Boilers.
Babcock & Wilcox Co.

Books, Electrical.
Electrician Publishing Co.
Drake & Co., F. J.

Booths, Telephone.
Yesbera Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Western Electric Company.

Cable Hangers.
National Tel. Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
National Carbon Co.
Reisinger, Hugo.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Coloring, Lamp.
Webster Chem. Co.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company.
American Stone Conduit Co.
Central Electric Co.
Electric Appliance Co.
Fibre Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical SupplyCo.

Contractors and Electric Light Plants.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Lewis Lumber & Mfg. Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
National Electric Co.
Northern Electrical Mfg. Co.
Northwestern Electric Co.
Sprague Electric Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Brown Elect'l Const. Co.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
Byrne Const. Co., M. P.
General Engineering Co.,The.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W
Jackson, D. C. & W. B.
Kohler Brothers.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Eldredge Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Elec. Specialty Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Amer. Diesel Engine Co
Dustin Co., Chas. E.
Sturtevant Co., B. F.
Tod Co., Wm.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg.Co.

Flashers.
Haller Machine Co.
Reynolds El. Flasher Mfg.Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Central Electric Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg.Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Thomas & Sons Co., R.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus,Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Novelties, Glass, Elec.
Ithaca Elect'l Novelty Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co.Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Bushnell, A.
Carney Bros. Co.
Columbia Mfg. Co.
Coolidge Co., Marshall H.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lewis Lumber & Mfg. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Lumber Co.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Western Lumber & Pole Co.
Wisconsin Timber & Land Co.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Miller Electric Co.
Northwestern Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Schools and Colleges.
Electrical Engineer Inst.
Michigan College of Mines.
Rose Polytechnic Institute.

Second-Hand Mach'y.
Cent. Stat. Improvement Co.
Dustin Co., Chas. E.
Gregory Electric Co.
Matthews & Bro., W. N.
Northwestern Electric Co.
Walsh's Sons & Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Fahnestock Transmitter Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Murdock & Co., Wm. J.
National Elec. Signalling Co.
Stromberg-Carlson Tel. M.Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wireless Tel. App'tus.
Clark Wirel.Tel.&Tel.Co.T.E.
National Elec. Signalling Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co.
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

THERE'S NO SPLIT
OVER THIS
NOMINATION
OKONITE
TRADE MARK
FOR ELECTRIC LIGHT
AERIAL, UNDERGROUND
& SUBMARINE PURPOSES
OKONITE
TRADE MARK
FOR ELECTRIC POWER
& STREET RAILWAYS
OKONITE
TRADE MARK
FOR TELEPHONE & TELEGRAPH
AERIAL, UNDERGROUND & SUBMARINE USES
OKONITE
TRADE MARK
FOR HIGH TENSION PURPOSES
AERIAL & UNDERGROUND
OKONITE
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TRADE MARK
THE STANDARD FOR RUBBER INSULATION
Manfrs Ohm Bureau N.Y.

Standard Vitrified Conduit Co.

B. S. BARNARD, Manager

39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND

SEND FOR CATALOGUE

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

STONE CONDUIT

For Underground Wires. The Only Conduit that Improves with Age.
AMERICAN STONE CONDUIT CO., Suite 29, 94 La Salle St., Chicago, Ill.

BITUMINIZED FIBRE CONDUIT

FOR

ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.

Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.

There has never been a gas explosion in our conduits nor the slightest evidence of electrolysis.

Abrasion of the cables is an impossibility.

It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.

Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.

All sizes from one inch to ten inches interior diameter. Bends of all angles.

The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required

PROMPT DELIVERIES

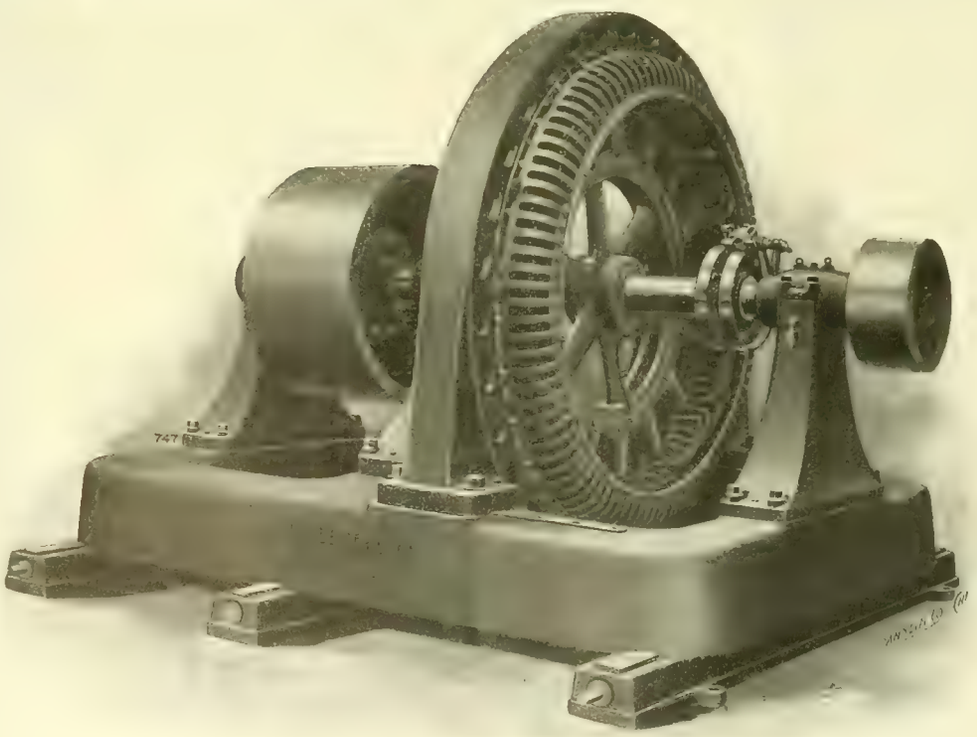
FACTORIES: Philadelphia, Chicago, Los Angeles

American Conduit Company

SEVENTH FLOOR, 170 BROADWAY, NEW YORK

336 Macy St., Los Angeles, Cal. *Manhattan Bldg., Chicago*

National Direct and Alternating Current Generators



Built in Capacities up to
1500 KW.

FOR
LIGHTING
POWER AND
RAILWAY
SERVICE

Write for
Catalogue No. 60
descriptive of our
Alternating Current Machinery

National Electric Company

GENERAL SALES OFFICE and WORKS
MILWAUKEE

NEW YORK: 135 Broadway
PITTSBURG: Gellatly & Co.
PHILADELPHIA: 1509 Land Title Bldg.
CHARLESTON, W.Va.: Agnew Electric Co.

CHICAGO: Old Colony Bldg.
SEATTLE and
SAN FRANCISCO:
Kilbourne & Clark Co.

General Electric Company

Thomson High Torque Meter

For Alternating Current Circuits

High Torque. Light Moving Element. High Ratio of Torque to Weight. Small. Compact. Simple Adjustment. Reads Direct in Kilowatt Hours.

PRINCIPAL OFFICE - SCHENECTADY, N. Y.

CHICAGO OFFICE, Monadnock Block BOSTON OFFICE, 84 State Street

SALES OFFICES IN ALL LARGE CITIES

HOTEL WINDERMERE.
CHICAGO,
CHAS. G. MOORE, MANAGER.

March 28th, 1904.

The V. R. Lansingh Company,
207-209-211 Jackson Blvd.,
Chicago, Ills.

Gentlemen:-

Replying to your favor of March 19th, we take pleasure in stating that the installation of Hollophane Globes has been perfectly satisfactory in every detail.

The lighting of our office, dining room, reading room and bar is so far ahead of the old kind of globes, that we feel proud in stating we cannot see how you could be brought in competition with any other globe. As a matter of economy we are convinced that the saving is fully Thirty per cent.

Wishing you success, we remain,

Very respectfully,

THE WINDERMERE CO.

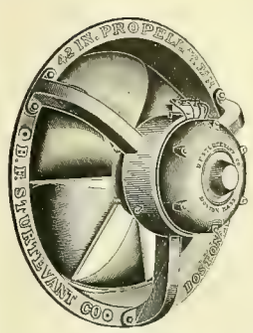
By - Chas. G. Moore

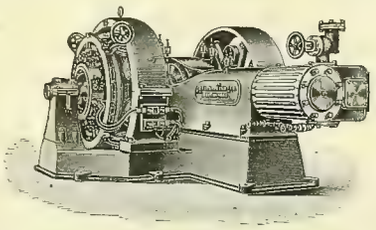
CENTRAL STATION HEATING

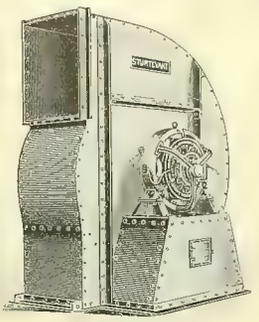
We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

American District Steam Company
LOCKPORT, N. Y. CHICAGO, ILL.







STURTEVANT ELECTRICAL PRODUCTS

Electrical Fans and Blowers
Motors and Generators

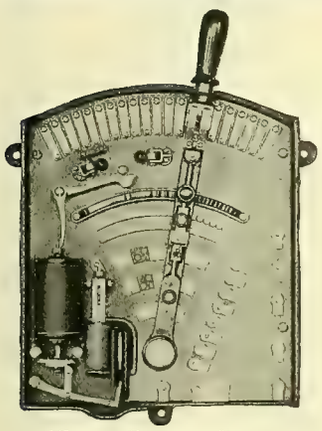
Electric Propeller Fans
Generating Sets

....and....

Fans, Blowers, Exhausters, Engines, Exhaust Heads, Heating, Ventilating and Drying Apparatus, Forges, Steam Traps, Industrial Equipments, Mechanical Draft Apparatus, Economizers

B. F. STURTEVANT CO., Hyde Park, Mass.

Boston New York Philadelphia Chicago London 360



(Cover Removed)

C & H

"Carpenter" Type

Press Controllers

Switch parts completely enclosed.
No arcing on contact surfaces.
Overload device positive and effective.
The most compact, easily installed and complete device on the market.

The Cutler-Hammer Mfg. Co.,

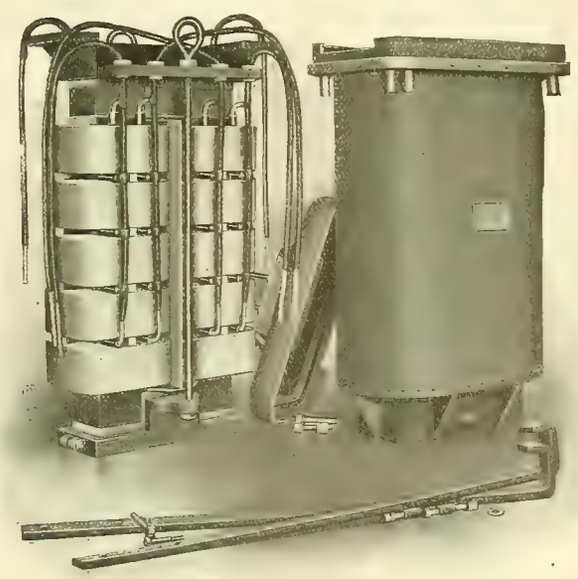
MILWAUKEE, WIS.

NEW YORK 136 Liberty St. | CHICAGO 1232 Monadnock Bldg. | PITTSBURG 322 Frick Bldg. | BOSTON 176 Federal St.

"HORNBERGER - IRWIN" TRANSFORMERS

This type from 75 K. W. to 500 K. W.

Submit your specifications for large sizes.



Type H. Ready to Assemble.

The feature of this type is its low operating temperature, low iron losses, and close regulation in operation of inductive loads of low power factor. Catalogue on application, explaining details in full.

MANUFACTURED BY **CRAWFORDSVILLE ELECTRIC CO.**

CRAWFORDSVILLE, INDIANA, U. S. A.

Central Station Heating

SCHOTT'S BALANCED COLUMN HOT WATER SYSTEM

No Back Pressure. No Noise.
Perfect Circulation. Greatest Capacity.
Absolute Regulation in Building.

SCHOTT'S REGULATED STEAM SYSTEM

Automatic Vacuum Circulation. Greatest Pipe Line Capacity.
Least Back Pressure. Highest Economy.
Absolute Regulation in Building.

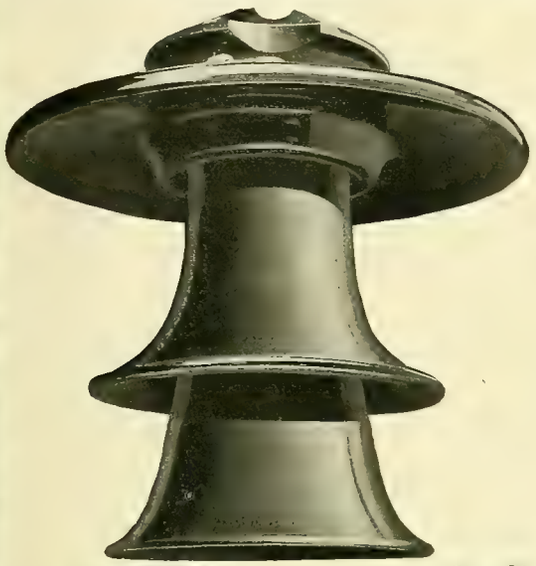
Designed and Built by

W. H. SCHOTT

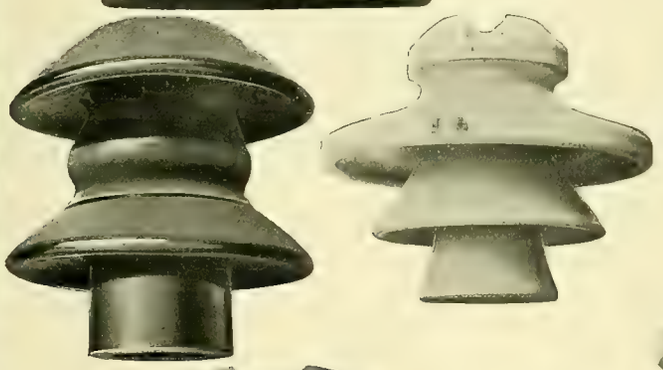
Engineer

1218-1221 Marquette Building, - CHICAGO

HIGH TENSION INSULATORS



A FEW TYPES FOR LINE VOLTAGE UP TO 60,000.



SEND FOR CATALOG SHOWING ALL TYPES.

THE R. THOMAS & SONS CO.

EAST LIVERPOOL, O.

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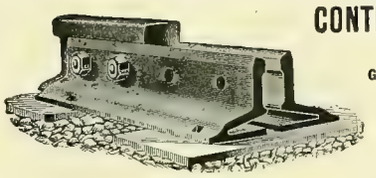
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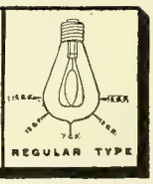
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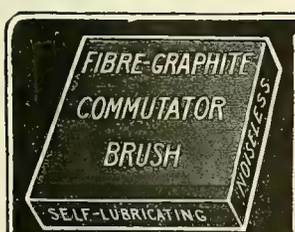

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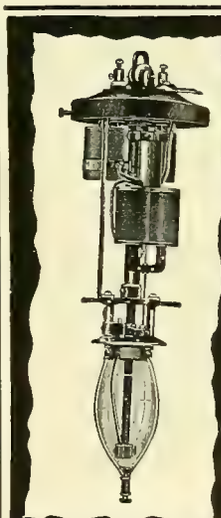
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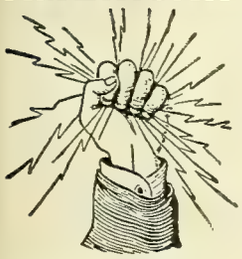

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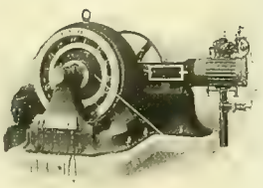

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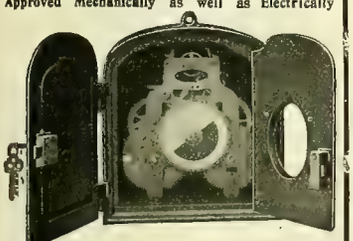

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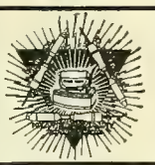

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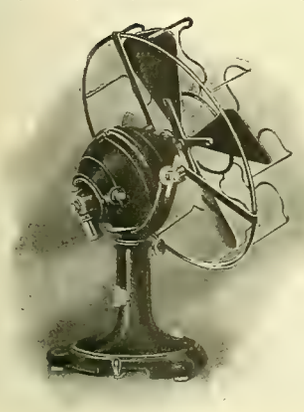

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As superintendent of electric light or water works plant; have had 16 years' experience in electric light business, and 15 years in handling boilers, engines and water works machinery and understand the business from the coal pile up. Will guarantee results as to economy and service furnished. Address BOX 342, care Western Electrician, 510 Marquette Bldg., Chicago

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By married man: ten years' experience with dynamos, motors, arc lights, transformers, interior wiring and line construction, A.C. or D.C.; also storage batteries. If you want a superintendent that knows, let me hear from you. If you use liquor don't answer. A1 references. I mean business. State salary. Address BOX 355, care Western Electrician, 510 Marquette Bldg., Chicago.

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As superintendent of electric plant. Experienced in both A. C. and D. C. systems and polyphase work, and modern systems of series alternating arc lighting. Can design and construct complete plants. Address BOX 357, care of Western Electrician, 510 Marquette Bldg. Chicago.

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As foreman or superintendent with interior construction company by a capable man with practical experience in the different branches of this work. Can plan work, give estimat and manage large contracts and men advantageously. Strictly temperate and a hustler. Address BOX 352, care Western Electrician, 510 Marquette Bldg., Chicago.

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By a young man of good character, first-class wire man and line man. Have completed course Int. Cor. Schools. Over three years' experience in wiring, line work, installing a. c. and d. c. motors, meters, arc lamps, etc. Can calibrate meters. Best of references and will go anywhere. Good knowledge of engines and boilers and familiar with both a. and d. c. apparatus. Prefer position as chief electrician in plant of about 1,500 k. w. capacity. Will take position as superintendent of small plant. Address BOX 344, care Western Electrician, 510 Marquette Bldg., Chicago.

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NOTICE FOR PROPOSALS

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All bids must be addressed to the Village Clerk, Kilbourn, Wis., and endorsed on the outside of the envelope, "Bids for Electric Light Plant."

Bidders must deposit a certified check for an amount equal to 3% of their bids.

Copies of the specifications may be seen at the office of L. W. Burch, Engineer, 323 E. Wilson St., Madison, Wis., or at the office of the Village Clerk, Kilbourn, Wis.

The Village Board of said Village reserves the right to reject any or all bids.

By order of the Village Board of said Village.

A. I. BENNETT,
Village Clerk.

Kilbourn, Wis., May 24, 1904.

"The Nation's pleasure ground and sanitarium." —*David Bennett Hill.*

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All the Brush arc generators have been entirely overhauled by the General Electric Company and are fitted with oil regulators and multicircuit device.

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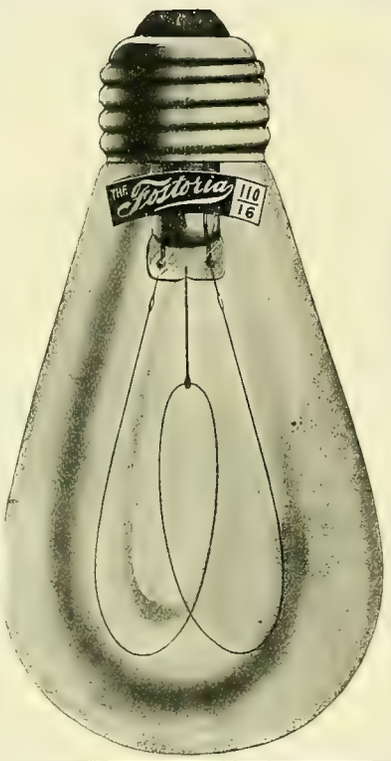

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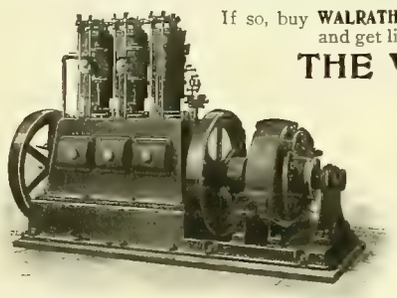

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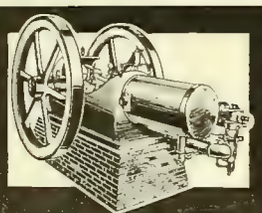

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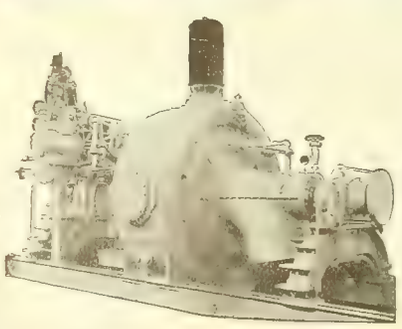

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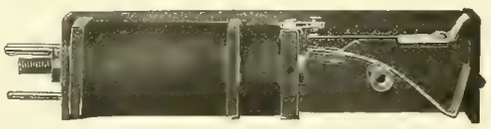

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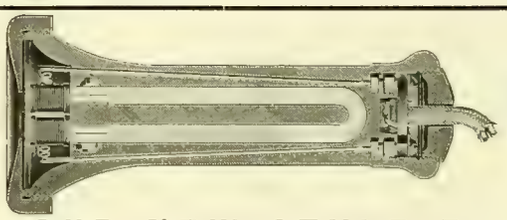

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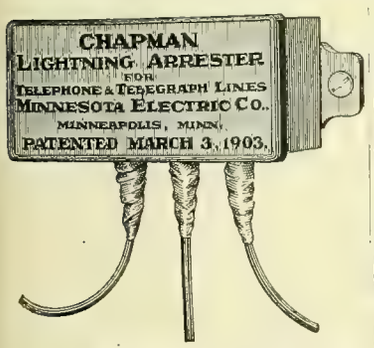

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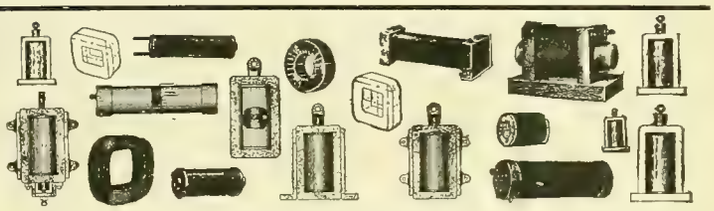

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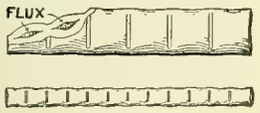

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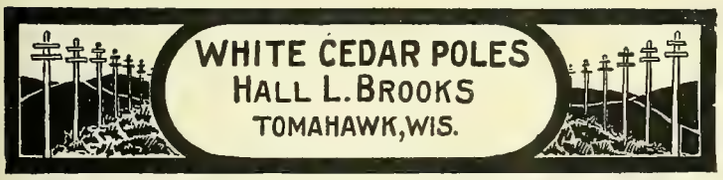

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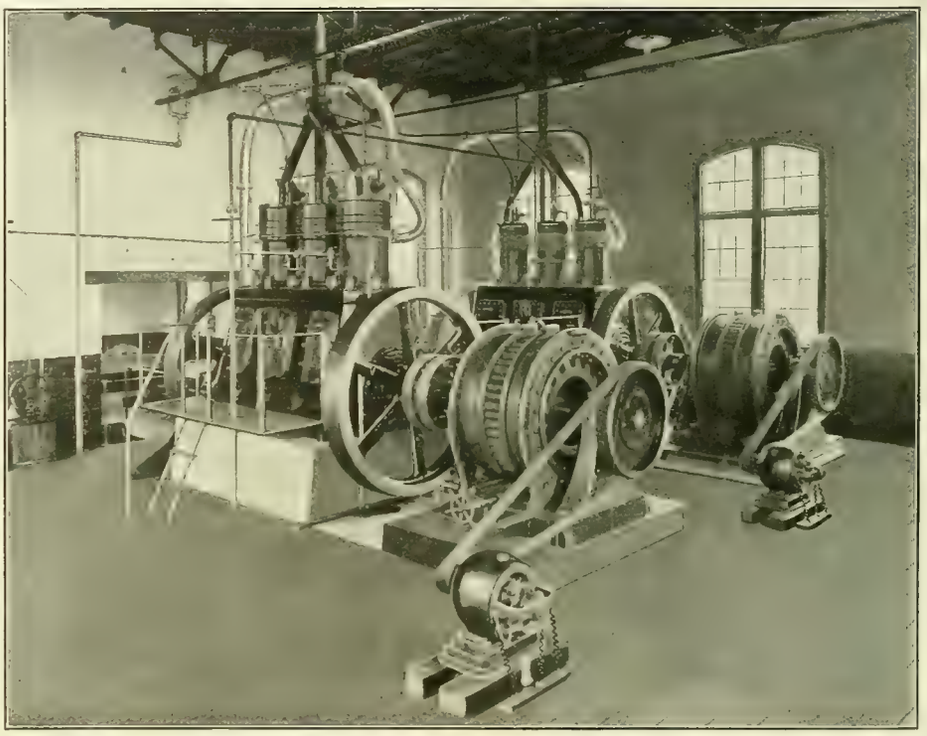

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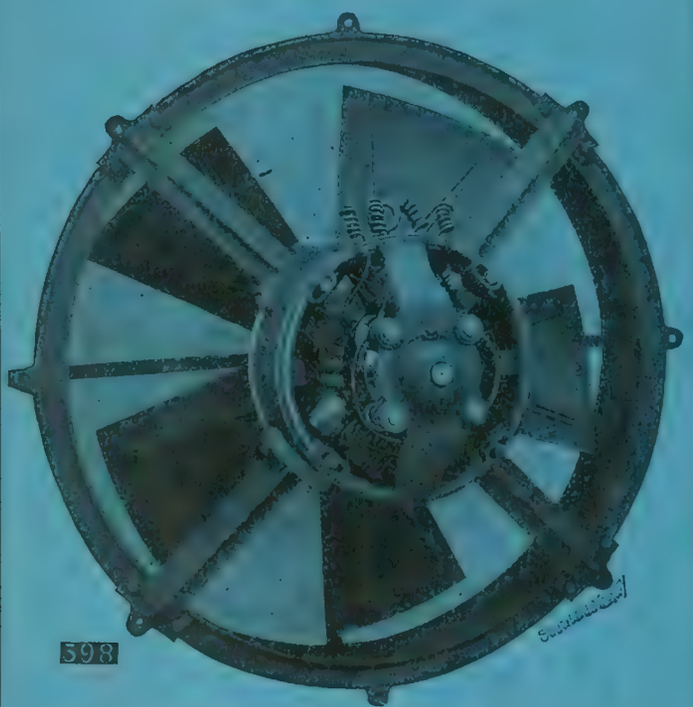

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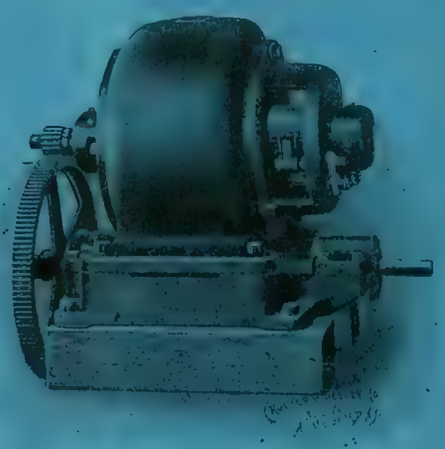

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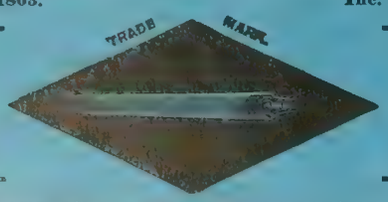

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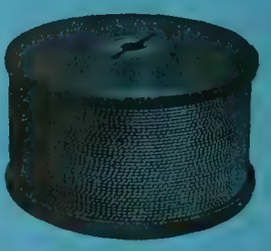

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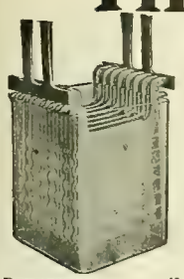

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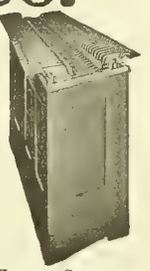

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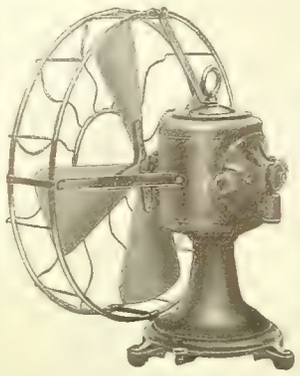

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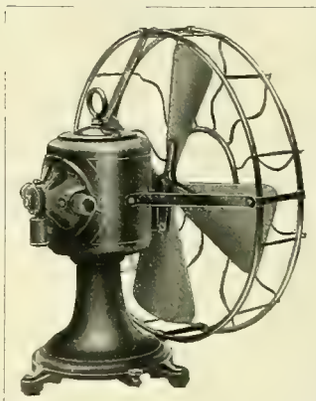

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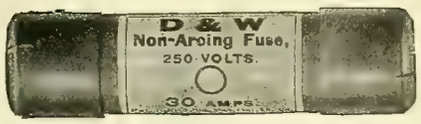

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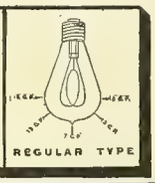
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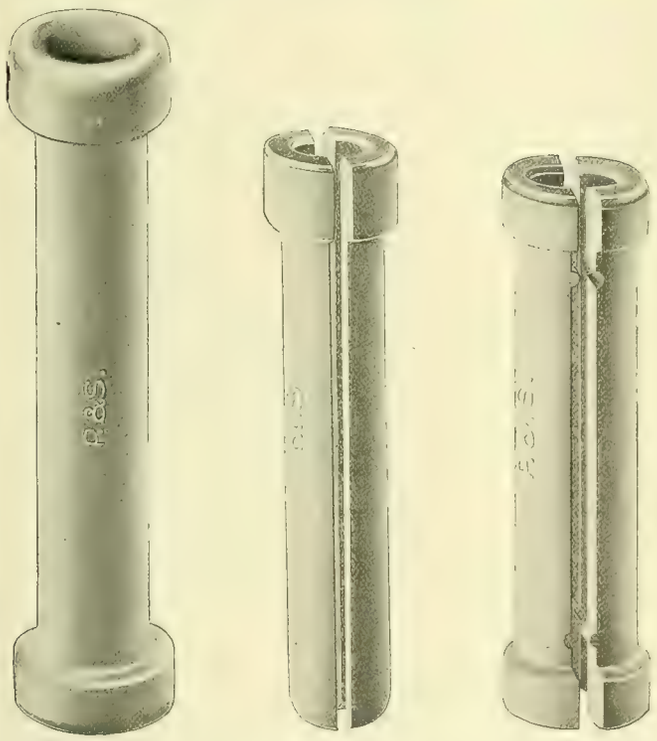

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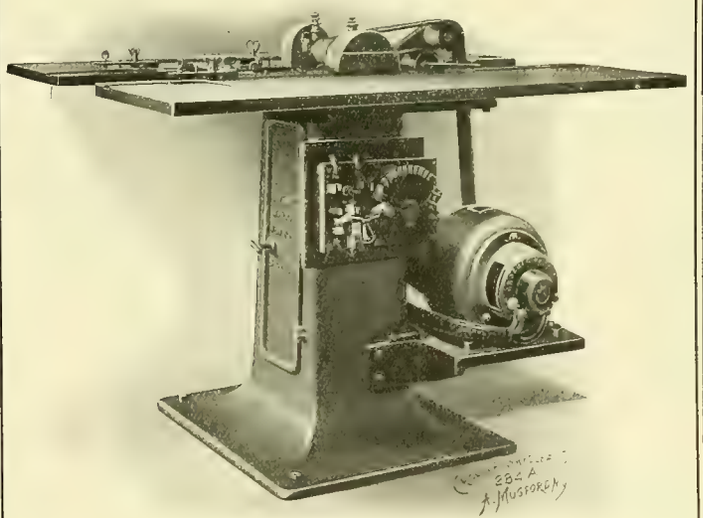
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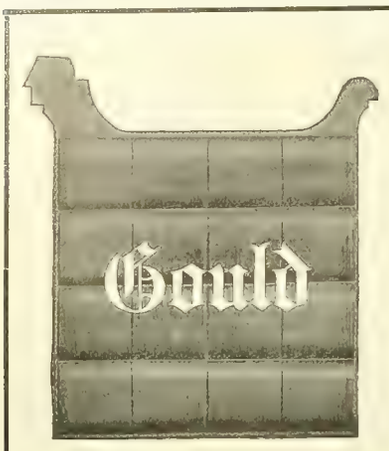

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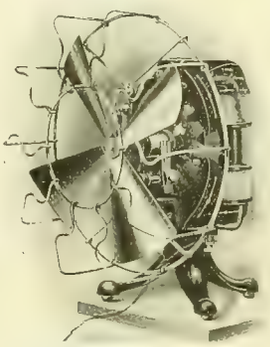

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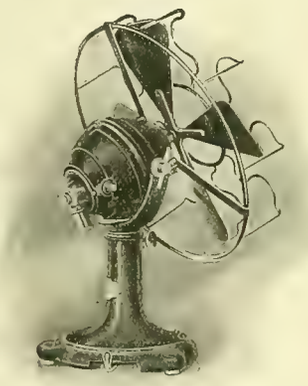

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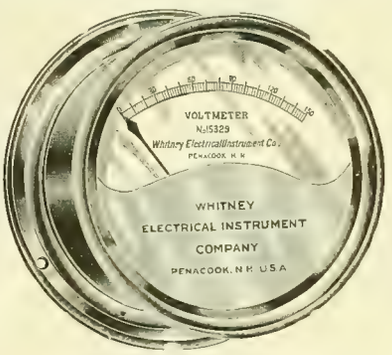

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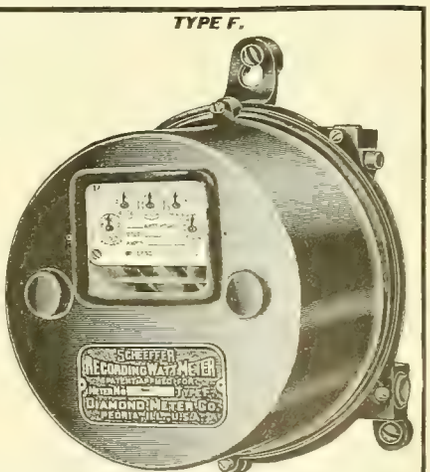

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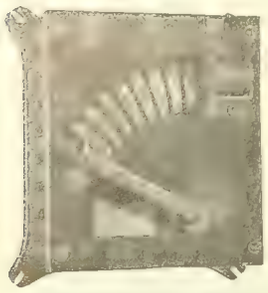

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Central Station Expansion

Is of considerable interest to you and to us. Such expansion means increased revenue for you, and can be effected by means of our

Single Phase Power Motors

without any additional investment for your distributing system. On your present lighting lines a power load can be developed during the day, thus utilizing to its fullest extent your station capacity.

Write for pamphlet "SINGLE PHASE FACTS."

THE WAGNER ELECTRIC MFG. CO.

ST. LOUIS, MO.

FIRE UNDERWRITERS' SALE

EVERY TYPE OF

Bare and Insulated Copper and Galvanized Iron Wire, Cable, Cordage, etc.

ON TUESDAY, JUNE 7th, 1904, AT 10 A. M., WE WILL SELL AT

PUBLIC AUCTION

FOR ACCOUNT FIRE UNDERWRITERS AT OUR TEMPORARY SALESROOMS **117-123 Market St., Chicago,** THE ENTIRE SALVAGE OF

American Electrical Works

Manufacturers Bare and Insulated Wire, Cable, Cordage, etc. "Chicago Branch," 82 Lake Street

CONSISTING OF

$30,000 Worth of Every Type of Bare and Insulated Copper and Galvanized Iron Wire, Cable, Cordage,

Etc., all in practically perfect condition.

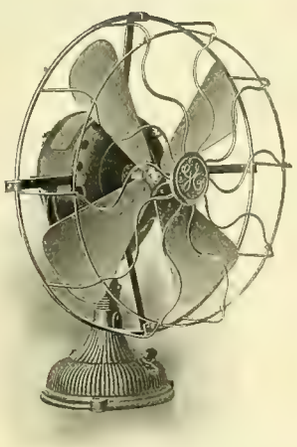
ON EXHIBITION DAY BEFORE SALE

SAMUEL GANS, MANAGER

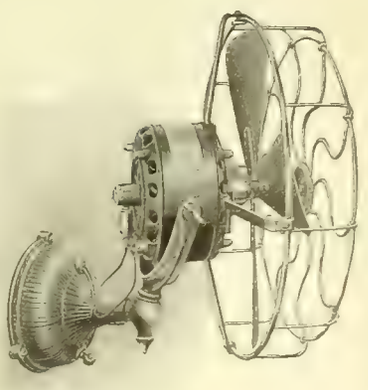
WATCH RECORD-HERALD FOR OUR ADVERTISEMENTS WESTERN SALVAGE WRECKING AGENCY

General Electric Company

FAN MOTORS—1904



Convertible type motors which may be used for either table or wall. Furnished with 12-inch and 16-inch fans for direct and alternating current in all standard voltages.



Desk Motor *Wall Motor*

GENERAL OFFICE: SCHENECTADY, N. Y.

SALES OFFICES IN ALL LARGE CITIES.

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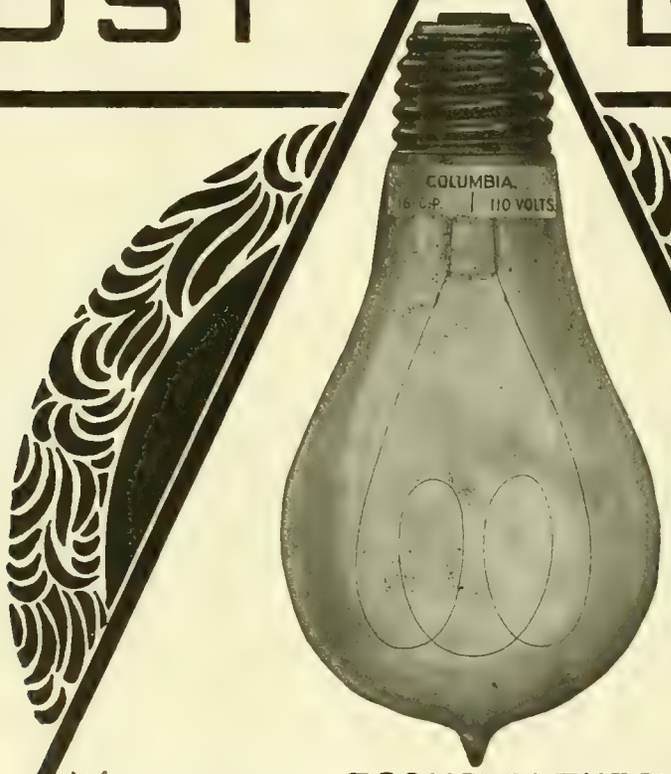
GIVE MOST LIGHT



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Columbia Lamps are manufactured under a license to use the Chemical Exhaust Process of exhausting lamps. This process is vitally necessary in the production of the highest quality of lamp. Every package of Columbia Lamps carries a label reading

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NEW YORK OFFICE: 1311 Havemeyer Bldg.
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SEND FOR OUR "WALLET—FULL OF WISDOM"

Nine Acres of Floor Space

2½ Times Larger than Former Plant

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TO HYDE PARK, MASS.

B. F. STURTEVANT CO., HYDE PARK, MASS.

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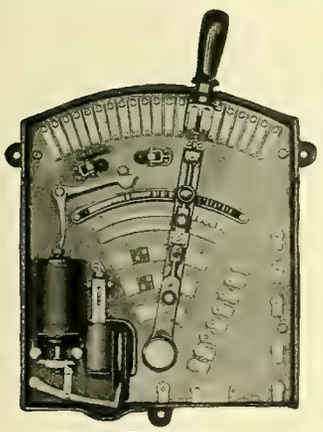

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"Carpenter" Type

Press Controllers

Switch parts completely enclosed.
No arcing on contact surfaces.
Overload device positive and effective.
The most compact, easily installed and complete device on the market.

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Bullock Electric Manufacturing Co.

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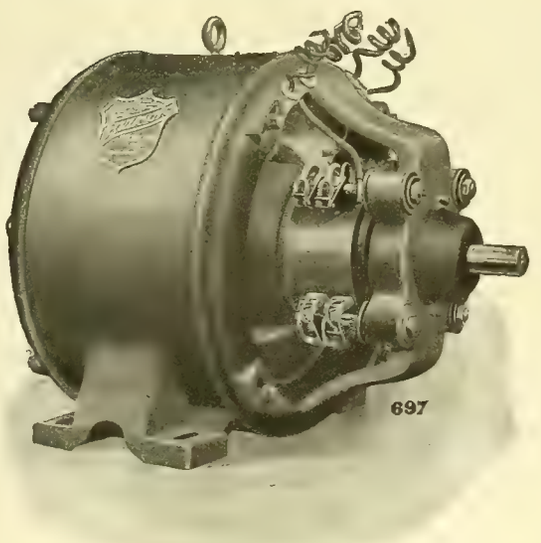

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Especially adapted for driving machinery requiring variable speeds using the BULLOCK Multiple Voltage System.

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SCHOTT'S BALANCED COLUMN HOT WATER SYSTEM

No Back Pressure. No Noise.
Perfect Circulation. Greatest Capacity.
Absolute Regulation in Building.

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Automatic Vacuum Circulation. Greatest Pipe Line Capacity.
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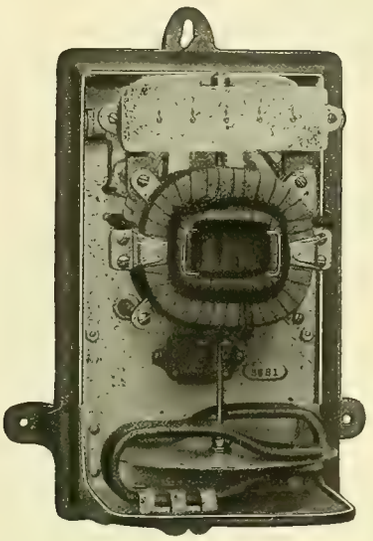
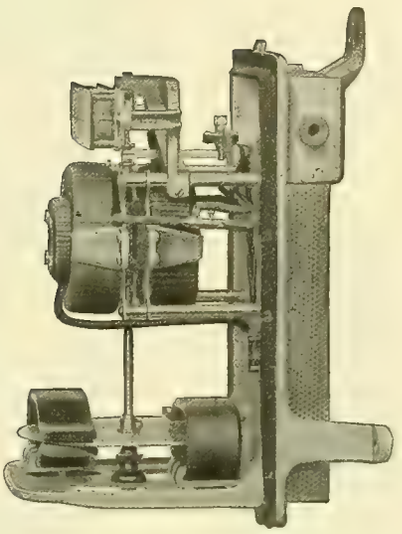
DIRECT CURRENT
WATTMETERS





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NEWEST FEATURES
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"A FAULTLESS METER," CENTRAL STATION MAN'S VERDICT

VISUAL BEARING (something absolutely new); hollow nickel-steel spindle; range of 60% increase in drag; no burning or charring of resistance; fire-proof and dust-proof binding posts; large porcelain direct reading dials; detachable non-tension-changing brushes; artificially aged magnets and commutator; case absolutely dust, insect and moisture proof; threadless jewel post that can be removed and inserted again in an instant; and

An entirely new means of compensating for friction and vibration on light loads by using a small multipoint switch in connection with the compensating coil. By moving the switch arm over the points of contact, any desired range of compensation can be secured instantly.

It is the simplest, quickest and most effective means yet devised and is absolutely permanent. These are some of the new features.

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GOOD GLOBES

We claim they are the BEST!

Unsolicited testimony from the largest users of INNER and OUTER Globes, prove that

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are of the HIGHEST STANDARD.

Try them and be convinced

Use them and you'll say they are the BEST!

☞Have you our catalogue No. 15 illustrating very desirable designs of Globes and Shades for Incandescent Electric Lamps?

For Globes of good quality for any service, write

The Phoenix Glass Company,

NEW YORK PITTSBURG CHICAGO

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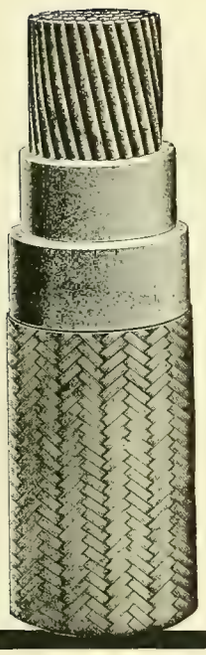

The National and State Governments buy PARANITE because they want the best and in buying PARANITE they DO get the best

Indiana Rubber and Insulated Wire Co.,

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ARE MONEY MAKERS FOR THE CENTRAL STATION.

Increase your day load and make one blade of business grow where none grew before by pushing the sale of Heating Apparatus. But first get information and prices from headquarters.

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ELECTRICAL SUPPLIES.

92-94 W. VAN BUREN ST., CHICAGO

Not a Luxury

Fans are a necessity.
We sell
Desk, Wall and Ceiling
styles for all voltages and currents.

Write for our 1904 bulletins.

THE WESCO SUPPLY CO.

"Everything Electrical" ST. LOUIS, U. S. A.

IMPORTANT TO MICA BUYERS!

Our Competitors Have Increased Prices.

WE HAVE NOT INCREASED PRICES on

Standard Manufactured MICA. We are Satisfied with a Reasonable Profit.

CHICAGO MICA CO., Valparaiso, Ind.

We are Responsible for Present Low Prices.

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

It will put that high gloss on the Commutator you have so long sought after.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or

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FOR ELECTRICAL PURPOSES.

Quality of the Best. Prices Low.

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ARE THE BEST. Send for descriptive Circular.

AMERICAN BATTERY CO., 171 S. Clinton St., Chicago.

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OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.

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For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.

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EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles,

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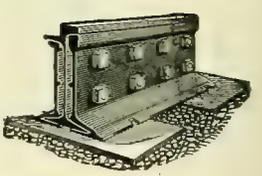

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OVER 20,000 MILES IN USE

Highest Award at Paris Exposition, 1900, Buffalo, 1901

Northern Apparatus

SUPERIOR DESIGN, WORKMANSHIP AND MATERIAL

Built in modern factories, equipped with all modern motor driven machine tools and appliances, enabling us to maintain a high standard of excellence. **Bulletin No. 2535.**

NORTHERN ELECTRICAL MFG. CO. MADISON, WIS.
221 ENGINEERS MANUFACTURERS U. S. A.

BABY AMMETER for Isolated Plants
LIST PRICE $15.00

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are now prepared to furnish their new type of Ammeters, Voltmeters, Portable Standard Round Pattern and Baby Instruments, for direct current, and solicit the patronage of their many friends.

DEAD-BEAT=Highest Grade Instruments=OUR SPECIALTY

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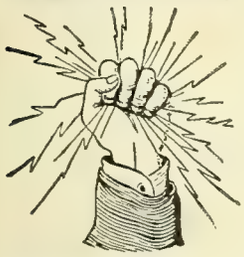
AMERICAN ELECTRICAL WORKS,



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BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,

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AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

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A Worm's Eye View of

STOMBAUGH GUY ANCHORS

THEY WORM THEIR WAY IN LIKE A CORKSCREW INTO A CORK

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES

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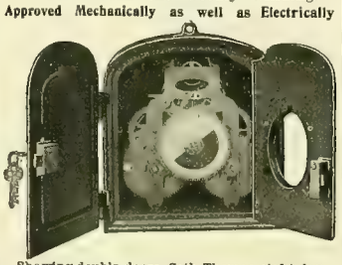
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

THE Hartford Time Switch

A mechanically operated switch, which turns lights ON and OFF at such hours as the user desires with no further attention than the weekly winding.

Approved Mechanically as well as Electrically



Showing double doors, Seth Thomas eight-day movement, auxiliary cut-out, auxiliary hand-trip, and switch indicator.

For controlling current used for show window lights, electric sign lights, street lights, apartment house hall lights, motors, batteries, burglar alarms. :: 10, 20, 35 and 50 Amperes. 250 Volts. 1, 2 and 3 Poles.

Consult us regarding any requirements

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GET ALLEN SOLDERING STICKS

MAKE SOLDER FLOW

FOR ALL ELECTRIC WORK

DO YOUR BEST—GET THE HABIT

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A Big Sample Stick for 10c.

Booklet "Soldering Sense" describes.

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Generators, Motors, Clutches, Commutator Truing Devices.

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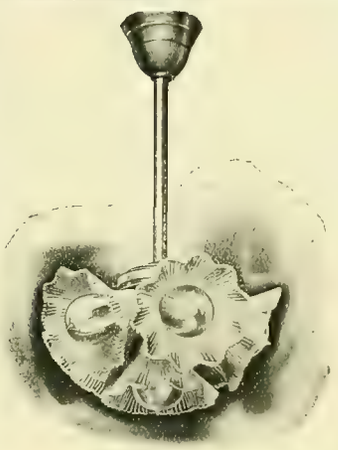
UNDERGROUND CONDUIT

RIGHT IN THEORY — RIGHT IN PRACTICE — RIGHT IN PRICE



Pagoda Wireless Clusters

Most Efficient and Cheapest Cluster on the Market.

Combines the advantages of the Benjamin, Dale and similar Clusters with the tremendous reflecting powers of the well-known

PAGODA SHADES.

Furnished in Edison Base Multiple only.

Suitable for lamps ranging from 4 to 24 C. P.

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Holophane Glass Co.

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WESTERN DISTRIBUTORS
V. R. LANSINGH CO.
207-211 Jackson Boulevard. - - - CHICAGO

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WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.

Slow-Burning Weatherproof and Ideal Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.

Office and Factory: PAWTUCKET, R. I.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

5 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

COLOR YOUR LAMPS

BY USING

CRYSTAL CHEMICAL COLORING

Cost One Cent Per Lamp

Brilliant, permanent color. Easily applied. Nine decorative effects. It will pay you to investigate.

WEBSTER CHEMICAL CO.

ST. PAUL, MINN.

DO YOU WANT THE BEST?

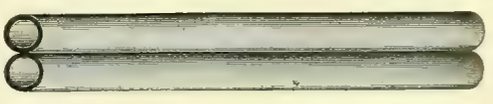
Then ALWAYS buy

THE MAXSTADT PATENT JOINT

Manufactured and sold by the owners of the Maxstadt Patent No. 655,905.

This is the best Joint on the market and gives entire satisfaction wherever used.

No. 882 represents the Joint ready for use.
Patented August 14, 1900, in the United States and Foreign Countries.



No. 882.

No. 884 represents the Joint, twisted, complete on the line.

No. 884.

These Joints are furnished in copper for copper wire and in tinned steel for galvanized iron wire. Samples and prices will be sent, without charge, upon request.

SOLE OWNERS OF THE MAXSTADT PATENT IMPROVED AMERICAN JOINT.

CHICAGO DIE & ELECTRIC COMPANY, 87-91 West Lake Street, CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

Cornell graduate in electrical and mechanical engineering desires change of position. Practical experience includes power plant and shop superintendence; power plant designing and testing; laying out and installing shop equipments; electric and pneumatic power distribution: applications of electricity in manufacturing plants, particularly individual motor drive; estimating; preparation of specifications and correspondence. Broad knowledge of general machinery. Executive and business ability. Excellent references. Satisfactory reasons for desiring change. Could invest small capital. Location, South or West. Address BOX 356, care of Western Electrician.

POSITION WANTED.

By first-class electrician with vast experience and general knowledge of the electrical machinery with light and power plant, railways, mills, factories or shops; conveyant with general repair. Thoroughly understands care, maintenance and economical management of same. Capable of taking charge of any system. Strictly sober and reliable; best reference as to character and ability. Address BOX 354, care Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

As superintendent of electric light or water works plant; have had 16 years' experience in electric light business, and 18 years in handling boilers, engines and water works machinery and understand the business from the coal pile up. Will guarantee results as to economy and service furnished. Address BOX 342, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent of electric plant. Experienced in both A. C. and D. C systems and polyphase work, and modern systems of series alternating arc lighting. Can design and construct complete plants. Address BOX 357, care of Western Electrician, 510 Marquette Bldg. Chicago.

POSITION WANTED.

All-round electrician of 10 years' experience, making a specialty of meters, motors arc lamps and all kinds of wiring wishes to leave the city and will consider an offer of a steady position with a plant where willingness means advancement. Salary reasonable. Address BOX 359, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

40 to 50 K. W. direct-connected unit. Must be standard make in first-class condition and a bargain for spot cash. Address, McGUIRE & COBB, Hotel Warner, 33d St. and Cottage Grove Ave., Chicago.

WANTED.

An electrical engineer graduate of noted technical university, eight years' experience in telephone engineering with prominent Bell company—experience covers inside and outside construction, traffic, theoretical and experimental work—desires a position, executive or engineering, with a large manufacturing or operating telephone company. Best possible references will be furnished. BOX 360, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

I have a limited amount of money to invest in an A1 specialty which can be manufactured at small cost and sold at a good profit. Willing to take in partner or buy outright. Article must have merit to receive consideration. Give full particulars. Address BOX 361, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

An established jobbing and construction house in a good city in the West. Price, $11,000. Owner has not the time to devote to the business. This is an excellent offer and is a splendid opportunity. BOX 358, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

A completely equipped electric light, power and heating plant in a city of 2,500 inhabitants. Incorporated under the laws of Illinois. The plant is thoroughly up to date, with complete duplicate equipment, and is constantly increasing its list of consumers. Parties owning the same wish to retire from this line of business and will sell for actual cost, taking part cash and mortgage for balance if desired. Charter, franchises and contracts will go with plant. Inspection of plant invited at any time. Address BOX 351, care Western Electrician, 510 Marquette Building, Chicago, Ill.

NOTICE FOR PROPOSALS

Sealed proposals will be received at Kilbourn City, Wis., until 4 p. m., Thursday, June 9th, 1904, for furnishing all labor, material and apparatus necessary for the construction of a complete electric lighting plant for the village of Kilbourn City in accordance with the plans and specifications on file with the village clerk of said village.

All bids must be addressed to the Village Clerk, Kilbourn, Wis., and endorsed on the outside of the envelope, "Bids for Electric Light Plant."

Bidders must deposit a certified check for an amount equal to 3% of their bids.

Copies of the specifications may be seen at the office of L. W. Burch, Engineer, 323 E. Wilson St., Madison, Wis., or at the office of the Village Clerk, Kilbourn, Wis.

The Village Board of said Village reserves the right to reject any or all bids.

By order of the Village Board of said Village.

A. I. BENNETT,
Village Clerk

Kilbourn, Wis., May 24, 1904.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

RUBBER MATS
FOR SWITCHBOARDS.
WALSH'S SONS & CO.
261 Washington St., NEWARK, N. J.

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.

For tickets and further information apply to nearest ticket agent, or write

AS. C. POND. Gen'l Pass. Agt., Milwaukee, Wis

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All Kinds.
ELECTRICIAN PUBLISHING COMPANY,
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DIRECT CONNECTED RAILWAY UNITS.

850 Kw. with cross-compound Corliss engine.
500 Kw. with cross-compound Corliss engines.
425 Kw. with simple Corliss engine.
425 Kw. with simple Greene engine.
400 Kw. with Russell four-valve engines.
400 Kw. with simple Corliss engine.
325 Kw. with tandem compound engine.
300 Kw. with tandem-compound engine.
300 Kw. with tandem compound engines.
250 Kw. with Westinghouse compound engine.
225 Kw. with cross-compound engine.

DIRECT CONNECTED LIGHTING AND POWER UNITS.

300 Kw. 60-cycle two-phase, with simple engine.
300 Kw. 60-cycle three-phase, with simple engine.
200 Kw. 60-cycle three-phase alternator, with simple engine.
200 Kw. 25-cycle three-phase alternator, with simple Buckeye engine.
150 Kw. 60-cycle single-phase alternators with tandem-compound engines.
125 Kw. 125-volt, with simple engines.
75 Kw. 250-volt, with simple engine.
75 Kw. 125-volt, with simple engine.
60 Kw. 125-volt, with simple engine.
50 Kw. 125-volt, with tandem-compound engine.
50 Kw. 125-volt, with simple engine.
42 Kw. 240-volt, with simple engines.
25 Kw. 250-volt, with simple engines.
25 Kw. 125-volt, with simple engine.

BELT DRIVEN ALTERNATORS.

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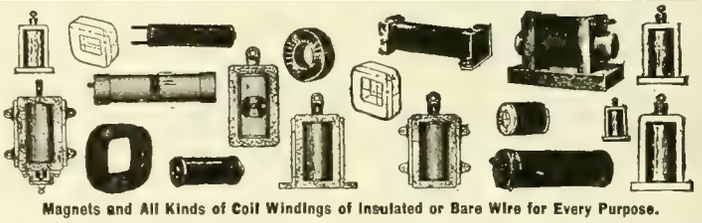

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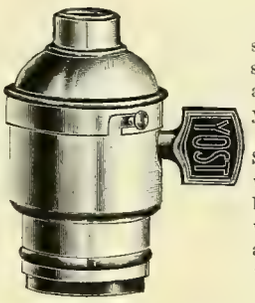

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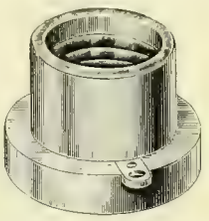

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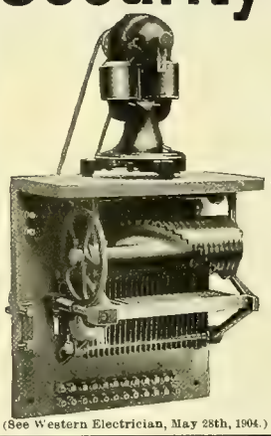

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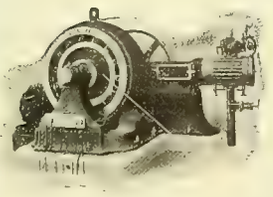

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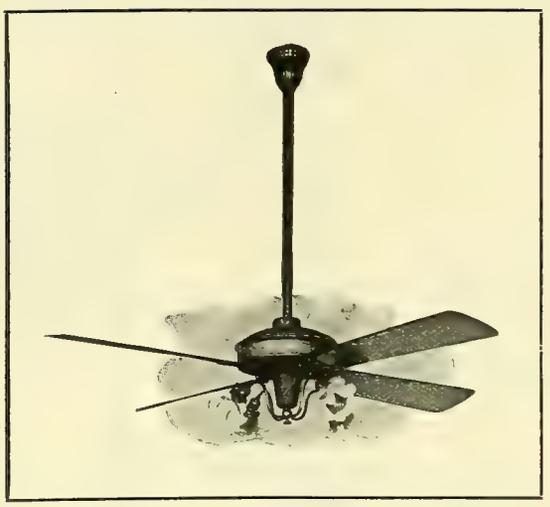

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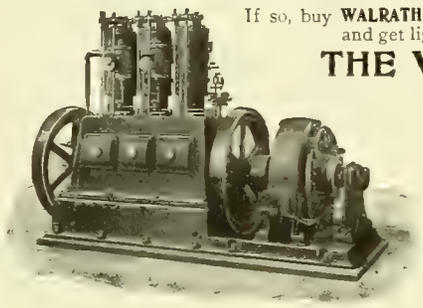

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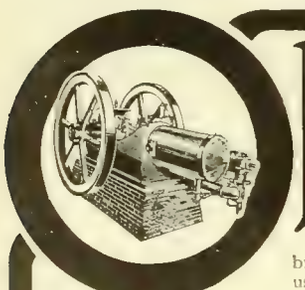

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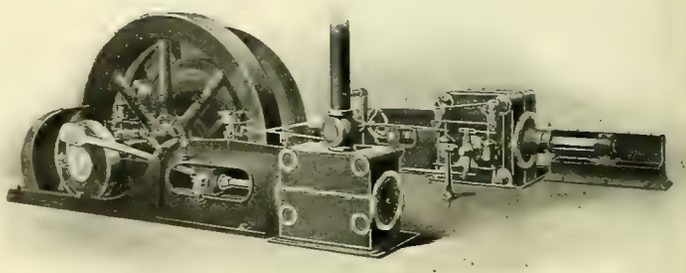

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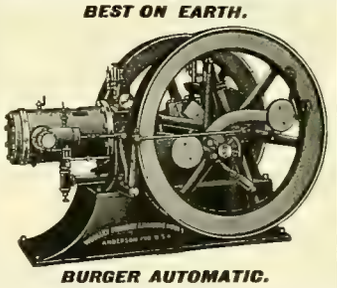

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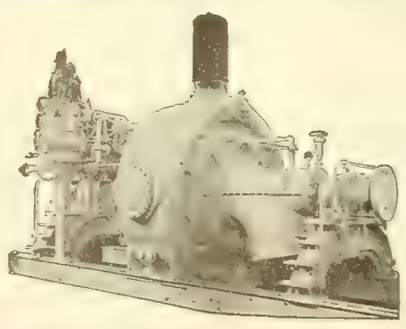

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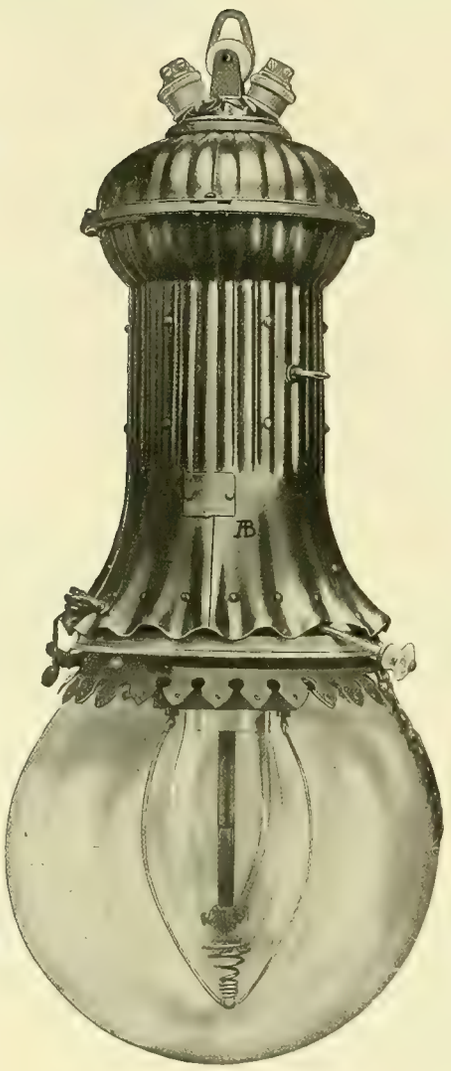

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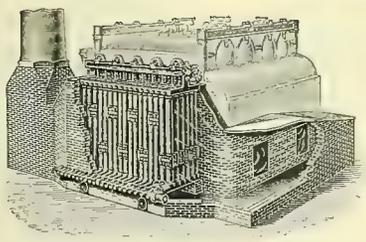

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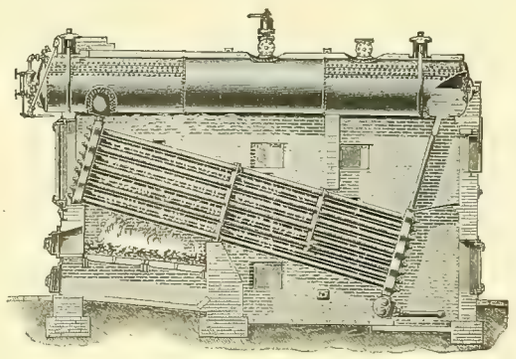

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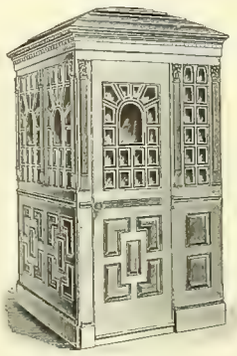

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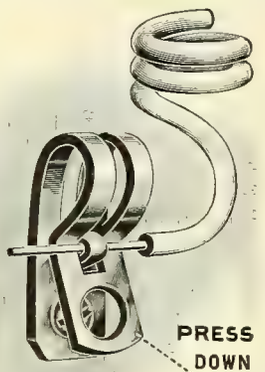

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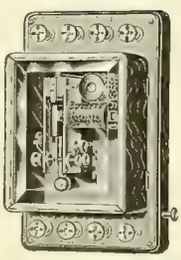

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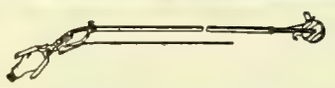

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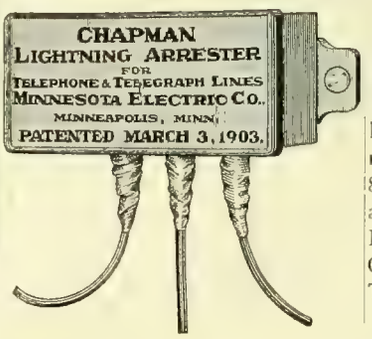

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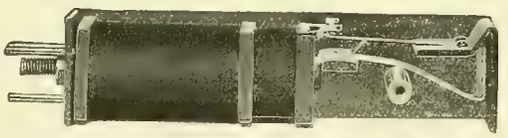

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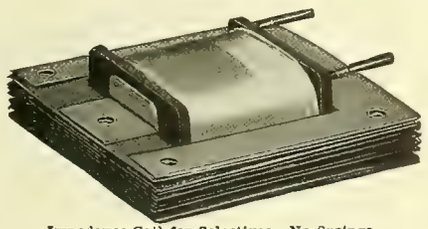

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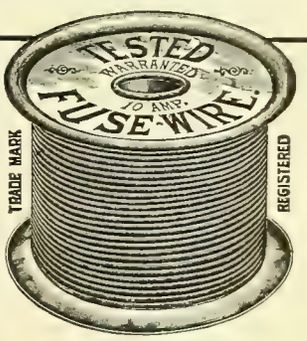

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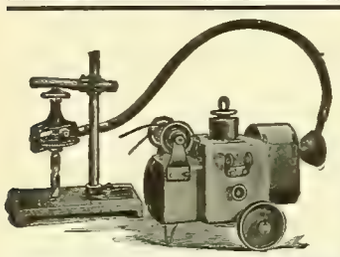

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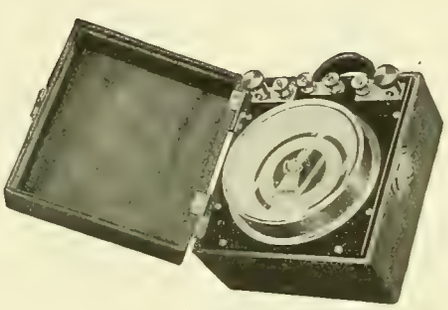

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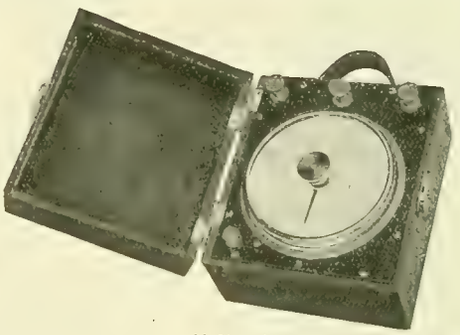
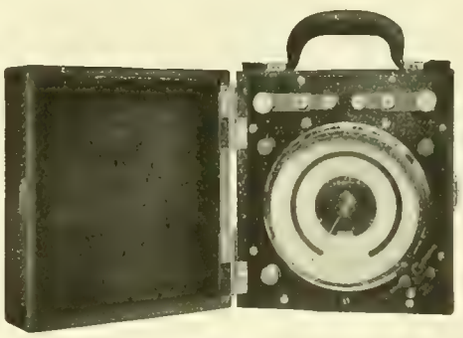


Voltmeter



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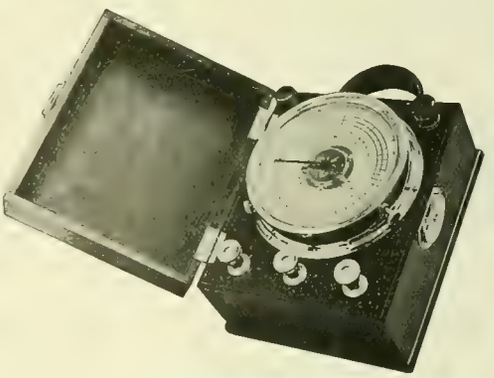

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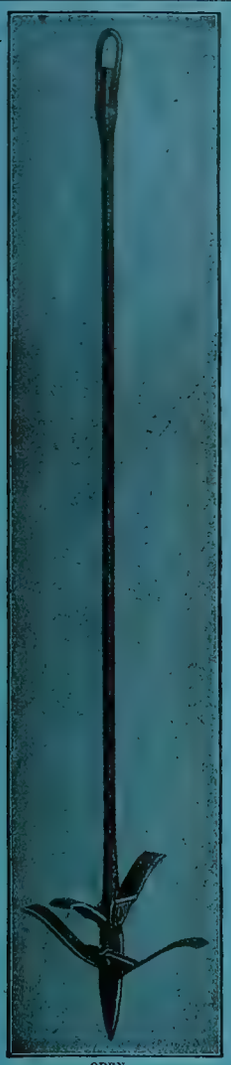
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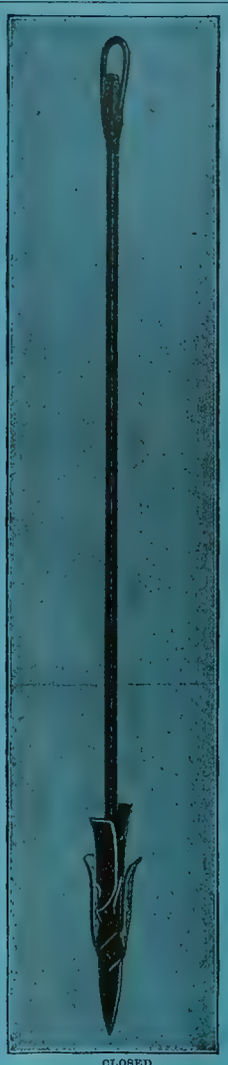
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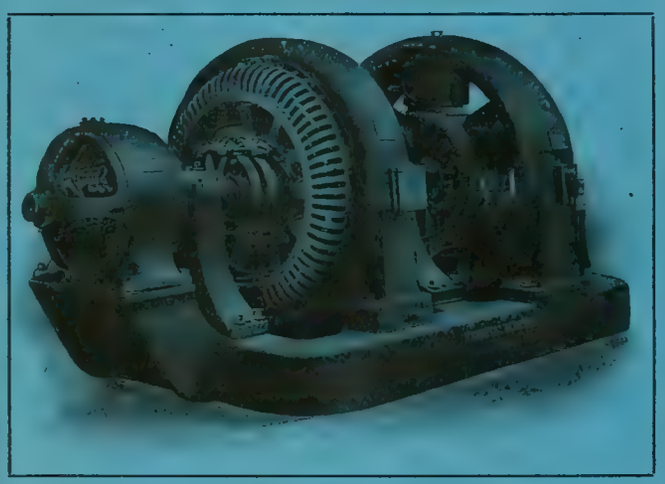

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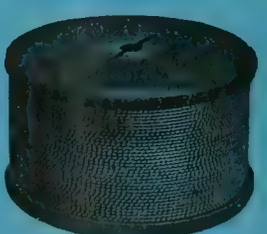

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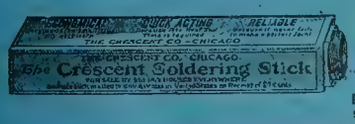

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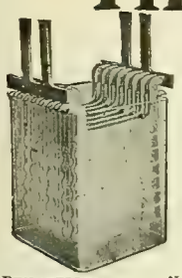

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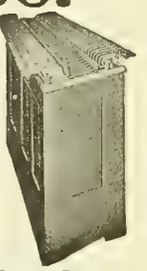

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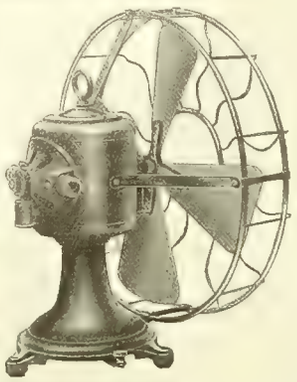

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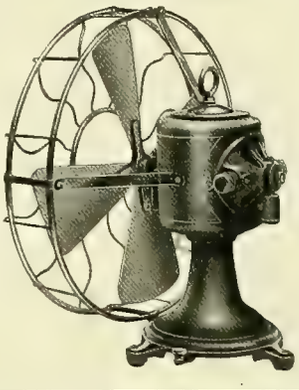

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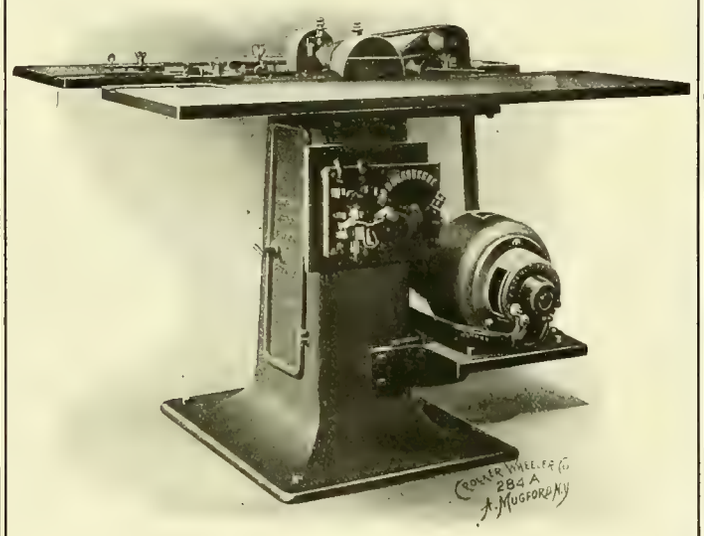

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Branch Offices in Sixteen Principal Cities

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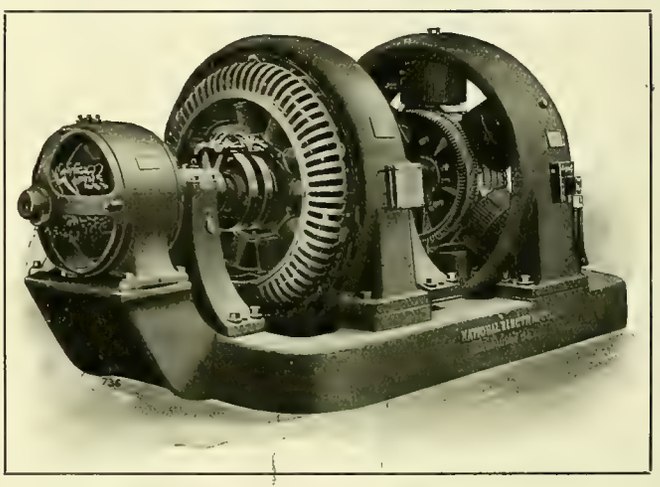
builders of high-grade Electrical Machinery for LIGHTING, POWER and RAILWAY SERVICE



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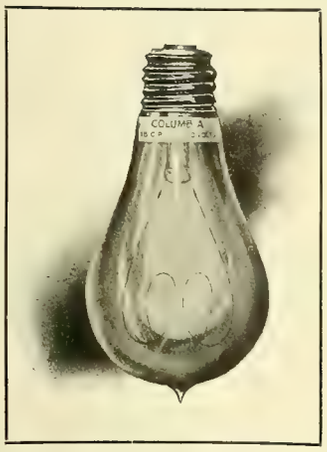

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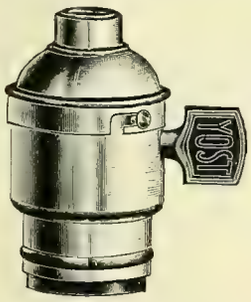

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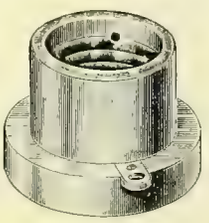

THE YOST ELECTRIC MFG. CO.

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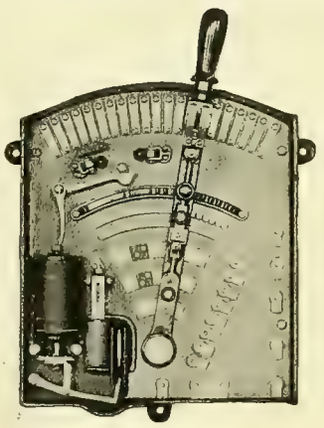

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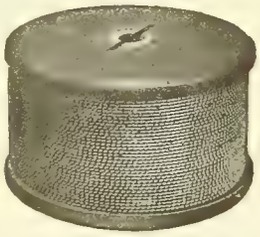

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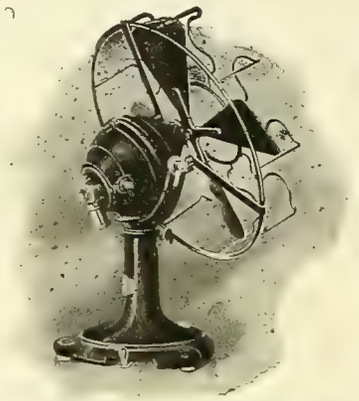

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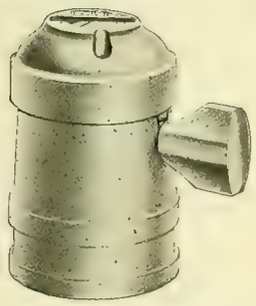

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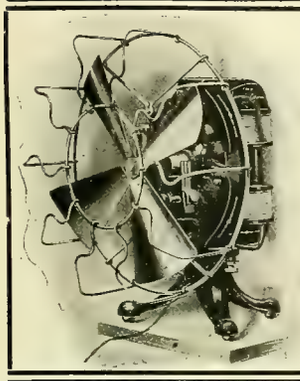

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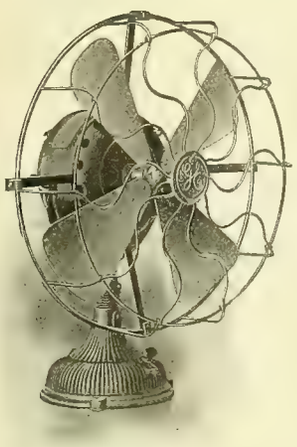

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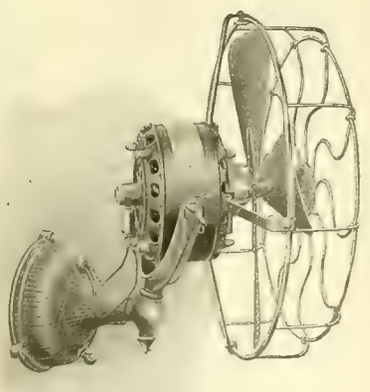

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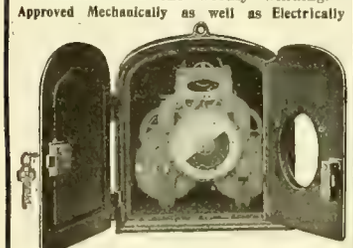

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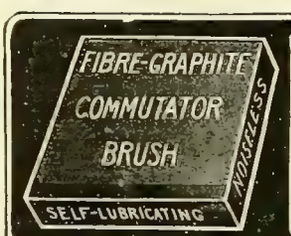

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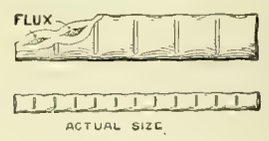

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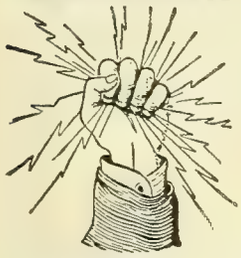

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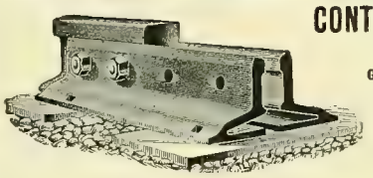

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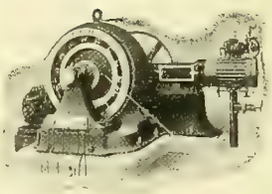

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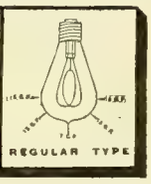

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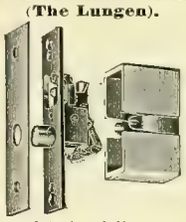

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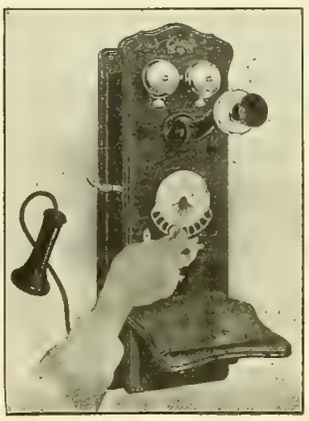

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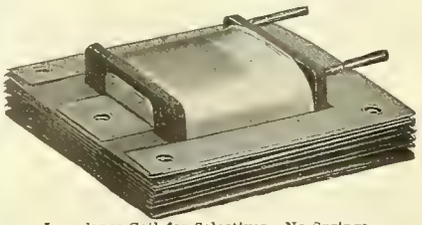

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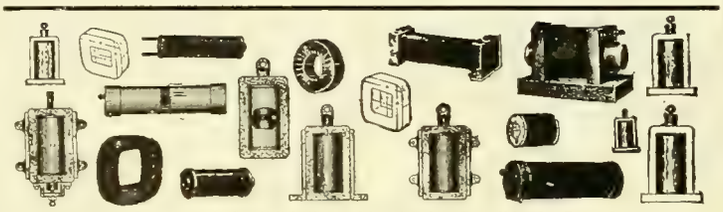

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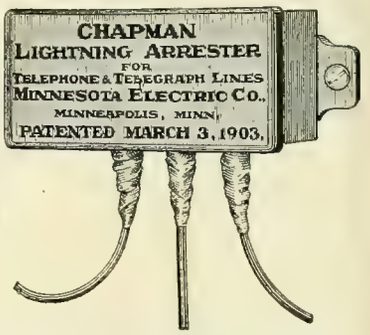

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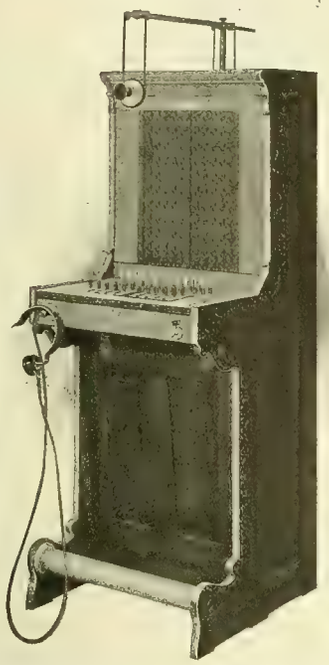

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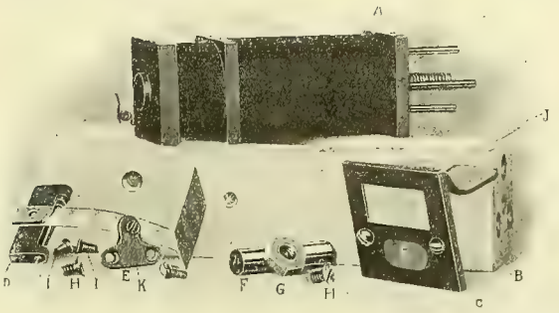

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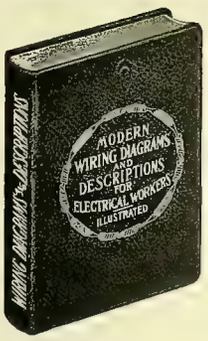

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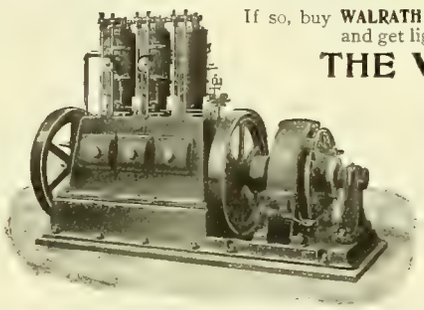

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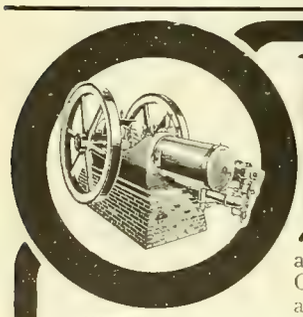

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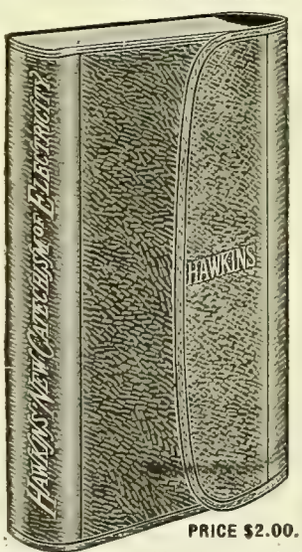

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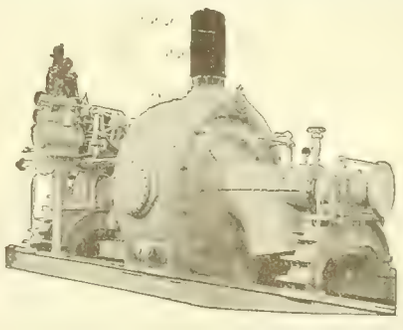

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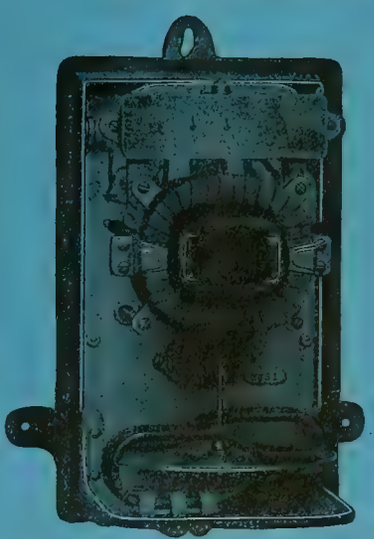

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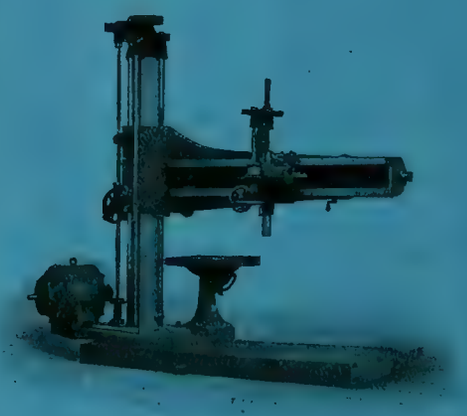

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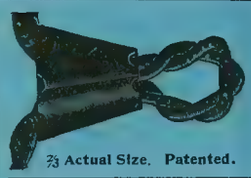
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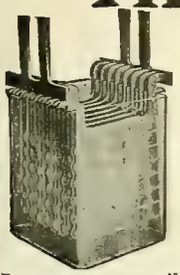

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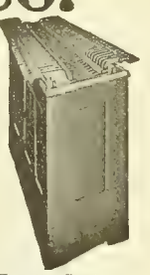

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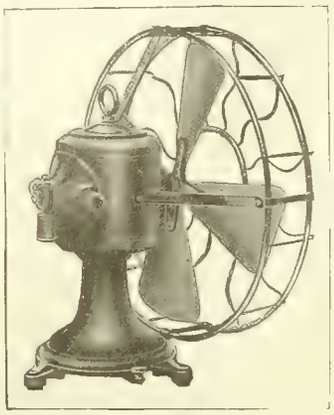

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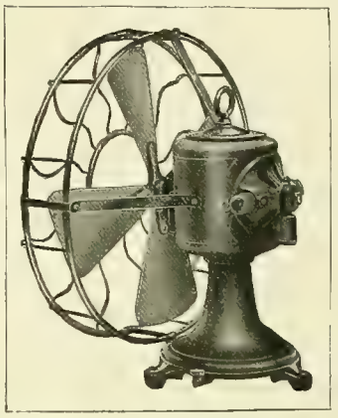

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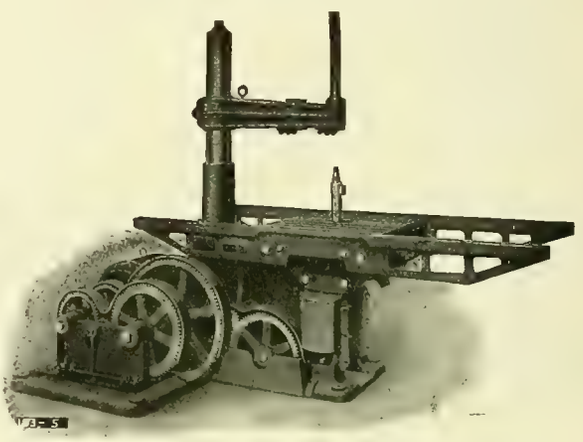

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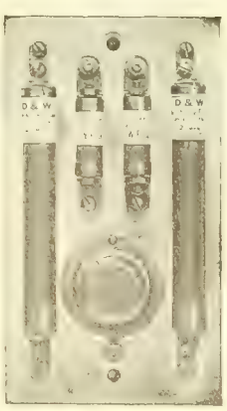
The Bullock Multiple Voltage System

provides the only successful means of controlling the speed of motors driving machinery which requires variable speeds.



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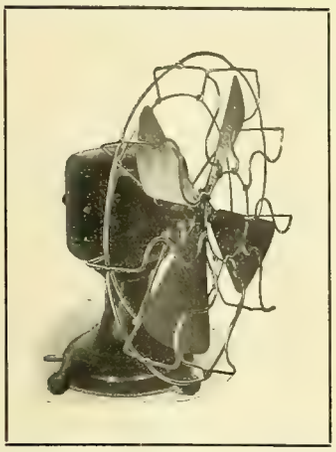

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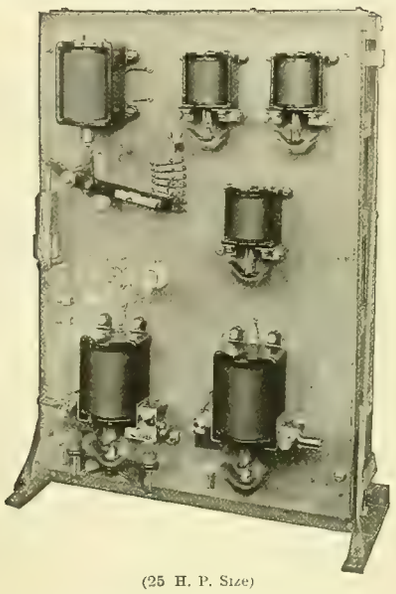

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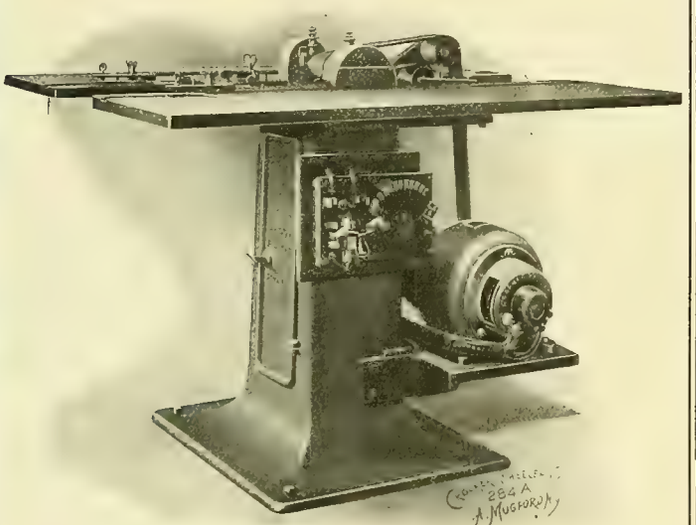

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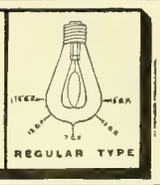

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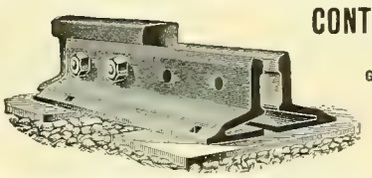

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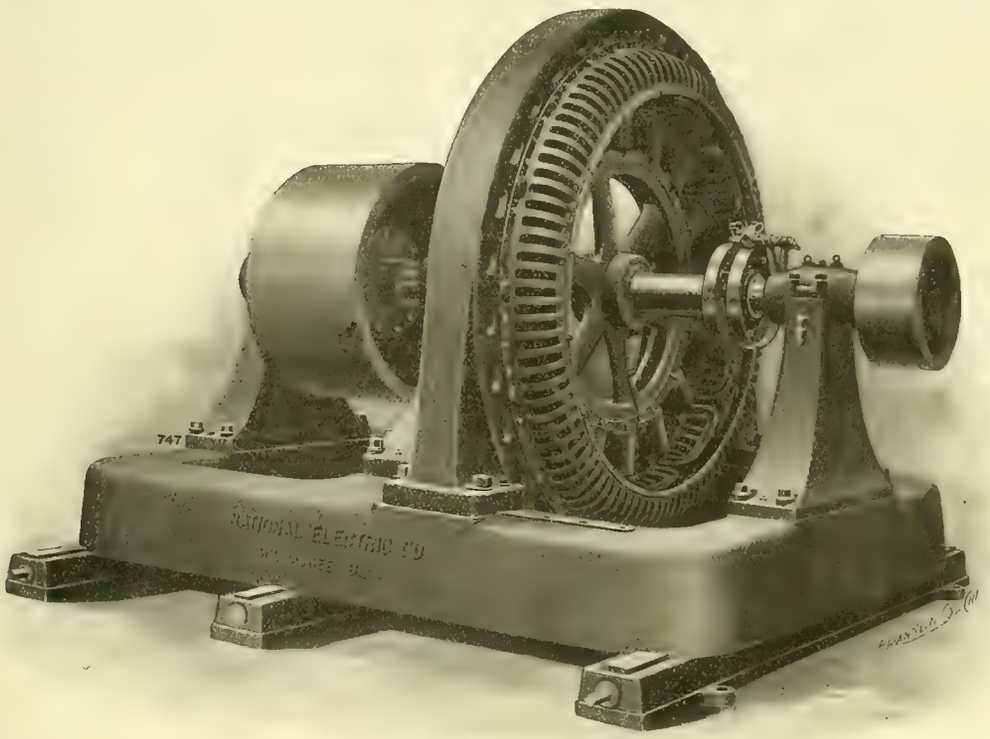

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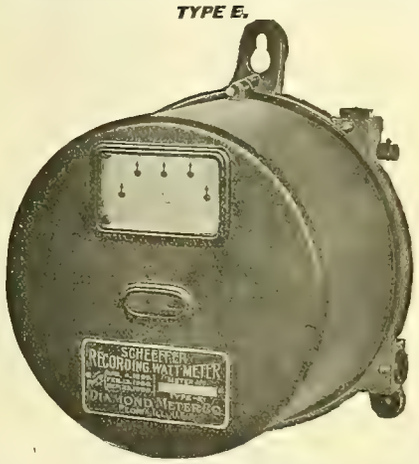

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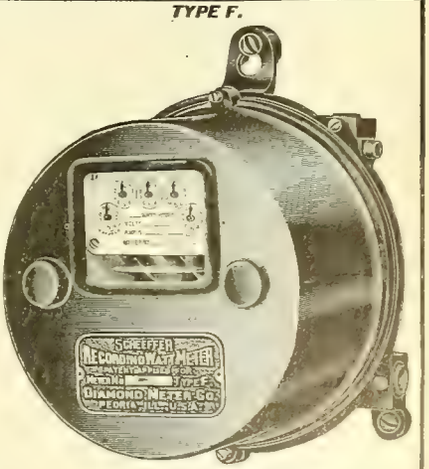

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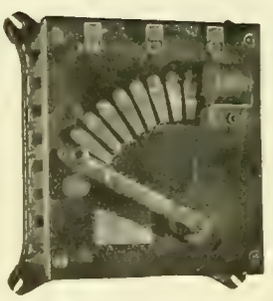
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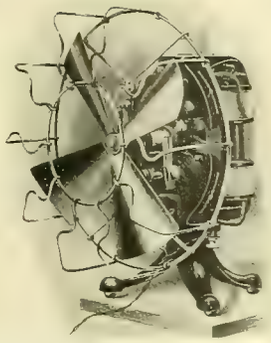
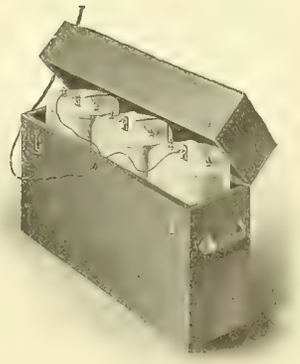


EDISON BATTERY FAN MOTOR OUTFITS



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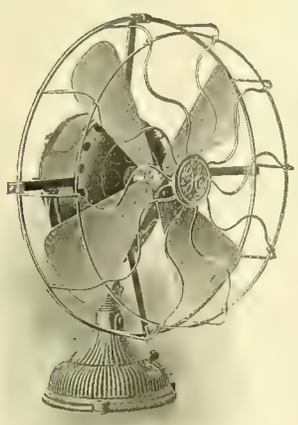

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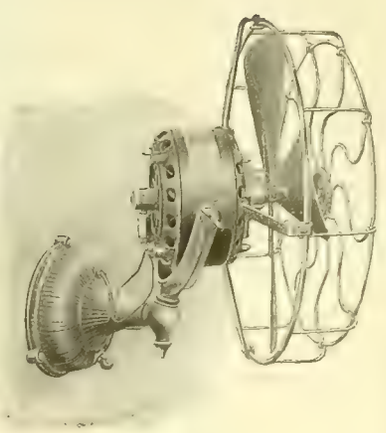

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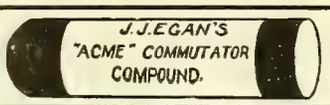

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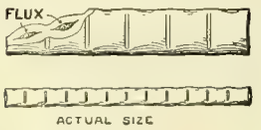

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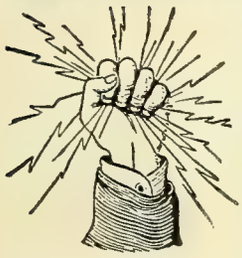

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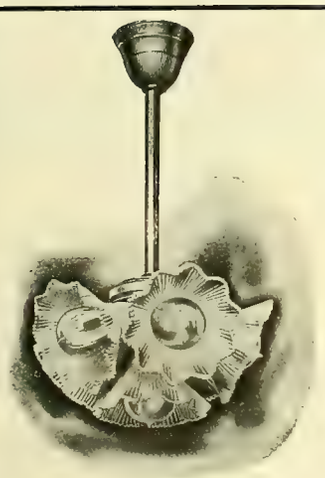

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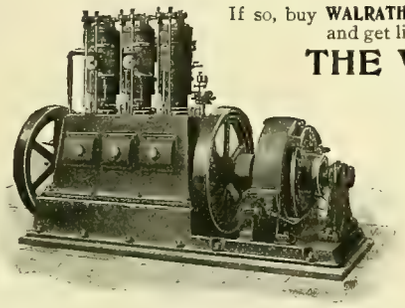

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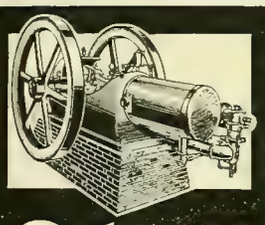

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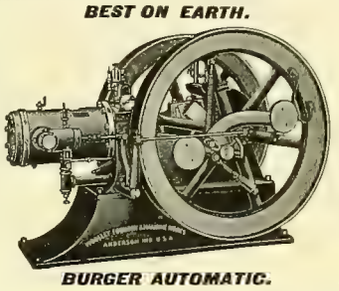

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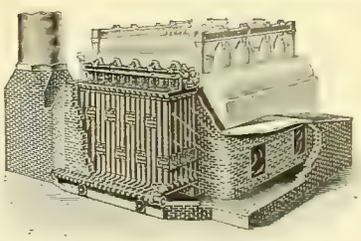

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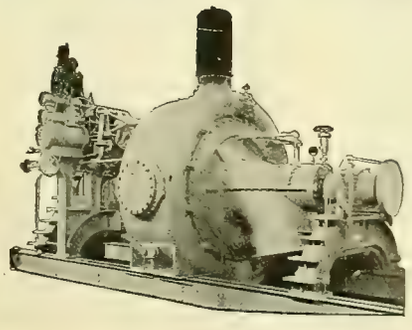

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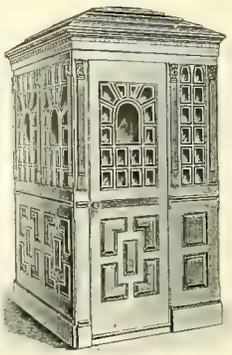

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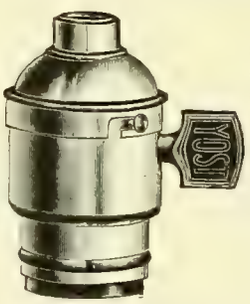

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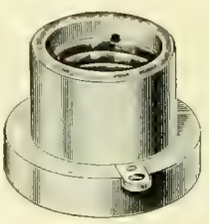

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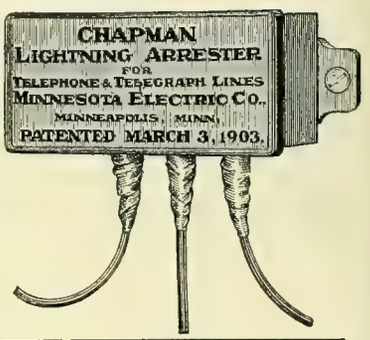

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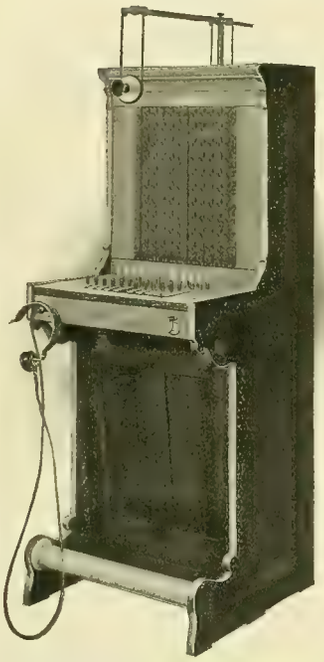

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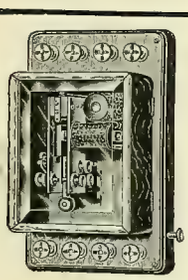

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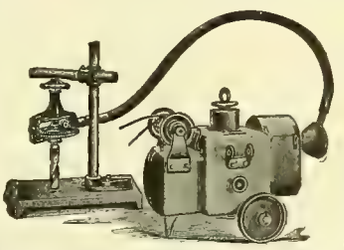

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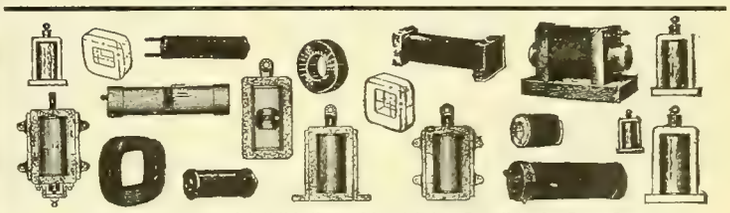

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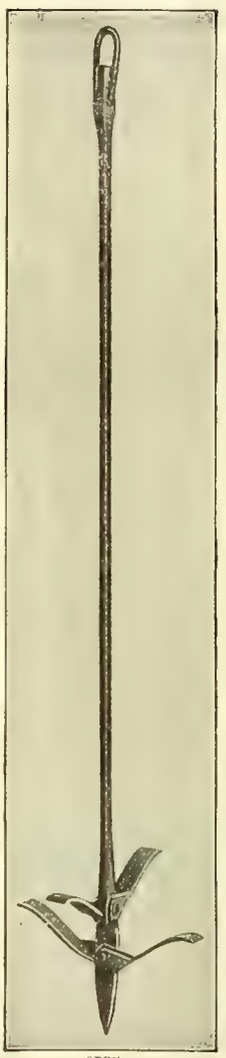
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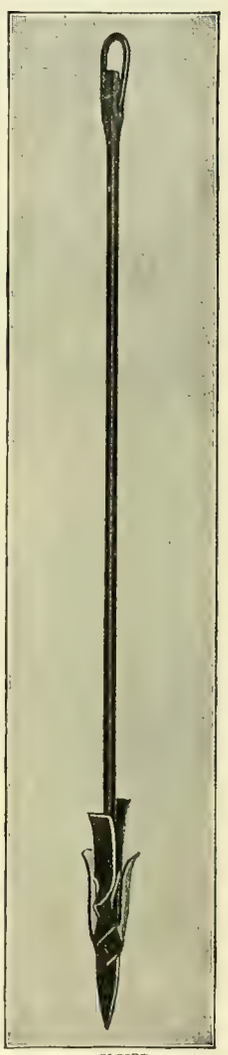
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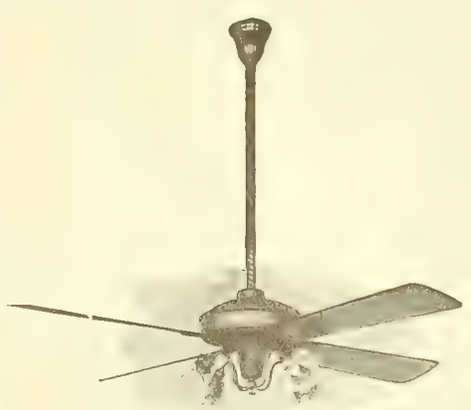

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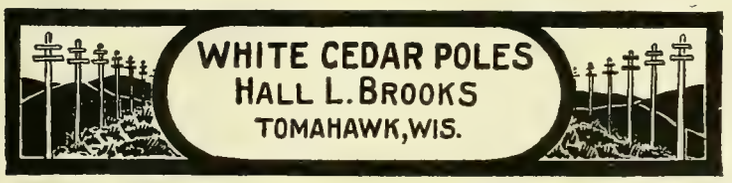

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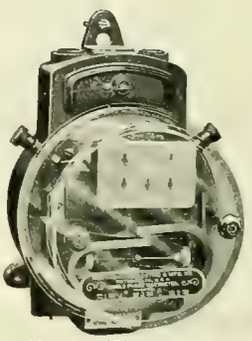

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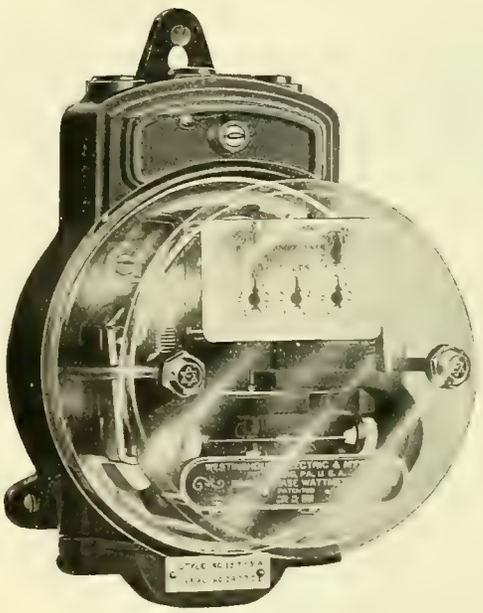

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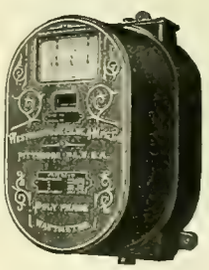

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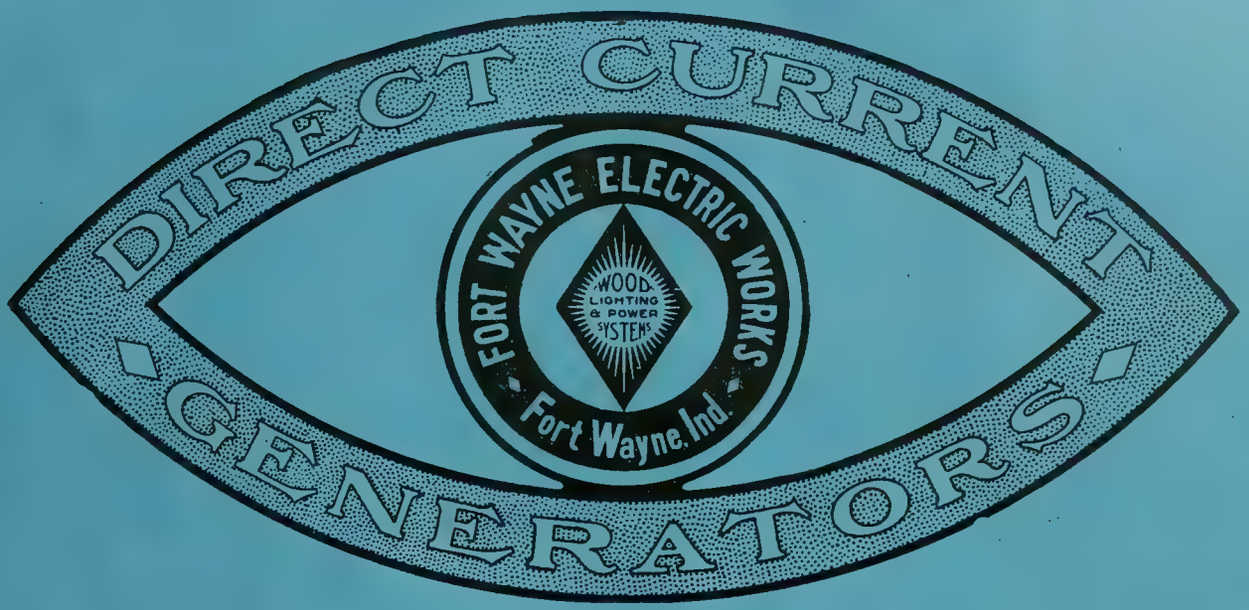

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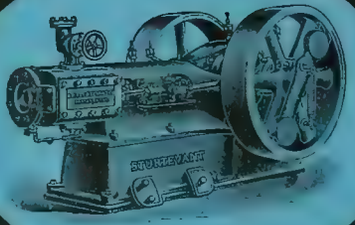

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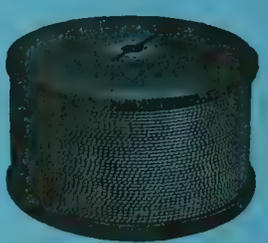

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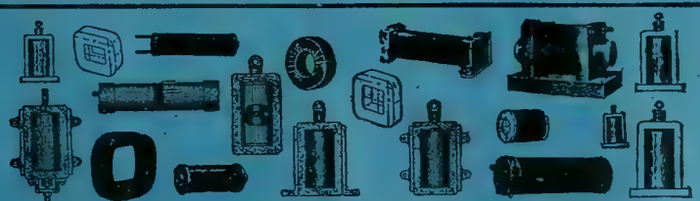

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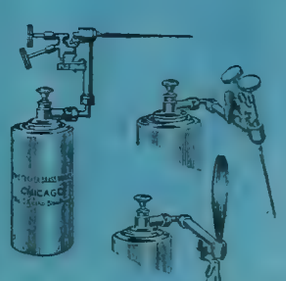

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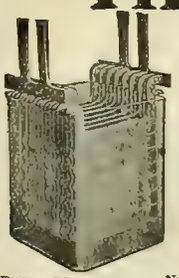

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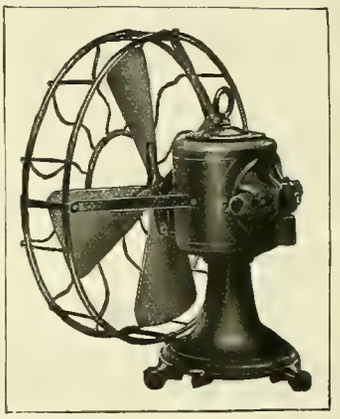

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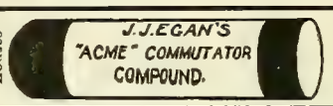

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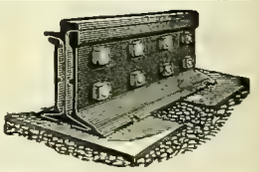

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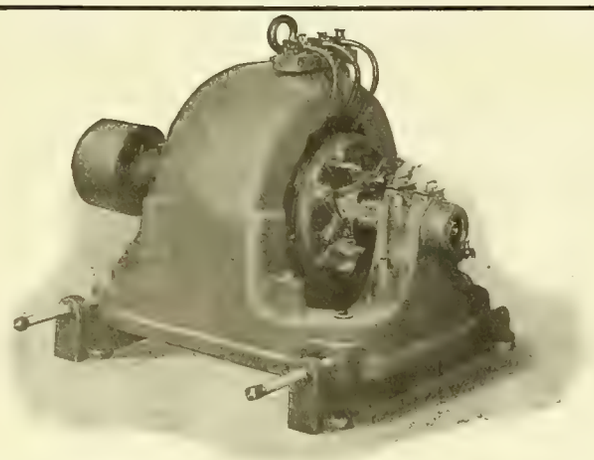

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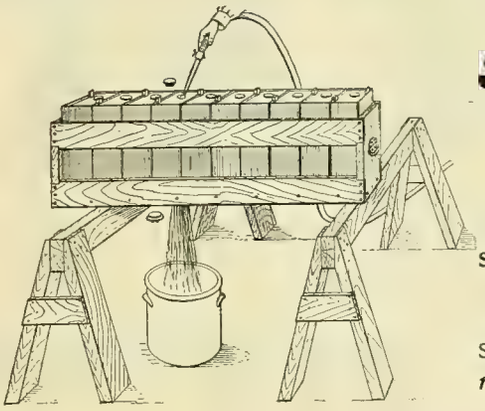

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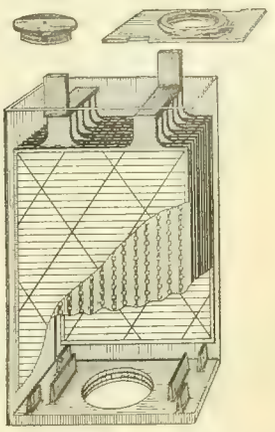

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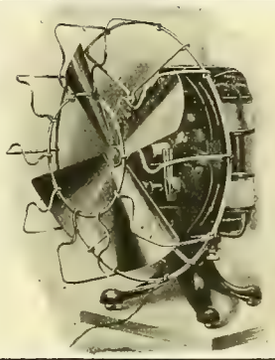

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Another Weston Patent Sustained

Patent No. 497,482, for shunts for Electric Light and Power Stations sustained by his honor Judge Holt of the United States Circuit Court, Southern District of New York.

Extract from the opinion of the Court in the case of the Weston Electrical Instrument Co., vs. Empire Electrical Instrument Co.

"This is a suit to restrain the infringement of a patent, No. 497,482, dated May 16th, 1893, issued by Edward Weston and now owned by the complainant, for a shunt for electric light and power stations. There are no questions as to jurisdiction, parties or title. **The proof of infringement is conclusive and is not controverted.** * * * Prior to Weston's patent in 1893, no practical method for the use of a shunt in connection with the measuring instruments for such large currents had been found, although the necessity for such an instrument was thoroughly appreciated, **and many electricians all over the world attempted to invent one.** In actual practice, no shunt at that time was used. The measuring instrument was applied to the entire current, but the result was unsatisfactory. The measuring instruments were complicated, inconvenient and expensive, and the measurements which could be made by them were inaccurate and unsatisfactory.

"The essential problem in discovering a shunt which could be used with a powerful current was not electrical but thermal. * * * The instruments manufactured under Weston's patent **immediately entered into substantially universal use** in all large central electric power and light stations, and have ever since been used almost exclusively as ammeters of large electric currents. * * * All the shunts relied upon by the defendants were shunts which made no use of the methods which Weston used to dissipate the heat in the case of a large current. **None of them had struck upon the idea of making the plates of high resistance short, so that the heat in them would be rapidly absorbed by the terminals, and none of them had hit upon the idea of making the terminals massive,** so that they would radiate a large amount of heat rapidly from the plates of high resistance.

"I think that Weston's patent not only embodies invention, but that it embodies invention of a very high and superior order. It adopted a method of dissipating heat which was not only novel, but was in a line entirely opposite to the direction in which all other electricians had been working. * * * La Roche testified that he constructed in or about 1884 an instrument called a voltmeter, and a shunt, and that from 1884 until about 1888 or 1889, he used this shunt in connection with this voltmeter as a measuring instrument, for the purpose particularly of testing storage batteries, at his workshop in Germantown or Philadelphia. * * * The evidence establishes in my opinion, that the instrument called a voltmeter was formed by putting together a number of instruments or parts embodying different inventions, none of which had been made or was known to electricians before Weston applied for his patent; that it would have been a marvelous and almost impossible thing for the most skillful electrical inventor at that time to have devised such an instrument; that La Roche is a man not only without any scientific education but without even the ordinary electrical knowledge of a skillful electrical mechanic; that his reputation for veracity is bad; **that his shunt never was used as a measuring instrument in connection with his voltmeter between 1884 and 1889; that the various pieces of apparatus constituting the voltmeter were put together by La Roche after the issue of the patent in suit to Weston, with the object of being used in support of his own untruthful testimony** to be given in this and other suits for the purpose of attempting to invalidate this and other patents issued to Weston; **that a part of the apparatus contained in the said voltmeter are two magnets, which are so arranged that their poles neutralize each other; that as a result it is impossible for a current of electricity in passing through the instrument to move the coil; that therefore the instrument is and always has been inoperative, and the shunt could not have been used as a measuring instrument in connection with it.** In short, I cannot avoid the conclusion that the testimony of La Roche in this case was deliberately and intentionally untruthful and that to support it he deliberately fabricated an instrument to be used upon this trial and other trials involving Weston's patents. **It was a careful, premeditated and elaborate attempt, by untruthful testimony, fortified by fabricated exhibits, to deprive Weston of his just rights in his invention, to impose upon this Court, and to pervert the course of justice. I direct that the evidence and exhibits in this case be submitted to the District Attorney in order that he may take under consideration the question whether a prosecution should be brought against La Roche for perjury."**

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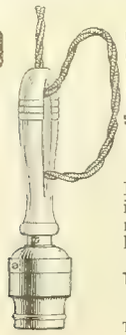

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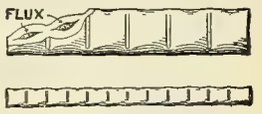

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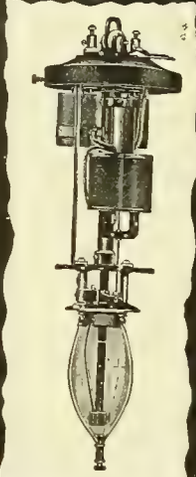

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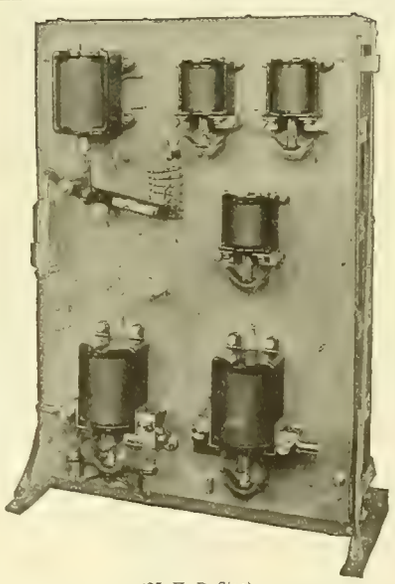

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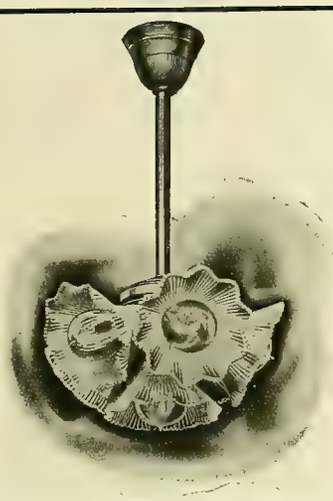

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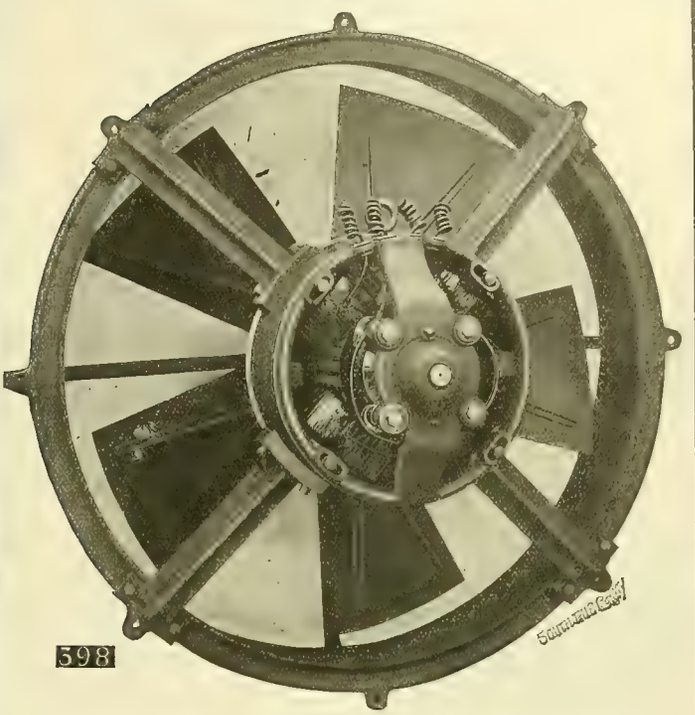

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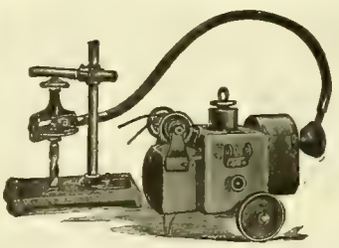

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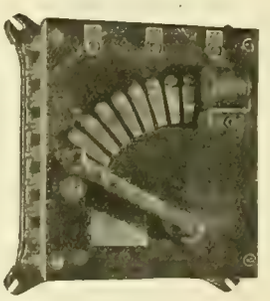

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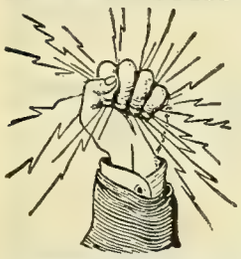

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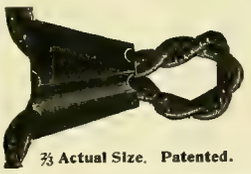

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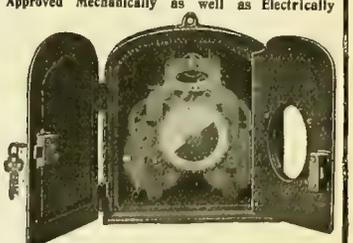

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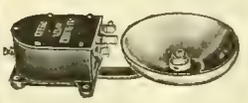

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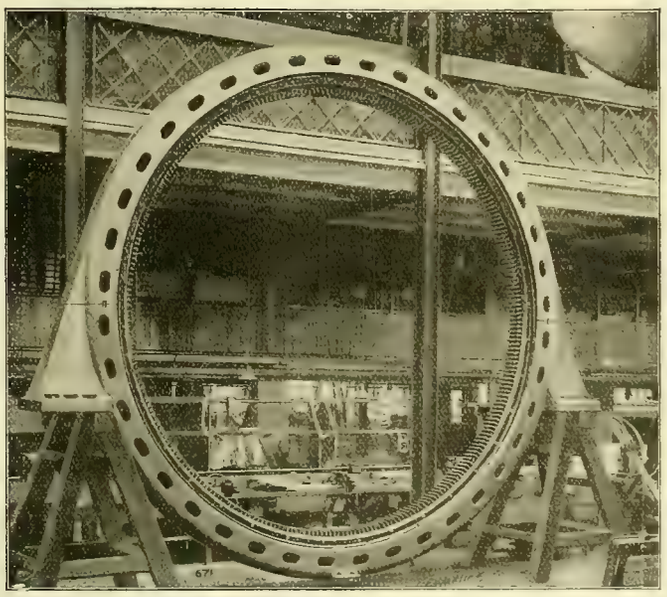
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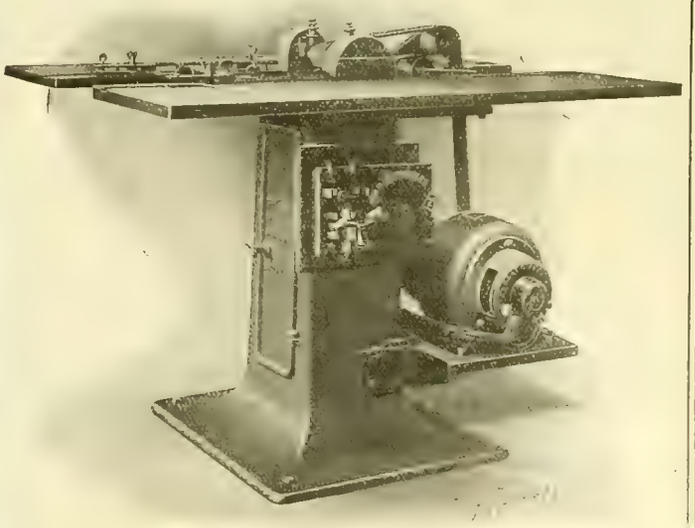
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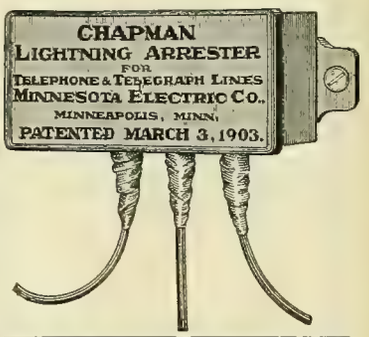

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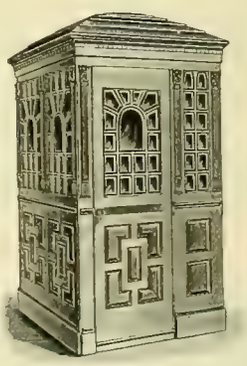

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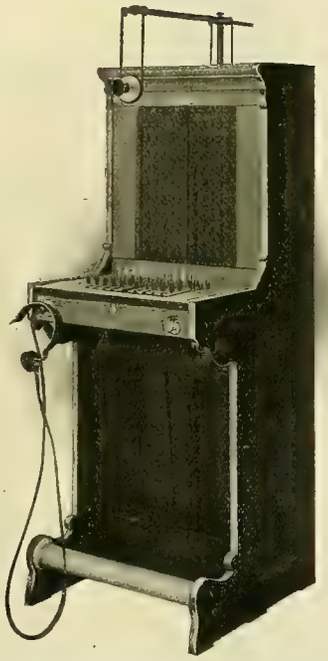

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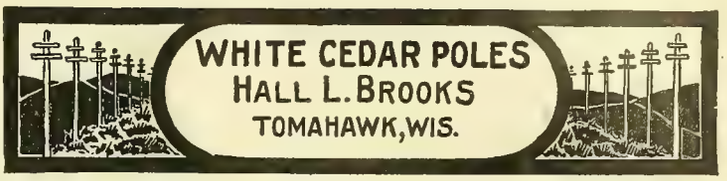

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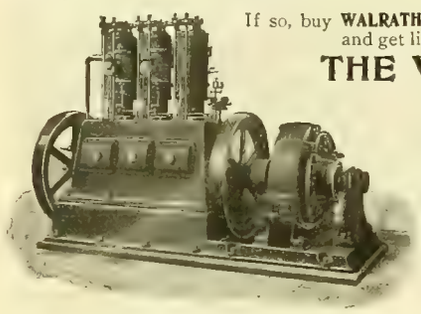

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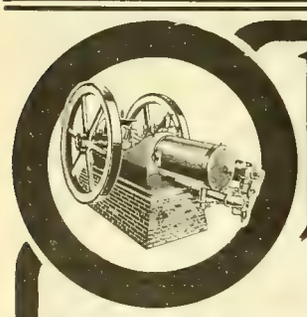

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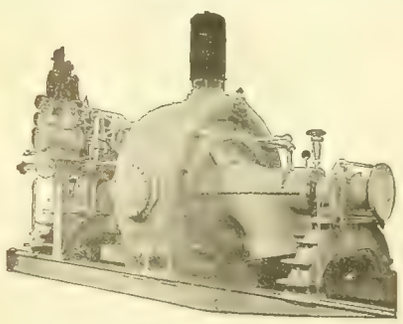

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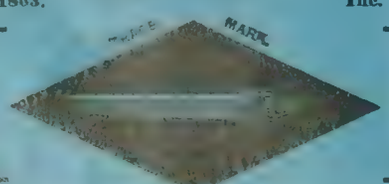
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